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Environmental quality of primary and secondary construction materials in relation to re-use and protection of soil and surface water

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ABBREVATIONS

DGM : Directorate General for the Environment
RIVM : National Institute of Public Health and the Environment
VROM : Ministry of Housing, Spatial Planning and the Environment
V&W : Ministry of Transport, Public Works and Water Management
RIZA : National Institute for Inland Water Management and Waste Water Treatment
CRMH : Central Council for Environmental Hygiene
RWS : National Water State
DWW : Division Road and Water Construction
NNI : Dutch Institute for Standardization
LUW : Agricultural University Wageningen
CUR : Civil Engineering Centre Realization, Research and Rules
CROW : Centre for Rules and Research in the Soil, Water and Road Construction and Traffic Engineering
TCB : Technical Commission Soil
KNB : Royal Dutch Brick Union
SKK : Corporation Quality Guarantee of the Granule Mixture
VBW : Union at the Advancement of Working Asphalt
VVAV : Union from Processors of Waste
Cemij : Cement Company
ECN : Dutch Power Station
KNMI : Royal Dutch Meteorological Institute
RvC : Certification Council
oBB : draft Building Materials Decree
NMP : National Environment Policy Plan
Milbowa : Environment Quality Goals Soil and Water
MTR : Maximum Allowable Risk
VR : Negligible Risk
AVI : Municipal Solid Waste Incineration (MSWI)
ELO : Electric Oven
PAH : Polycyclic Aromatic Hydrocarbon
PCB : Poly Chloro Biphenyl

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NB. The effects of the latest adjustments by VROM/DGM of:

1 the PAH-total-compostition standard of 75 mg/kg to 50 mg/kg for construction and demolition waste and products made of it are not incorporated in this appendix.

2 the raise of the sulphate immission from 62000 to 100000 mg/m^2 for category 1 non-prefabricated construction materials are not incorporated in this appendix.

SAMENVATTING[1]

Uitgangspunten voor de normstelling ontwerp Bouwstoffenbesluit juni 1991

In 1991 werd het ontwerp Bouwstoffenbesluit (oBB) in de Staatscourant [1] voor inspraak gepubliceerd. Voor de toepassing van bouwmaterialen wordt in het ontwerp Bouwstoffenbesluit (oBB) de maximaal toelaatbare belasting van de bodem omschreven als een zeer geringe verhoging van de gehalten in de vaste fase van de bodem, én als bescherming van het grondwater op het niveau van de streefwaarden grondwaterkwaliteit; "marginale bodembelasting". Onder de bouwmaterialen worden ook de rest- en afvalstoffen als secundaire grondstoffen gerekend die in Nederland op of in de bodem worden gebracht voor weg- en waterbouw. Voor de toepassing van bouwmaterialen in het oppervlaktewater is aangesloten bij de systematiek voor toepassing van bouwmaterialen op of in de bodem. Als rekenkundige invulling van het beleidsconcept "marginale bodembelasting" is in het oBB gekozen voor:

> "Een belasting ten gevolge van uitloging uit een bouwmateriaal die leidt tot een toename van een stof in de vaste fase van de bodem van 1% ten opzichte van de streefwaarde bodemkwaliteit in 100 jaar gemiddeld over de eerste meter van een als homogeen te beschouwen bodem."

Uitgaande van deze definitie van toegelaten immissie (marginale bodembelasting) en enkele eenvoudige aannames was het mogelijk de toegelaten immissie om te rekenen in een toelaatbare emissie uit bouwmaterialen. De aannames betroffen:

- Het soortelijk gewicht van de bodem (1400 kg/m^3).
- Het soortelijk gewicht van afvalstoffen (1550 kg/m^3).
- De effectieve infiltratie in een bouwwerk (300 mm/j).
- De toepassingshoogte van een bouwwerk voor niet-vormgegeven bouwmaterialen (0.7 m) of de toepassingsdikte van vormgegeven bouwmaterialen (0.3 m).

De toelaatbare emissies uit een bouwmateriaal worden per stof in bijlage 2 van het oBB vermeld. Voorts wordt in het oBB gesteld dat de gemeten uitloging[2] in het laboratorium uit

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[1] Dit rapport is in het Nederlands beschikbaar als RIVM-rapport 771402006 "Milieuhygiënische kwaliteit van primaire en secundaire bouwmaterialen in relatie tot hergebruik en bodem- en oppervlaktewateren-bescherming".

[2] Niet-vormgegeven volgens o-NEN 7343, vormgegeven volgens o-NEN 7345, zie ook bijlage 3.

bouwmaterialen, waaronder rest- en afvalstoffen die in Nederland op of in de bodem worden gebracht, genoemde toelaatbare emissies (normen voor uitloging) voor bouwmaterialen niet mogen overschrijden. Een aantal bouwmaterialen wordt in het oBB op voorhand toegewezen aan een toepassingscategorie[3] (bijlage 1 van het oBB). Bovendien zijn ten aanzien van de samenstelling eisen gesteld aan de concentraties van anorganische en organische stoffen.

Definities toegespitst op normstelling voor bouwmaterialen in deze studie

Immissie	Belasting van een compartiment met stoffen uit bouwmaterialen mg/m^2.
Emissie	Afgifte van stoffen vanuit een bouwmateriaal naar een compartiment in mg/kg of mg/m^2.
Toegelaten immissie (I_{max})	Een beleidsmatig toegelaten belasting van een compartiment (bodem of oppervlaktewater) in mg/m^2.
Gemeten emissie (E_{gem}) of uitloging	Uitloging van stoffen uit een bouwmateriaal in mg/kg of mg/m^2.
Berekende immissie (I_b)	Een immissie die is afgeleid uit de uitloging in het laboratorium en gecorrigeerd voor lab/praktijk-effecten in mg/m^2.
Maximaal toelaatbare emissie (E_{max})	Een emissie die is afgeleid uit de toegelaten immissie waarbij voor vormgegeven en niet-vormgegeven bouwmaterialen op verschillende wijze rekening is gehouden met lab/praktijk-effecten in mg/kg of mg/m^2.

[3] - Cat. G : vrije toepassing
- Cat. 1 : vrije toepassing, maar met terugnameplicht
- Cat. 2 : geïsoleerde toepassing, minimum hoeveelheid en terugnameplicht

Kritiek op de normen voor bouwmaterialen van het oBB

De kritiek van het bedrijfsleven richtte zich ten aanzien van het ontwerp Bouwstoffenbesluit, zowel op de ongedifferentiëerdheid van sommige aannames[4] als op de wijze van omrekening; namelijk:

* Een onvoldoende balans tussen hergebruik en bodem- en oppervlaktewaterbescherming.
* De voorgestelde normen voor bouwmaterialen worden door betrokkenen nu al in de toepassingsoverwegingen meegenomen, waardoor een aantal nu nog toegestane bouwmaterialen in de praktijk niet wordt toegepast.
* De normen voor uitloging zijn gebaseerd op relatief korte ervaringen met laboratorium-proeven.
* De adviezen over het hanteren van de normen voor de samenstelling zijn niet eensluidend.
* Er wordt geen rekening gehouden met mogelijke verschillen tussen de uitloging in het laboratorium en in de praktijk. Men vermoedt dat de feitelijke uitloging in de praktijk lager is in vergelijking met de uitloging die wordt gemeten in het laboratorium. In feite wordt er in het oBB van uitgegaan dat de emissie die wordt gemeten in het laboratorium ook in de praktijk plaatsvindt.

Immissie-eisen blijven

In de standpuntsnotitie van de minister van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer (VROM) aan de Tweede Kamer in juni 1992[5] worden de te stellen emissie-eisen voor bouwmaterialen gebaseerd op de toegelaten immissies (marginale bodembelasting) van stoffen in de bodem. De toegelaten immissies zijn berekend met dezelfde definitie als in het ontwerp Bouwstoffenbesluit. De toegelaten immissies in de bodem worden in dit rapport gegeven in tabel 1.1.2. De emissies uit bouwmaterialen mogen in de praktijk deze toegelaten immissies niet overschrijden.

De normen voor de anorganische samenstelling van bouwmaterialen die geen bodem worden, zijn vervallen. Voor organische stoffen worden wel eisen gesteld aan de samenstelling van bouwmaterialen. Bouwmaterialen die bodem mogen worden, moeten aan de streefwaarden bodemkwaliteit getoetst worden.

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[4] Bijvoorbeeld de toepassingshoogte in de wegenbouw is vaak 0.2 m in plaats van 0.7 m.

[5] Mede namens de minister van Verkeer en Waterstaat (V & W).

Vragen aan het RIVM en het RIZA

Het ministerie van VROM heeft het Rijksinstituut voor Volksgezondheid en Milieu (RIVM) gevraagd om een overzicht te geven van:

1. De bouwmaterialen die kunnen worden gebruikt volgens de normen voor bouwmaterialen van het oBB (bijlage 2 van het oBB).
2. Een evaluatie te geven van de berekening van de normen voor de uitloging.
3. De consequenties van de normstelling voor het hergebruik van bouwmaterialen te evalueren.
4. Een evaluatie te geven van de normen voor de samenstelling.

Het RIVM heeft zich geconcentreerd op de toepassing van bouwmaterialen op of in de bodem. Door het ministerie van Verkeer en Waterstaat (V&W) is ten aanzien van de punten 2 en 3 voor de waterbouw hetzelfde gevraagd aan het Rijksinstituut voor Integraal Zoetwaterbeheer en Afvalwaterbehandeling (RIZA).
Het RIVM en het RIZA hebben op basis van de huidige kennis, met als uitgangspunt marginale belasting van bodem en oppervlaktewater, de normstelling voor bouwmaterialen geëvalueerd.

Correctie van de uitloging in het laboratorium voor effecten in de praktijk

In feite wordt er in het oBB van uitgegaan dat de emissie die wordt gemeten in het laboratorium, ook in de praktijk plaatsvindt. Een betere beschrijving van de relatie laboratorium/praktijk was, gezien de wetenschappelijke kennis op dat moment, niet mogelijk. Intussen was veel onderzoek geïnitieerd dat ook na het verschijnen van het oBB is doorgegaan. Op dit moment wordt nog onderzoek verricht naar de relatie tussen laboratoriumuitloging en emissiegedrag in de praktijk.
In het Bouwstoffenbesluit wordt er, uitgaande van de huidige stand der wetenschap, zo veel mogelijk invulling gegeven aan de verschillen tussen de uitloging in het laboratorium en de feitelijke emissie in de praktijk. Dit heeft geresulteerd in een formule waarin de gemeten emissie (uitloging) in het laboratorium wordt gecorrigeerd voor praktijkeffecten (berekende immissie). De formule en de onderbouwing van de formule zijn weergegeven in dit rapport.
De aanpassingen hebben ertoe geleid dat er bij gelijkblijvende toegelaten immissie, bouwmaterialen in het laboratorium meer mogen uitlogen in vergelijking met het oBB.

Bovendien zijn de toepassingshoogte c.q. toepassingsdikte, de diffusiecoëfficiënt, etc. als variabelen in de formules gebracht.

Voorstellen gedaan door het RIVM en RIZA ten aanzien van de normstelling

Door het RIVM zijn de volgende voorstellen gedaan:

* In het Bouwstoffenbesluit de normstelling voor bouwmaterialen op toegelaten immissies van stoffen in de bodem baseren in plaats van op toelaatbare emissies van stoffen uit bouwmaterialen.
* In de rekenformules, om te komen van toegelaten immissies naar toelaatbare emissies, rekening te houden met de toepassingswijze. De rekenregels worden in dit rapport beschreven in Deel 1 en 1A.

In de rekenformules zijn de onderstaande correcties voor het verschil tussen uitloging in het laboratorium en in de praktijk verwerkt.

Niet-vormgegeven bouwmaterialen:

- De uitloogwaarden voor metalen in grond gebruiken als voorlopige correctiefactor voor de uitloging in het laboratorium naar de praktijk. Uit onderzoek is namelijk gebleken dat natuurlijke gronden door het verstoren van het natuurlijk evenwicht in het laboratorium in de kolomproeven ook uitloging vertonen die hoger was dan men op basis van de concentraties in het grondwater zou verwachten.

Vormgegeven bouwmaterialen:

- Een correctiefactor te gebruiken voor bevochtiging voor bouwmaterialen die bloot staan aan de lucht maar niet continu vochtig zijn.
- Een correctiefactor te gebruiken voor de temperatuur. In het laboratorium heerst een temperatuur van 20°C, in de praktijk gemiddeld 10°C.
- Voor stoffen met een hoge mobiliteit zijn er extrapolatiefactoren voor de volgende twee factoren: uitputting en veranderingen in de diffusiecoëfficiënt. Voorgesteld wordt om de laagste van de twee extrapolatiefactoren te gebruiken.

Door het RIZA zijn de volgende voorstellen gedaan:

* Een definitie vormen voor een, voor de toepassing van bouwmaterialen, als marginaal te beschouwen belasting (toegelaten immissies) van oppervlaktewater.
* De toegelaten immissies voor de waterbodem gelijk te stellen aan die voor de bodem.
* De rekenformules om te komen van toegelaten immissies naar toelaatbare emissies,

rekeninghoudend met de toepassingswijze, te beschrijven in dit rapport (Deel 1 en 1B). De door het RIVM aangebrachte correcties voor het verschil tussen uitloging in het laboratorium en in de praktijk zijn, voor zover relevant, in de formules verwerkt.

* Te corrigeren voor de afgifte van stoffen aan het oppervlaktewater tijdens het aanbrengen van niet-vormgegeven bouwmaterialen. Deze aan het oppervlakte water afgegeven stoffen dragen niet bij aan de emissie naar de waterbodem.
* Na een analyse van de meest maatgevende emissie-routes (naar de waterbodem en naar het oppervlaktewater), de normstelling te baseren op de route naar de waterbodem.

Gegevensverzameling van bouwmaterialen

De testresultaten van samenstellingsproeven (totaal- en koningswaterontsluiting) en uitloogproeven (kolom-, cascade- en diffusieproeven) zijn door het RIVM in brede kring verzameld bij VROM/DGM, RIVM, diverse onderzoeksinstituten en het bedrijfsleven. Hierna is op basis van de verzamelde testresultaten van bouwmaterialen een overzicht opgesteld van de bouwmaterialen die kunnen worden gebruikt volgens de normen voor bouwmaterialen uit het oBB en de door RIVM/RIZA berekende normen voor bouwmaterialen (Deel 2).

Om het hergebruik van enkele bouwmaterialen veilig te stellen, zijn de toegelaten immissies van barium, vanadium, fluoride, chloride en sulfaat en de samenstellingseisen voor PAK's en minerale-olie door VROM/V&W bijgesteld. Als gevolg van deze bijstelling van de normen wordt een meer dan marginale belasting van de bodem c.q. oppervlaktewater voor deze stoffen aanvaard. Dit besluit is verwoord in de standpuntsnotitie d.d. 23 juni 1992 van de Minister van VROM aan de Tweede Kamer der Staten Generaal [2].

Resultaat van de aanpassing van de normstelling

In het oBB wordt voor elke denkbare toepassing van een bouwmateriaal uitgegaan van één algemene uitloogeis per stof. Daarmee kan de toepasbaarheid van elk bouwmateriaal "eenvoudig" worden vastgesteld. Het bouwmateriaal is daarmee ook uitwisselbaar van de ene toepassing naar de andere. In de nieuwe opzet is de toelaatbare emissie voor een bouwmateriaal afhankelijk van de feitelijke toepassingshoogte c.q. dikte, waardoor per geval ook (meer) rekening met de constructiewijze kan worden gehouden bij de bepaling van de toelaatbare emissie. Voor de waterbouw blijkt de waterbodem het maatgevende compartiment. De normen voor niet-vormgegeven bouwmaterialen verschillen nauwelijks en die voor vormgegeven bouwmaterialen verschillen in het geheel niet van de normen voor de toepassing van bouwmaterialen in of op de bodem. Het netto effect is dat veel meer bouwmaterialen kunnen worden toegepast in vergelijking met het oBB zonder dat de bodem zwaarder wordt belast dan de toegelaten belasting volgens het beleidsconcept "marginale bodembelasting". De controle op naleving van de regels zal nu wel per toepassing dienen te geschieden.

Milieuhygiënische kwaliteit van bouwmaterialen toepasbaar op of in de bodem

De beoordeling van de milieuhygiënische kwaliteit van de bouwmaterialen heeft plaatsgevonden op de beschikbare gegevens. De op of in de bodem toepasbare bouwmaterialen zijn onder te verdelen in de volgende categorieën:

Categorie 1 : Bouwmaterialen die geen van de samenstellingswaarden overschrijden en op zodanige wijze worden gebruikt dat, ook indien geen isolatiemaatregelen worden genomen, geen van de toegelaten immissies worden overschreden.

Categorie 2 : Bouwmaterialen die geen van de samenstellingswaarden overschrijden en op zodanige wijze worden gebruikt dat, slechts indien isolatiemaatregelen worden genomen, geen van de toegelaten immissies worden overschreden.

Verder is voor vormgegeven bouwmaterialen de bevochtigingstijd relevant. Onderscheid wordt gemaakt in de volgende toepassingen:

Type A : Vrijwel continu vochtige toepassingen.

Type B : Periodiek vochtige toepassingen ten gevolge van atmosferische omstandigheden.

Uit dit onderzoek naar de milieuhygiënische kwaliteit van bouwmaterialen blijkt dat alle onderzochte natuurlijke materialen, onafhankelijk van hun herkomst, voldoen aan de criteria voor categorie 1 bouwmaterialen. De natuurlijke bouwmaterialen afkomstig uit de Nederlandse bodem overschrijden de streefwaarde bodemkwaliteit niet.

Granulaten, zoals asfalt- beton-, metselwerk- en menggranulaat afkomstig van bouwpuin waarin alleen primaire grondstoffen zijn verwerkt, vallen in de regel geheel of grotendeels in de categorie 1 bouwmaterialen. Zeefzand en recycling brekerzand zijn op basis van de metalen categorie 1 bouwmaterialen. Sulfaat is een kritische stof die een deel van de bouwrecyclingmaterialen kan doen opschuiven naar categorie 2. De PAK- en minerale oliegehalten (samenstelling) zullen, na verhoging van de samenstellingsnorm door VROM/V&W, voor de gangbare bouwrecycling-granulaten niet leiden tot afkeuring voor hergebruik. In zeefzand en in mindere mate in recyclingbrekerzand komen organische stoffen voor die tot een gedeeltelijke afkeuring van het produkt kunnen leiden.

De reststoffen die ook zelfstandig kunnen worden toegepast in de vorm van ongebonden ophoog-, aanvulling- en/of funderingsmateriaal, zijn AVI-bodemas, EC-bodemas, hoogovenstukslak en fosforslak en zijn alle geheel of deels toepasbaar als categorie 2 bouwmaterialen. AVI-bodemas zal bijna geheel niet toepasbaar zijn in deze vorm. Dit bouwmateriaal kan alleen nog in de zogenoemde "bijzondere categorie" worden toegepast. Mijnsteen, hoogovenschuimslak, gegranuleerde hoogovenslak en hoogovenslakkenzand blijken veelal toepasbaar als categorie 1 bouwmaterialen.

De emissies uit vormgegeven produkten gemaakt van primaire grondstoffen zijn veelal lager dan de toelaatbare uitloogemissies.

Cementbeton en asfaltbeton met een toevoeging van E-vliegas zijn toepasbaar als categorie 1 bouwmaterialen in type A- en B-toepassingen. Grof keramische produkten, kalkzandsteen en cellenbeton (gasbeton) met E-vliegas zijn voor (een aantal van) de gebruikelijke toepassingen van deze materialen geschikt.

Grof keramische produkten en kalkzandsteen met lage percentage E-vliegas zijn als categorie 1 bouwmaterialen toepasbaar in A-toepassingen.

Lichtgebonden fosforslak en fosforslak zijn als categorie 1 bouwmaterialen toepasbaar in type A- en B-toepassingen. Gebonden AVI-bodemas is meestal als categorie 1 bouwmateriaal toepasbaar in B-toepassingen en als categorie 2 bouwmateriaal in A-toepassingen.

Milieuhygiënische kwaliteit van bouwmaterialen toepasbaar in het oppervlaktewater

Breuksteen, grind, zand, gebroken steen, fosforslak, LD-staalslak en betonelementen zijn toepasbaar als categorie 1 bouwmaterialen. Van fosforslak en LD-staalslak betreft het alleen de toepassing als vormgegeven bouwmaterialen.

Voor oppervlaktewateren wordt in grote lijnen aangesloten bij de beoordelingsmethodiek die is voorgesteld voor de toepassing van bouwmaterialen in of op de bodem. Categorie 1 bouwmaterialen kunnen vrij maar terugneembaar worden toegepast in oppervlaktewateren.

De toepassing van categorie 2 bouwmaterialen en type B-toepassingen (alleen vormgegeven bouwmaterialen) blijven vergunningplichtig.

Consequenties voor de herbruikbaarheid en het hergebruik

In dit rapport (Deel 3) is een vergelijking gemaakt van de herbruikbaarheid op basis van de normstelling in het oBB en de door RIVM/RIZA berekende én eventueel door VROM/V&W aangepaste normen. Na aanpassing van de rekenmethodes voor de normering van bouwmaterialen voor de uitloging en aanpassing van de samenstellingsnormen voor organische stoffen, neemt de totale hoeveelheid herbruikbare bouwmaterialen, die niet voldoet aan de normen en gestort moet worden, met ongeveer 80% af in vergelijking met het oBB. Indien rekening wordt gehouden met de toepassing van AVI-bodemas in de "bijzondere categorie" en met het gegeven dat EC-vliegas momenteel volledig wordt toegepast in vormgegeven bouwmaterialen, is de afname nog groter, namelijk circa 95%. Bovendien wordt een verschuiving van circa 40% in de richting van categorie 1 gerealiseerd. AVI-bodemas en asfaltgranulaat met teer zijn nog steeds voor een belangrijk deel niet toepasbaar. In de standpuntsnotitie van 23 juni wordt door de Minister van VROM aangegeven dat deze bouwmaterialen hergebruikt kunnen worden in een aparte categorie in het Bouwstoffenbesluit. Bij de vergelijking is alleen rekening gehouden met de milieuhygiënische eisen (herbruikbaarheid op milieuhygiënische gronden). Naast de herbruikbaarheid spelen aspecten zoals marktacceptatie en prijsvorming een rol in de kwantificering van het effectieve hergebruik. Deze aspecten zijn niet meegenomen. Door RIVM/RIZA wordt verwacht dat voor veel bouwmaterialen nu zoveel duidelijkheid is gegeven met betrekking tot de milieu-hygiënische kwaliteit, dat de markacceptatie en daarmee het hergebruik van de categorie 1 bouwmaterialen zeer wordt bevorderd.

Overleg Bedrijfsleven, VROM/DGM, Rijkswaterstaat, RIVM en RIZA

De inhoud van dit rapport is in een drietal bijeenkomsten van het bouwbedrijfsleven, VROM/DGM, V&W/Rijkswaterstaat, RIZA en RIVM besproken. De verslagen van deze bijeenkomsten zijn opgenomen in bijlage 13.

Belangrijkste verschillen tussen de eerste en deze versie van dit rapport

In de periode tussen de eerste versie van dit rapport (RIVM-rapport 771402005) en het onderhavige rapport zijn meer data beschikbaar gekomen en verwerkt. De commentaren van de besprekingen met het bouwbedrijfsleven, VROM en V&W zijn verwerkt en de normen zijn in een enkel geval door VROM/V&W aangepast (minerale olie en PAK). Het verschil met de eerste versie van het rapport betreft een betere invulling van de constanten in de relatie laboratorium/veld en een meer uitgebreid overzicht van de mogelijke kosten (analyse-, stort- bewerkingskosten, etc.) die met deze maatregel gepaard gaan. Voorts is deel 1b "normstelling voor de toepassing van bouwmaterialen in de natte waterbouw" toegevoegd.

Toetsingsprocedure

Zie voor details in RIVM-rapport no 771402010

Een eerste aanzet tot een toetsingsprocedure ziet er als volgt uit:

- Baken een partij af van 2000 ton bouwmateriaal of de gehele partij als deze kleiner is dan 2000 ton.
- Neem tenminste 12 aselecte grepen uit deze partij volgens NEN 7300.
- Voeg deze grepen aselect samen tot tenminste c=3 mengmonsters van tenminste m=4 grepen elk (elk monster hetzelfde aantal grepen).
- Meet de te toetsen eigenschappen van de monsters per stof volgens de NEN 73xx-serie.
- Bereken per stof (i) het gemiddelde ($\bar{x}_i$) van de meetresultaten van de drie of meer mengmonsters.
- Keur de partij af als $\bar{x}_i$ > afkeurfactor * toetsingswaarde voor stof i (T_i).

Lees de afkeurfactor af in tabel 11.3.1 en de toetsingswaarde in bijlage 1 van het Bouwstoffenbesluit voor het geval van 3 of 4 mengmonsters van elk 4-20 grepen.

NB. voor andere waarden van c en m kan de afkeurwaarde worden berekend met formule 3:

$$\overline{x_i} \leq AW_i = T_i * AF = T_i * e^{1.282 * VC_{Part} * \sqrt{\frac{1}{n} + \frac{1}{c} * \frac{VC^2_{meet}}{VC^2_{part}}}} \qquad (3)$$

hierin is n =c * m

SUMMARY

Starting points for standard-setting for the proposed Building Materials Decree, June 1991

In 1991, the proposal for the Building Materials Decree (oBB) was published in the Staatscourant [1] in order to stimulate public comment. In this proposed Building Materials Decree, the maximum allowable burdening of the soil is described as a marginal increase of the concentrations of inorganic compounds in the solid phase of the soil, and the protection of groundwater at the target value level for groundwater quality, i.e. "marginal soil burdening". This is described for construction materials brought onto or into the soil in the Netherlands, including waste materials used as secondary raw materials for road- and waterways construction. Application of construction materials in surface water is related to the method for their use on or in the soil. As a mathematical definition of the proposed policy for "marginal soil burdening", the oBB has chosen:

"a burdening due to leaching from a construction material which leads to a 1% increase of a compound in the solid phase of the soil compared to the target value for soil quality in 100 years averaged over the first metre of a soil which is considered to be homogeneous".

Using this definition of allowable immission (marginal soil burdening) and several simple premises, it was possible to convert the allowed immission into an allowable emission from construction materials. The premises were:

- the specific weight of the soil (1400 kg/m^3)
- the specific weight of the waste materials (1550 kg/m^3)
- the effective infiltration of water in a structure (300 mm/y)
- the application height of a structure for non-prefabricated construction materials (0.7 m) or the application thickness of prefabricated construction materials (0.3 m).

The acceptable emissions from a construction material are described per compound in Appendix 2 of the oBB. Furthermore, the oBB also states that the leaching[6] from construction materials (including waste materials) measured in the laboratory which are brought onto or into the soil in the Netherlands, may not exceed the acceptable emissions mentioned (leaching standards) for construction materials. Several construction materials have already

[6] Non-prefabricated according to NEN 7343, prefabricated according to NEN 7345. See also Appendix 3.

been placed into a certain application category[7] (Appendix 1 of the oBB). Requirements for the composition have also been stipulated for the concentrations of inorganic and organic compounds.

Definitions focused on standard-setting for construction materials in this study

Immission	burdening a compartment (soil or surface water) with compounds from construction materials, in mg/m^2.
Emission	the discharge of compounds from a construction material to a compartment in mg/kg or mg/m^2.
Accepted immission (I_{max})	burdening a compartment (soil or surface water), which is acceptable to the Dutch Ministry of Housing, Spatial Planning and the Environment and indicated in mg/m^2.
Measured emission (E_{meas}) or leaching	leaching of compounds from a construction material in mg/kg or mg/m^2 measured in the laboratory.
Calculated immission (I_c)	an immission derived from leaching in the laboratory and corrected for differences between laboratory leaching and actual leaching (lab/actual differences) in mg/m^2.
Maximum allowable emission (E_{max})	an emission derived from the acceptable immission in which lab/actual differences for prefabricated and non-prefabricated construction materials are taken into consideration in various ways, in mg/kg or mg/m^2.
Compound	inorganic compounds (metals, anions) and organic compounds (PAHs, mineral oil, etc)

[7] - Cat. G: free application
- Cat. 1: free application, but with removal obligation
- Cat. 2: isolated application, minimum quantity and removal obligation

Criticism of the oBB standards for construction materials

The criticism of Dutch Trade and Construction Industry on the proposed Building Materials Decree (oBB) was directed towards the indifferentiality of certain premises[8] and to the method of conversion, namely:

* an insufficient balance between re-use and the protection of soil and surface water.
* the proposed standards for construction materials are already being incorporated into the considerations for application, so that a number of construction materials which are currently still allowed are no longer being used in practice.
* the standards for leaching are based on relatively short laboratory experience.
* the advices given for managing composition standards are not uniform.
* possible differences between leaching in a laboratory setting and leaching in an actual setting are not considered. The actual leaching is suspected to be lower in comparison to leaching measured in the laboratory. The oBB is, in fact, based on the idea that the emission measured in the lab is the same as the emission which takes place in actual practice, because information about the leaching is practice were only limited available.

Immission requirements remain

In the policy position note of the Minister of Housing, Spatial Planning and the Environment (VROM) to the House of Commons in June 1992[9], the emission requirements to be determined for construction materials are stated to be based on the allowed immissions (marginal soil burdening) of compounds into the soil. The allowed emissions are calculated according to the same definition as given in the proposal for the Building Materials Decree, stated in Table 1.1.2. of this report. Emissions from construction materials may not exceed the immissions allowed in actual practice. The standards for the inorganic composition of construction materials which do not turn into soil have been cancelled. However, requirements concerning the composition of construction materials have been given for organic compounds. Construction materials which are allowed to become soil must be compared to the target values for soil quality.

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8 For example, the application height in road construction is often 0.2m instead of 0.7m

9 Also on behalf of the Minister of Transport, Public Works and Water Management.

Questions directed to RIVM and RIZA

The Ministry of VROM has asked the National Institute of Public Health and the Environment (RIVM) to:

1. Survey the construction materials which may be used according to the standards for construction materials stated in the oBB (Appendix 2 of the oBB).
2. Give an evaluation of the calculation of the standards concerning leaching.
3. Evaluate the consequences of the standards for the re-use of construction materials.
4. Give an evaluation of composition standards.

The RIVM has concentrated on the application of construction materials on or in the soil. Concerning 2 and 3, the Ministry of Transport, Public Works and Water Management (V&W) has asked the National Institute for Inland Water Management and Waste Water Treatment (RIZA) to do the same for the application of construction materials in the surface water. On the basis of current knowledge, the RIVM and RIZA have evaluated the setting of standards for construction materials using marginal burdening of the soil and the surface water as their starting point.

Correction of the leaching in the laboratory for effects in actual practice

The oBB in fact assumes that the emission measured in the laboratory also takes place in actual practice. A better description of the relationship between lab/actual practice was not possible, given the scientific knowledge at that time. In the meantime, much research had been initiated which continued after the oBB came into being. Also, at this very moment, research is still being carried out to determine the relationship between lab-leaching and emission behaviour in actual practice.

In the Building Materials Decree, the differences between leaching in the lab and in actual practice are given as much substance as possible, given the current level of scientific knowledge. This has resulted in a formula in which the measured emission (leaching) in the lab is corrected for actual practice effects (calculated immission). Both the formula and the grounds on which it is based are reflected in this report. The adaptations to the formula have meant that construction materials in the lab may leach more in comparison to the oBB criteria where the allowable immission stays the same. Also, the application height and/or application thickness, the diffusion coefficient, etc., are used as variables in the equations.

Proposals made by the RIVM and RIZA on standard-setting

The RIVM has made the following suggestions:

* To base standard-setting for construction materials in the Building Materials Decree on allowed immissions of compounds in the soil, instead of on allowed emissions of compounds out of construction materials.
* The calculation equations to convert from allowed immissions to allowable emissions, keeping in mind the application of construction materials described in this report (Part 1 and 1A). Included in these equations are the corrections mentioned below for the differences between leaching in the lab and in actual practice.

Non-prefabricated construction materials:

- To use the leaching values for metals in the soil as a temporary correction factor between leaching in the lab and in actual practice. Research has shown that natural soils of which the natural balance had been disturbed in the lab also showed leaching in the column experiments which was, based on concentrations in the groundwater, higher than expected.

Prefabricated construction materials:

- To use a correction factor for the wetness of construction materials which are exposed to the air but are not continuously wet.
- To use a correction factor for the temperature. In the lab the temperature is 20°C; in actual practice the average temperature is 10°C.
- For materials with a high mobility, there are extrapolation factors for the following two factors: exhaustion and changes in the diffusion coefficient. It is suggested that the lowest of the two extrapolation factors be used.

The RIZA has made the following suggestions:

* Define what is to be regarded as marginal burdening (allowed immissions) of surface water for the application of construction materials.
* Make the immissions allowed for the sediment equal to those allowed for soil.
* In this report (Part 1 and 1B) the calculation equations to convert allowed immissions to allowed emissions are described, keeping in mind the method of application. For as far as they are relevant, the corrections given by the RIVM for the difference between leaching in the lab and in actual practice are included in the equations.
* Correct for the discharge of compounds to the surface water during the application of non-

prefabricated construction materials. These compounds given off to the surface water do not contribute to the emission to the sediment bed.

* After an analysis of the most important emission routes (to the sediment and to the surface water), base the setting of standards on the route to the sediment.

Collection of data from construction materials

The test results of composition measurements (total destruction and aqua regina) and leaching experiments (column, cascade and diffusion experiments) have been collected by the RIVM from Directorate General of the Environment (VROM/DGM), RIVM, various research institutes and trade and industry. Afterwards, a survey, based on the collection of test results for construction materials, was drawn up of the construction materials which may be used according to the standards for construction materials as described in the oBB and calculated by the RIVM/RIZA (Part 2). To ensure the re-use of various construction materials, the allowed immissions of barium, vanadium, fluoride, chloride and sulphate as well as the composition requirements for PAHs and mineral oil have been adjusted by VROM/V&W. As a result of these adjustments, a greater than marginal burdening of the soil and the surface water is accepted for these compounds. This decision is published in the policy position note dated June 23, 1992, given by the Minister of VROM to Parliament [2].

The result of adapting standard-setting

For every possible application of a construction material, the oBB works on the assumption of one general leaching requirement per compound. In this way the applicability of each construction material can be "easily" determined. The construction material is then also exchangeable from one application to another. In the new format, the allowable emission for a construction material is dependent on the actual application height and/or application thickness, so that, per case, (more) consideration can be taken of the construction method when determining the allowable emission. For waterway construction, the sediment is shown to be the decisive compartment. The standards for non-prefabricated construction materials barely differ from the standards for the application of construction materials on or in the soil; for prefabricated construction materials they do not differ in this at all. The overall effect is that many more construction materials can be applied in comparison to the oBB without burdening the soil more than the burdening allowed by the "marginal soil burdening" policy. Ensuring the enforcement of the rules will now have to be done per application.

The environmental quality of construction materials applicable on or in the soil

The evaluation of the environmental quality of the construction materials was done with the available data. The construction materials applicable on or in the soil can be divided into the following categories:

Category 1: construction materials which do not exceed the composition values and are used in such a way that none of the allowable immissions are exceeded, even if no isolation measures are taken.

Category 2: construction materials which do not exceed the composition values and are used in such a way that none of the allowable immissions are exceeded only if isolation measures are taken.

Furthermore, for prefabricated construction materials, the wetting time is relevant. A distinction is made between the following applications:

Type A: virtually continuously wet applications.

Type B: periodically wet applications as a result of atmospheric conditions.

This research into the environmental protection quality of construction materials shows that all the natural materials researched, meet, independent of their origin, the criteria for category 1 construction materials. The natural construction materials taken from the Dutch soil do not exceed the target values for soil quality.

Aggregates, such as asphalt, cement and masonry aggregates, and mixed aggregate of cement and masonry aggregates in which only primary raw materials are incorporated, belong, as a rule, completely or for the most part in category 1 construction materials. Sieve sand and recycling breaker sand are category 1 construction materials, based on their leaching of metals. Sulphate is a critical compound which results in a part of the construction recycling materials being moved up to category 2. The PAH and mineral oil levels (composition) for the current construction recycling aggregates will not lead to rejection for re-use after VROM/V&W have increased the composition standard. In sieve sand and to a lesser measure in recycling breaker sand, organic compounds that could lead to a partial rejection of the product are present.

The waste materials that can also be applied independently in the form of unbound material, supplemental and/or road base materials are MSWI bottom ash, E bottom ash, blast furnace slag and phosphor slag; they are all completely or partially applicable as category 2 construction materials. MSWI bottom ash will be almost completely unusable in this form. This construction material can only still be applied in the so-called "special category". Mine stone, blast furnace foam slag, granulated blast furnace slag and blast furnace slag sand are shown to be usually applicable as category 1 construction materials.

The emissions from prefabricated products made from primary raw materials are usually lower than the allowable leaching emissions.

Cement concrete and asphalt cement with an addition of Electric power station fly ash (E-fly ash) are applicable as category 1 materials in types A and B applications. Rough ceramic products (bricks), calcium-silicate bricks and aerated concrete (blocks) with E fly ash are suitable for (several) of the usual applications of these materials.

Rough ceramic products and calcium-silicate with a low percentage of E fly ash are used as category 1 construction materials in A applications.

Slightly stabilised phosphor slag and phosphor slag are applicable as category 1 construction materials in A and B applications. Stabilised MSWI bottom ash as a category 1 construction material is usually applicable in B applications and as category 2 construction material in A applications.

The environmental quality of construction materials applicable in surface water

Crushed natural stone, gravel, sand, phosphor slag, LD slag and concrete elements are applicable as category 1 construction materials. Phosphor slag and LD slag are only for application as prefabricated construction materials. For surface waters, the evaluation method proposed for the application of construction materials onto or into the soil is generally adhered to. Category 1 construction materials can be freely applied in surface waters but must be removable. Application of category 2 construction materials and type B applications (only prefabricated construction materials) are allowable under licensed conditions.

Consequences for re-useability and re-use

In this report (Part 3), a comparison is made between the re-useability based on the standard-setting in the oBB, and on the standards calculated by RIVM/RIZA and possibly adapted by VROM/V&W. After adapting the calculation methods used to set standards for leaching and after adapting the composition standards for organic compounds, the total amount of re-useable construction materials which do not meet the standards (and which must be dumped), was found to decrease by approximately 80% in comparison to the oBB. If it is kept in mind that MSWI bottom ash is used in the "special category" and that E fly ash is currently fully used in prefabricated construction materials, then the decrease is even greater, namely around 95%. Also, a shift of approximately 40% towards category 1 is realised. MSWI bottom ash and asphalt aggregate with tar are still largely non-applicable. In the policy position note of June 23, 1992, the Minister of VROM indicated that these construction materials could be re-used under a separate category in the Building Materials Decree. In the comparison, only the environmental protection demands (re-useability based on grounds of environmental protection) are considered. Besides re-useability, aspects such as market acceptance and pricing also play a role in the quantification of effective re-use. These aspects are not included. The RIVM/RIZA expects that for many construction materials, enough clarity has been given concerning their environmental quality, so that the market acceptance of the category 1 construction materials will be greatly stimulated, and so also their re-use.

Consultation between industries, VROM/DGM, Department of Public Works, RIVM and RIZA

The contents of this report were discussed during three meetings between the construction industry, VROM/DGM, V&W, RIZA and RIVM. The reports of these meetings are given in Appendix 13.

The most important differences between the first and this version of the report

In the period between the first version of this report (RIVM report no. 771402005) and this one, more data have become available and been processed. The comments given at the meetings with the construction industries, VROM and V&W have been processed and in a few cases the standards have been adapted by VROM and V&W (sulphate, mineral oil and PAH). Compared to the first version of this report, there is now a better definition of the constants in the relationship of lab/field, and a more extensive survey of the possible costs (analysis costs, dump processing costs, etc.) which accompany this measure. Furthermore, Part 13, "standard-setting for the application of construction materials in the wet waterway construction", has been added.

1. DETAILED SUMMARY

The draft Building Materials Decree (oBB), June 26, 1991, included a list of compounds with their accompanying standards for composition and leaching. From this list one can determine under which conditions construction materials may be applied on or in the soil (Appendix 2, oBB). Also included is a list of construction materials which, during a certain transition period, can be applied on or in the soil and in the surface water without being tested according to the standards for construction materials (Appendix 1, oBB). In this report, construction materials are: stone-like primary and secondary raw materials as well as the products in which these have been processed. They are applied outside, either on or in the soil, or in the surface water.

Obstacles

The construction industries have ascertained the following obstacles in the oBB:

* There is an improper balance between re-use and the protection of the soil and surface waters.
* Appendix 2 of the oBB is already being used in any considerations made by users of construction materials as well as by the authorities, so that certain materials currently applicable according to Appendix 1 are in fact not being applied anymore in actual practice.
* Furthermore, the advice given on the standards for the composition of construction materials was not uniform.

The standards for construction materials stated in the oBB are applicable to leaching and composition of construction materials. The following must be taken into consideration:

* The standards for leaching for construction materials in the oBB are based on relatively short lab experiences and on the assumption that the relationship between the leaching in the lab and the actual practice is 1:1.
* The standards for the composition of construction materials are included in the oBB as an extra guarantee to support the short experience with the leaching tests, and also because despite the prohibition on the mixing of construction materials, and the recovery obligation, mixing with the soil can still take place.

Questions posed by VROM/V&W

VROM/V&W has requested the RIVM:

a. to give a survey of the construction materials which, based on the current knowledge of the environmental qualities of construction materials, can be fully or largely applied if the standards of Appendix 2 of the oBB are used.
b. to make a proposal to adjust the standard-setting on the basis of evaluation (described below). As mentioned before, no consideration is taken in the oBB of construction materials possibly leaching differently in actual practice than in the lab, as knowledge is still too limited to be able to quantify this. Based on current knowledge, the RIVM was asked to evaluate the calculation for setting the standard in the oBB, using a marginal burdening of the soil as starting point, and keeping in mind, as much as is justifiable, the possible differences between leaching in the lab (as an estimate for the leaching behaviour in actual practice) and leaching in actual practice.
c. to give a survey of the construction materials which may be used partially or totally if the adjusted standards were to be applied.
d. to evaluate the standards for the composition of construction materials.
e. to evaluate the consequences for re-use based on the measured environmental quality of construction materials.

RIZA has been asked to do the same with respect to b and c, for applications in the surface water.

The report comprises the following three parts:

* Part 1: General environmental protection starting-points for the setting of standards
* Part 1A: Setting a standard for the application of construction materials on or in the soil
* Part 1B: Setting a standard for the application of construction materials in surface waters
* Part 2: The quality of the construction materials
* Part 3: Re-usability and re-use

Consultation between industries, VROM/DGM, V&W, RIVM AND RIZA

The contents of this report were discussed at three meetings between industrial representatives, VROM/DGM, V&W, RIZA and RIVM. The minutes of these meetings are recorded in Appendix 13.

The most important differences between the first and present version of this report
In the period between the first version of this report (RIVM report no. 771402005) and this report, more data has become available and been processed. The comments given during the meetings with the industries, VROM and V&W have been processed, and in some cases the standards have been adjusted by VROM/V&W (mineral oil and PAH). Compared to the first version of the report, the constants in this one are better defined as to the relationship of lab/field, and there is a more extended survey of the possible costs (analysis costs, dumping costs, etc.). Also, Part 1B, "Setting standards for the application of construction materials in wet waterway construction", has been added.

1.1. Standards for leaching from construction materials

Basis

The quality goals for soil and surface water are stated as target and limit values, respectively, worded in the parliamentary paper as "Environmental quality goals for soil and water[10]. The target values are based on an ignorable risk for humans, plants, animals and the ecosystem. Determining these values has taken place by way of ecotoxological risk evaluations. The quality goals for the surface water are worded in the third Bill on Water Management [3].

In the Netherlands, this evaluation for limit and target values has not yet taken place for all the compounds mentioned in the oBB. The oBB is therefore partly based on the background of concentrations measured in the country. The target values and the limit values for soil and surface water quality, as well as the values based on the background amounts, are documented in Table 1.1.1.

[10] Parliamentary paper 21 990, no. 1, parliamentary session 1990/1991

Table 1.1.1. Target values for soil and groundwater quality and limit values for surface water quality in the Netherlands

compound	soil mg/kg	groundwater μg/l	surface water μg/l
As	29	10	10
Ba	200	50	(150)
Cd	0.8	0.4	0.2
Co	20	20	(2)
Cr	100	1	20
Cu	36	15	3
Hg	0.3	0.05	0.03
Mo	10	5	(10)
Ni	35	15	10
Pb	85	15	25
Sb	(2.6)	NA	(2)
Se	(1)	NA	(0.5)
Sn	20	10	(0.25)
V	(68)	NA	(5)
Zn	140	65	20
Br	20	300	8000
Cl	(200)	100000	200000
F	500	500	1500
SO_4	(500)	150000	100000
CN-complex	5	10	(5)
CN-free	1	5	NA

- Taken from " POLICY STATEMENT ON THE MILBOWA NOTE" (Jan. 5, 1992) and the Third Policy Document on Water Management", with the exception of the values in parentheses ()
- NA = not available
- Antimony, selenium and vanadium taken from [4]

Basis for the calculation of the standards for construction materials

The following starting points are used by VROM/V&W for developing the standards:

* The standards for construction materials are independent of the soil type and surface water, except for applications on salty and brackish soils, and salty surface water,
* In the calculation of the standards, burdening by other sources is not considered;
* No difference may be made between primary and secondary raw materials when setting the standards;

* The standards for the application of construction materials on or in the soil are based on average emissions over time. For construction materials which are applied in the surface water, initial leaching is also of importance.
* Spreading of the burdening over several compartments is not considered in the calculations, except for applications in waterway construction where emission is divided between the surface water and the (sediment) bed;
* Soil, groundwater and surface water must remain multifunctional in potency.

The standards for construction materials are applicable to each construction material and to each surface water area.

The definition of maximum allowable burdening

In the oBB, the choice has been made for a maximum allowed burdening ("marginal soil burdening") based on the following considerations:

* Soil, groundwater and surface water must be protected.
* The re-use of waste materials must be stimulated in order to minimise the use of natural materials and the volume of the waste to be dumped.
* Waste materials have an increased concentration of compounds compared to the target values, and in general leach more in comparison to most of the natural construction materials.

The maximum allowed burdening (immission) constitutes a time factor, a thinning factor and/or surface factor, a target value (concentration) and a receiving environmental compartment. The limit of the maximum allowed soil burdening is defined by placing requirements on the factors above. The maximum allowed burdening of the soil ("marginal soil burdening") is mathematically defined by VROM/V&W as:

"A burdening as the result of leaching from a construction material which leads to a 1% increase of a compound in the solid phase of the soil compared to the target value for soil quality in 100 years averaged over the first metre of a soil considered to be homogeneous."

The RIZA has also used this definition for the sediment.

Chloride and sulphate are barely or not at all absorbed and will therefore burden the groundwater. For this reason, no target value has been derived for the solid phase of the soil, so that a marginal burdening could not be determined according to the above- mentioned method. For these compounds, a maximum allowed burdening has been related by VROM/DGM to the target value for groundwater as follows:

"A burdening as the result of leaching from a construction material which leads to a 100% average increase of the target value for groundwater quality in the first year for chloride and sulphate in the percolate which is, or becomes, groundwater."

The allowed burdening of the surface water is defined as:

"A cumulative burdening from out of the entire work area bordering on the surface water as the result of leaching from a construction material, which at the most leads to an average increase of 10% of the limit value for surface water quality in the along-flowing surface water (flow rate) considered homogeneous for a period of four days."

Maximum allowed immission

The maximum allowed immissions to the soil, groundwater and the surface water can be calculated from the postulated definitions of maximum allowed burdening of the soil, groundwater and surface water. In the calculation, the emission and the immission surfaces have been made equal. The calculated maximum allowed immissions are shown in Table 1.1.2.

Table 1.1.2. Maximum allowed immissions for soil, groundwater and surface water calculated using the definitions for marginal burdening

compound	soil	groundwater	surface water**	
	max. allowed immission in mg/m² per 100 years	max. allowed immission in mg/m² per year	max. allowed immission as Q_{surf} = 5 m³/s in mg/m² per 4 days	max. allowed immission as Q_{surf} = 25 m³/s in mg/m² per 4 days
As	435		346	1728
Ba	(3000) 6300 #		5184	25920
Cd	12		7	35
Co	300		69	346
Cr-tot	1500		691	3456
Cu	540		104	518
Hg	4.5		1.0	5.2
Mo	150		346	1728
Ni	525		346	1728
Pb	1275		864	4320
Sb	39		69	346
Se	15		17	86
Sn	300		9	43
V	(1020) 2400 #		173	864
Zn	2100		691	3456
Br	300		276480	1382400
Cl		prefab: 30000 en 60000 * n-prefab: 87000 en 174000 # *	6912000	34560000
F	(7500) 14000 #		51840	259200
SO_4		prefab and n-prefab cat 2: 45000 and 90000 * n-prefab cat 1: 100000 + en 124000 * #	3456000	17280000
CN-tot	75		173	864
CN-free	15			

* The first value concerns applications on or in the "dry" soil with an infiltration of rainwater or a groundwater stream of 300 mm/y. The second value concerns applications in "wet" waterway construction with an infiltration of surface water or a groundwater flow of 600 mm/y.

** The maximum allowed immissions are dependent on the extent of the long-flowing flow rate and the extent of the work. In this table, the value for the flow rate is given as Q_{surf} of 5 and 25 m³/s and the value for the extend of the work is 5000 m².

The allowed imissions increased by VROM/V en W. The RIVM calculated allowed immissions are shown in parentheses.

\+ Recently raised by VROM from 62000 to 100000 mg/m². Category 1 and category 2 applications of prefrabicated and non-prefabricated construction materials in in direct contact with seawater and brackish water, this value is 180000 mg/m².

In order to make the re-use of the construction materials cement aggregate, phosphor slag, and steel slag possible under category 1 conditions, the standards for construction materials for barium, fluorine, sulphate and vanadium, respectively, have been adjusted by VROM/V&W. VROM/V&W have also not reduced the leaching standards for category 1 construction materials for chloride and sulphide emitted from non-prefabricated materials to the allowed immission, as calculated by the RIVM, but has left these at the level indicated by the oBB. As a result of the decisions made by VROM/V&W to make re-use possible, a greater than marginal burdening by these compounds is permitted. The compounds with a greater allowed immission are also included in Table 1.1.2.

From immission requirements to emission standards for construction materials

The emission from construction materials must be such that the maximum allowed immissions are not exceeded. Emission due to leaching from construction materials can take place through contact with rainwater, groundwater or surface water. Contact with water can be prevented by means of isolation. The measure of isolation determines the applicability of the category 2 construction materials[11] applied on or in the soil". The isolation of construction materials applied to surface waters, considered to be difficult, although not impossible to carry out, is not set down in the general valid isolation regulations. The application of category 2 construction materials to surface waters therefore may therefore only be done with V&W permits. In the Building Materials Decree, a difference is made between non-prefabricated construction materials, applied in unbound applications, and prefabricated construction materials[12].

In contrast to applications to the dry soil, applications for surface water occupy various routes of influence in the environment. A distinction is made between a route to the (sediment) bed and a route in the direction of surface water. Both routes have been turned into mathematical rules to be used for actual emissions. The allowed immission on the route in the direction of surface water is partly dependent on the flow rate: the allowed immission decreases with decreasing flow rate. With low flow-rates, the route in the direction of the (sediment) bed is shown to be the measure for the quality which a construction material must have. Besides the long-flowing water (flow rate), the water already present (volume of water

[11] Construction materials which do not leach more than the U1 limit value may be applied under the conditions of category 1. Construction materials which do not leach more than the U2 limit value but which do leach more than the U1 limit value, may be applied under the conditions of category 2. Construction materials which leach more than the U2 limit values may not be applied outside. For the application conditions, refer to the oBB. The manner in which actual examination takes place, where sample size and spreading are considered, and also where it is also determined if a sample is applicable or not, will be described in the Ministerial regulation "testing protocol". In this regulation, the factors mentioned in the explanatory note on page 114 (oBB) will also be included.

[12] For precise definition see oBB

system) can also absorb leached pollutants. Keeping this in mind, the primary and secondary construction materials most used in waterway construction can be applied virtually problem-free within the defined boundaries in most waters. The limit flow rate below which the route to the surface water becomes important is around 1.0 m^3/s. This would mean that for a small range of surface water flow rates it is necessary not only to calculate the route to the (sediment) bed, but also to calculate the route to the surface water in order to determine the maximum allowable emission. Within this range it also becomes necessary to look more closely at the route to the surface water in relation to the volume of the water system. This makes assessment in this range of flow rates complex. Since the materials most used in waterway construction can also be used without too many problems in smaller surface waters, the choice has been made to omit testing according to the route towards the surface water, and in the range of flow rates below 1 m^3/s. The advantages of this are:

- a great simplification of the testing of construction materials.
- a list of surface waters and flow rates is unnecessary.
- there is no below-limit flow rate or acceptable emission and/or indication of construction materials which may always be applied to surface water.
- missing limit values for surface water do not cause problems in the testing.

1.2. The method of comparing measured emission with allowed immission

The Policy position note of the Minister dated June 1992 [2] determined that construction materials may be applied on or in the surface water if:

- none of the composition standards for organic compounds are exceeded,
- furthermore, they are used in such a way that, even if no isolation measures are taken (category 1 construction materials), or only if isolation measures are taken (category 2 construction materials), none of the immission values for inorganic compounds are exceeded.
- the application of category 2 construction materials and type B[13] applications (prefabricated construction materials) may only take place under permit for application to surface water.

This means that immissions must be calculated from the emissions (leaching) measured in

[13] Category 1 construction materials are distinguished according to their type of application; namely A and B applications. A construction material in a type A application is virtually always wet. A construction material in a type B application is only periodically wet, depending on atmospheric conditions.

the lab (E_{meas}). These calculated immissions (I_c) must be compared to the allowed maximum immission (I_{max}), and be lower in value. For non-prefabricated (N) and pre-fabricated (V) construction materials, separate equations, focused on the specific leaching test, have been developed, keeping in mind the difference between leaching behaviour in actual practice and that in the lab (see Part 1A and 1B). In the following sections, the equations for the calculated maximum allowable emissions for N and V construction materials are converted into calculated immissions (I_c), given along with the correction factors for the difference between leaching in the lab and in actual practice.

Calculated immission for non-prefabricated construction materials

The calculated immission from non-prefabricated construction materials is achieved with the help of:

- a standardised leaching test (measured emission; $E_{max}(L/S=10)$: the column test (NEN 7343).
- the application height (h).
- an extrapolation factor ($f_{ext}(h,\kappa,N_i)$) which shows the connection between the $E_{max}(L/S=10)$ and the period in which emission to the soil is allowed to take place (J=100 years or 1 year) for the burdening of the (sediment)bed of the surface water and for the burdening of surface water (D=4 days).

RIVM/RIZA have suggested that, based on current developments, the leaching behaviour in actual practice be taken into consideration as follows:

* Research has shown that natural soils also show leaching in the column tests when their natural balance is disturbed. The emission was greater than to be expected on the basis of the concentrations in the groundwater. *Using the leaching values for metals in soil (E_g is equal to the correction factor a) is suggested as a temporary correction factor to translate the leaching in the lab into actual practice, while waiting for more insight into the factors which are responsible for the difference.*

In the $f_{ext}(h,\kappa,N_i)$, the effective infiltration (N_i) is also counted. This has been fixed at N_i=300mm per year for open applications (freely accessible to rainwater), and at N_i=600mm per year for applications in surface waters. Research is still ongoing on the actual isolation to be achieved in the structures of construction materials. The isolation regulations will be expanded upon in a ministerial regulation (MR) as part of the Building Materials Decree. Concerning the development of knowledge on isolation at dump sites, VROM/DGM have calculated a value of maximum N_i=6mm per year for the transport of water through an isolating layer as a mathematical basis to determine the allowable emission from category 2 construction materials. For applications of these in surface water, isolation is considered to be difficult to realise. The immission is calculated as follows:

$$I_c = d_c * (E_{meas(L/S=10)} - a) * h * f_{ext-N}(h,\kappa,N_i) < I_{max}$$

I_{max} = maximum allowed immission (mg/m^2).
I_c = calculated immission in the (sediment) bed as the result of using a construction material (mg/m^2).
d_c = 1550 kg/m^3; density construction material (kg/m^3).
$E_{meas(l/S=10)}$ = leaching from a construction material measured in the lab (mg/kg).
$a=E_{soil}$ = correction factor (see Table 1.2.1) for leaching from a construction material in actual practice (mg/kg). For applications in the surface water, this factor has been set at zero in the calculation of the immission in the surface water. The column test gives a realistic approach for the leaching which will occur in actual practice.
h = the greatest height in which a construction material is brought into the works (m), with a minimum of 0.2 m. If the same construction material is introduced in several layers, then h is the sum of these layers.
$f_{ext-N}(h,\kappa,N_i)$ = factor for the extrapolation of the measured emission by L/S=10 with the column test to the emission over 100 years and for C1 and SO_4 over 1 year.

For applications on or in the soil

$$f_{ext-N} = \frac{1 - e^{-\kappa * \frac{t * Ni}{1550 * h}}}{1 - e^{-\kappa * 10}}$$

For application in the surface water, the route in the direction of the (sediment) bed is the measure, and is

$$f_{ext.n} = \frac{e^{-\kappa * 0,1} * (1 - e^{-\kappa * \frac{t * N_i}{1550 * h}})}{1 - e^{-\kappa * 10}}$$

κ = constant, measure for the rate of leaching (see Table 1.2.1.).
N_i = effective infiltration (mm/y); 300 mm/y for category 1 construction materials and 6 mm/y for category 2 construction materials. With applications of category 1 construction materials in surface waters, the first leaching, which always goes to the surface water, is considered. The effective infiltration is 600 mm/y instead of 300 mm/y. Category 2 construction materials remain allowable under permit only for applications in surface water.
t = time (year); 1 year for chloride and sulphate, 100 years for the other compounds.

Table 1.2.1. Correction factors for non-prefabricated construction materials for the difference between leaching in the lab and leaching in actual practice

compound	$a=E_{soil}$	κ	compound	$a=E_{soil}$	κ
As	0.7	0.03	Se	0.03	0.38
Ba	0.9	0.15	Sn	0.03	0.19
Cd	0.021	0.50	V	0.4	0.05
Co	0.18	0.20	Zn	2	0.28
Cr	0.09	0.18	Br	2.6	0.35
Cu	0.25	0.28	Cl	51	0.57
Hg	0.016	0.05	F	1.5	0.22
Mo	0.15	0.35	SO_4	118	0.33
Ni	0.63	0.29	CN-complex	0	0.35
Pb	0.8	0.27	CN-free	0	0.35
Sb	0.02	0.11			

Calculated immission for prefabricated construction materials

The emission from prefabricated materials is measured with a standardised leaching test, i.e. the diffusion test (NEN 7345) over a period of 64 days. This is translated into an immission over 100 years with the help of the effective diffusion coefficient (D_e), stated as the pD_e (negative logarithm of the D_e). A compound in construction materials with a $pD_e > 12$ has a low mobility, while a compound in construction materials with a $pD_e < 10.5$ has a high mobility.

The emission standards given in the oBB for prefabricated construction materials were based on the knowledge available at that time. On the basis of current developments, the RIVM suggests that the leaching behaviour in actual practice be considered in the following manner:

* *To correct for changes in the diffusion behaviour ($f_{ext}(h,x\%,D_e)$):*
  - *Reduction in the diffusion driving force due to exhaustion of the compound. This correction is especially applicable to compounds with a high mobility and products with small dimensions (h).*
  - *Changes in the diffusion coefficient (D_e) in time as the result of changes in the matrix and/or the chemical form which determines the diffusion.*
* *The diffusion test assumes a continual wetness (type A applications). Applying a correction factor for construction materials which are made wet by rain (type B*

applications) is suggested for that part of the time in which the product is wet (x%).

* *In the lab situation, the temperature is 20°C, while in actual practice the temperature is an average of 10°C. Applying a correction factor for this difference (f_{tem}) is suggested.*

Prefabricated category 1 construction materials are distinguished according to type of application, namely types A and B applications. A construction material in a type A application is almost always wet (x=100%). Examples of this type of application are an embankment/bank/quay, a road base, a street or (part of) a wall which is made wet by surface water or groundwater (also through capillary action of the soil). A construction material in a type B application is only periodically wet, depending on atmospheric conditions (x%=10%). Examples of this type of application are: a roof or the (top part) of a wall, as long as the applications cannot be made wet (through the capillary action) by the groundwater or the surface water. This type of application is constructed in such a way that the construction materials are made wet during a certain period, in which wetting takes place independent of atmospheric conditions.

Construction materials which, unisolated, can cause a greater than marginal burdening, may be applied isolated. This isolation must then reduce the burdening to less than marginal. For isolated, prefabricated (category 2) construction materials, it has been calculated that by applying isolation, it is possible to achieve an isolation factor of x%=10%. For applications in surface water there is continual wettening, and isolation is considered to be difficult to carry out.

The calculated immission for type A applications, for type B applications and for isolated applications is given in the following equation:

$$I_c = E_{meas(64d)} * f_{ext-V}(h,x\%,D_e) * f_{tem} < I_{max}$$

I_{max}	=	maximum allowable immission (mg/m²).
I_c	=	calculated immission in the soil as the result of the use of a construction material (mg/m²).
$E_{meas(64d)}$	=	leaching from a construction material, determined in the lab (mg/m²).
$f_{ext-V}(h,x\%,D_e)$	=	factor for the extrapolation of the leaching measured with the diffusion test into leaching for 100 years (see Table 1.2.2).
h	=	thickness of the prefabricated construction with a minimum of h = 0.1 m.
f_{tem}	=	factor for the difference in temperature when determining the leaching of a construction material in the lab and with the actual use of that construction material (see Table 1.2.2).

Table 1.2.2. Correction factors $f_{ext\text{-}V}(h,x\%,D_e)$ and f_{tem} for prefabricated construction materials for the difference between leaching in the lab and leaching in actual practice.

pD_e (rounded off)	category 1 type A (x%=100%)								category 1 type B (x%=10%) and category 2 (x%=10%)								
	$f_{ext.V}$								$f_{ext.V}$								f_{tem}
	THICKNESS OF THE CONSTRUCTION MATERIAL (h)								THICKNESS OF THE CONSTRUCTION MATERIAL (h)								
	0.1 m	0.2 m	0.3 m	0.5 m	0.7 m	1 m	2 m	10 m	0.1 m	0.2 m	0.3 m	0.5 m	0.7 m	1 m	2 m	10 m	
5	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	2	0.7
6	1	1	1	1	1	1	1	5	1	1	1	1	1	1	1	5	0.7
7	1	1	1	1	1	2	3	15	1	1	1	1	1	2	3	5	0.7
8	1	1	2	2	3	5	10	15	1	1	2	2	3	5	5	5	0.7
9	2	3	5	8	11	15	15	15	2	3	5	5	5	5	5	5	0.7
10	5	10	15	15	15	15	15	15	5	5	5	5	5	5	5	5	0.7
$pD_e \geq 11$	15	15	15	15	15	15	15	15	5	5	5	5	5	5	5	5	0.7
Cl, SO_4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7

The leaching emission is measured using the diffusion test (in accordance with NEN 7345). Judging if the emission is determined by diffusion is based on the direction coefficient from the double logarithmic graph showing the time and the emission (for more details about the calculation of the diffusion coefficient, see NEN 7345):

Direction coefficient > 0.6: The emission is not determined through diffusion. The emission must be determined according to NEN 7343 (the column test).

0.35 < Direction coefficient < 0.6: The emission is determined through diffusion (correction may take place, depending on the pD_e).

Direction coefficient < 0.35: The emission is controlled by rinsing and/or exhaustion. If rinsing is the case, I_c can be calculated ("worst case") with the measured emission ($E_{meas,64d}$), which is not determined through diffusion, and the factors for compounds with $pD_e \geq 11$. A column test may also be applied (see above procedure under direction coefficient >0.6). If there is exhaustion of the available quantity during the diffusion test, then the diffusion test must be repeated with a greater volume of prefabricated construction material (see NEN 7345).

1.3. Comparison between maximum allowable emissions in the oBB and the Building Materials Decree

In order to be able to compare the results of the adjusted calculation methods for determining the standards with the standards of the oBB, the maximum allowable emissions have also been calculated according to the adjusted calculation methods. In the oBB, the standard-setting was such that although no demands were made for immission in the soil (I_{max}), they were made for the leaching of a construction material in the lab in the column test or in the diffusion test. The following survey shows a calculation of what the maximum allowable emission may be in the column test (Table 1.3.1) and in the diffusion test (Table 1.3.2) with the maximum allowed immission, considering the proposed corrections.

Table 1.3.1. Comparison of the standards stated in the oBB with the maximum allowable emissions at L/S = 10 from non-prefabricated construction materials according to this report, measured in the column test for h=0.7m

LEACHING COLUMN-TEST	oBB standards non-prefabricated construction materials in mg/kg			maximum allowable emissions for non-prefabricated construction materials in mg/kg*	
compound	U1	U2	S1	cat. 1	cat. 2 *
As	0.30	3.0	375	0.88	7.0
Ba	4.0	40	7500	(3.1) 5.5	(27) 58
Cd	0.010	0.10	10	0.032	0.066
Co	0.20	2.0	250	0.42	2.5
Cr	1.0	10	1250	1.3	12
Cu	0.35	4.0	375	0.72	3.5
Hg	0.005	0.050	5	0.018	0.076
Mo	0.050	0.50	125	0.28	0.91
Ni	0.35	4.0	250	1.1	3.7
Pb	0.80	8.0	1250	1.9	8.7
Sb	0.030	0.30	50	0.045	0.43
Se	0.020	0.20	50	0.044	0.10
Sn	0.20	2.0	250	0.27	2.4
V	0.70	7.0	1250	(0.9) 1.6	(14) 32
Zn	1.4	14	1250	3.8	15
Br	0.20	2.0	500	2.9	4.1
Cl	600	5000	5000	(240) 600	8800
CN-complex	0.050	0.50	125	0.067	0.38
CN-free	0.010	0.10	25	0.013	0.076
F	5.0	50	4500	(7.3) 13	(52) 100
SO_4	750	10000	25000	(576) 750+	22000

* The Cat. 1 standards for the application of construction materials in surface waters barely differ from those for application on or in the soil. The application of category 2 and 1B construction materials in wet waterway constructions remains applicable under government authority permit only. The standards for construction materials calculated by the RIVM on the basis of the definition of maximum allowable burdening are shown in parentheses.

\+ Recently the ministry of VROM has increased the maximum allowed immission for SO_4 in granular construction materials.

The adjusted standards presented here are calculated for a set of corrections which agree with the starting points of the oBB, i.e. h=0.7 m for non-prefabricated construction materials and h=0.3m and $pD_e \geq 10$ for prefabricated construction materials. In this way, a direct comparison between the oBB and the Building Materials Decree is possible.

Table 1.3.2. Comparison of the standards in the oBB with the maximum allowable emissions from prefabricated construction materials according to this report, measured by way of the diffusion test for h=0.3m, $pD_e \geq 11$ in mg/m^2

LEACHING DIFFUSION-TEST	oBB standards prefabricated construction materials in mg/m^2			maximum allowable emissions for prefabricated construction materials in mg/m^2	
compound	U1	U2	S1	cat. 1 A	cat. 2 & cat. 1 B *
As	25	125	750	41	140
Ba	350	1750	15000	(290) 600	(950) 2000
Cd	0.70	3.5	20	1.1	3.8
Co	15	75	500	29	95
Cr	90	450	2500	140	480
Cu	30	150	750	51	170
Hg	0.30	1.5	10	0.4	1.4
Mo	4.0	20	250	14	48
Ni	30	150	500	50	170
Pb	75	375	2500	120	400
Sb	2.5	13	100	3.7	12
Se	1.8	9.0	100	1.4	4.8
Sn	20	100	500	29	95
V	60	300	2500	(97) 230	(320) 760
Zn	125	625	2500	200	670
Br	20	100	1000	29	95
Cl	2250	11250		18000	54000
CN-complex	4.5	23	250	7.1	24
CN-free	0.90	4.5	50	1.4	4.8
F	440	2200	9000	(710) 1300	(2400) 4400
SO_4	15000	45000	40000	27000	80000

A= type A application; B= type B application, see Chapter 8.2.6.

* The U1 standards for the application of construction materials in surface waters barely differ from those for the application on or in the soil. The application of category 2 and category 1B construction materials in wet waterway constructions remains permissible under permit only.

Standards for construction materials calculated by the RIVM on the basis of the definition of maximum allowable burden are given in parentheses.

1.4. Comparison of the standards for the composition of construction materials in the oBB with those in the Building Materials Decree

The RIVM has not made any suggestions on adjusting the standards for the composition of construction materials. The RIVM was asked by VROM/DGM to calculate the consequences of the re-use if the composition limits for inorganic compounds were to be cancelled, and if the composition limits for several individual PAHs, total PAH (10) and mineral oil were to be increased, so that the re-use of cement aggregate, masonry aggregate, mix aggregate and asphalt aggregate as category 1 construction materials would not be hindered. At the same time, the difference between the S1 standards for organic components in prefabricated and non-prefabricated construction materials was also cancelled. Table 1.4.1 presents the standards of the oBB and the adjusted standards for construction materials.

Table 1.4.1 Composition standards for organic compounds for prefabricated and non-prefabricated construction materials

COMPOSITION in mg/kg	non-prefabricated construction materials		prefabricated construction materials	
	oBB standards	adjusted standards	oBB standards	adjusted standards
combination	S1	S1	S1	S1
Benzene	1.25	1.25		1.25
Ethylbenzene	1.25	1.25		1.25
Toluene	1.25	1.25		1.25
Xylene	1.25	1.25		1.25
Phenols	1.25	1.25		1.25
Aromatics (total)	-	-		-
Naphthalene	0.5	5	1	5
Phenanthrene	3	20	5	20
Anthracene	3	10	5	10
Fluoranthene	3	35	5	35
Chrysene	0.5	10	1	10
Benzo(a)anthracene	25	50	50	50
Benzo(a)pyrene	3	10	5	10
Benzo(k)fluoranthene	25	50	50	50
Indeno(1,2,3cd)pyrene	25	50	50	50
Benzo(ghi)perylene	25	50	50	50
PAHs (total)	25	75**	50	75
PCBs (total)	0.5	0.5		0.5
EOCl (total)	3	3		3
Organochloro-pesticides (total)	0.5	0.5		0.5
Chlorine-free pesticides (total)	0.5	0.5		0.5
Mineral oil *	250	500		500

* Asphalt cement, asphalt aggregate and crushed asphalt cement with more than 80% asphalt aggregate do not have to be tested according to the standards for mineral oil.

** this value is 50 mg/kg for construction waste and demolition waste and the products made from this waste. In this case, testing for the individual PAHs has been cancelled.

1.5. The environmental protection quality of construction materials

The RIVM has made a comparison between the available composition results and leaching results of construction materials according to the standards for construction materials in the oBB and the standards calculated by the RIVM/RIZA, and adjusted for some materials by VROM/V&W. The construction materials studied were those mentioned in Appendix 1 of the oBB, supplemented with the construction materials mentioned in the report "Definitions and applications of stone-like construction materials - current state of affairs", which was drawn up at the request of the CUR/CROW/NNI [5] (see Appendix 11).

The test results of the composition tests (total destruction and aqua regina) and the leaching tests (column tests, cascade tests and diffusion tests) were collected by the RIVM from various sources such as VROM/DGM, RIVM, different research institutions, engineering bureaus and industries. Full cooperation was given by all of these. The reports and analysis results were mostly carried out at the request of the industries and/or the authorities. The numerical information has been checked for quality by professionals at the RIVM. Part of the measurement results had to be rejected at first because it was not clear as to how the measuring was carried out, or whether only the ranges were stated instead of the individual measurement results. The data from the lab tests such as described in the oBB, and passing the quality control, were entered into a database. The results of total destruction were converted into aqua regina with the help of transformation factors.

The results of the cascade test were extrapolated to an equivalent for the column test. For each construction material, the number of measurements, averages and standard deviations of each material was calculated on the data in the database. Then, the tail probability, as well as the accompanying confidence interval, were calculated per material and construction material for each of the standard values. The basis was a binomial distribution of the measurements in the sample (dichotomy) with reference to the standard values for construction materials (percentage larger than the standard values).

It must be explicitly stated that dividing the construction materials into categories is sometimes hampered by the small number of observations done per construction material and/or the small number of measurements done per material. In some cases, critical parameters were not measured or reported. This means that a construction material which has been placed in a certain category based on the current available information, may later on, when the Building Materials Decree is adopted, fall into another category due to new information. The RIVM considers the tail probability of the most critical material to be the best estimate on which to base the categorical division.

Granular construction materials of natural origin

In the oBB this group is divided into natural construction materials (raw materials) which are also found in the Dutch soil and natural construction materials which do not appear in the Dutch soil. According to the oBB, the first group needs only to be tested against the target value for soil quality. When the target value for soil quality is exceeded, application as a category 1 construction material is possible. The second group, that of foreign, natural construction materials not found in the Dutch soil, must meet the criteria for non-prefabricated construction materials. Research has shown that after adaptation of the calculation method to convert from immission requirement to the allowable emission, all the natural materials investigated meet the criteria for category 1 construction materials, regardless of their origin.

The construction materials studied were: clay, gravel, natural sand, de-silted sea sand, limestone, basalt, flug sand and lava stone. The natural materials from the Dutch soil (the first four mentioned) do not exceed the target value for soil quality.

Construction recycling materials

Aggregates, such as asphalt aggregate, cement aggregate, masonry aggregate and mix aggregate from cement and masonry aggregate in which only primary raw materials are processed fall, as a rule, completely or largely into category 1 construction materials. Sieve sand and recycling breaker sand are category 1 construction materials because of their metals. Sulphate is a critical compound which can cause part of the construction recycling materials to be moved up to category 2[14]. Sulphate can be removed through washing. A high sulphate emission can also be prevented through selective demolition (e.g. separation of products containing sulphate from construction waste and demolition waste). It must be mentioned that for some compounds, however, there was sometimes only one measurement available. The conclusions are therefore based more on the group of construction recycling materials as a whole than on the individual construction materials. There is a chance that

[14] Recently VROM/V en W raised the standard value for SO_4 in category 1 aggregates.

aggregates, sieve sand and recycling breaker sand from products in which waste materials have been processed, are moved up to become category 2 construction materials. This depends partly on the leaching of the critical compounds out of the product, and on (ageing) processes which lead to the stabilisation of the metals in the products during the phase of use. The PAH and the mineral oil contents (composition) will not, after VROM/V&W increases the composition standard, lead to rejection for re-use. In sieve sand, and to a lesser measure in recycling breaker sand, organic compounds are present which could lead to a partial rejection of the product.

Secondary raw materials originating through industrial processes

In this category, a division must be made between waste materials, which can also be applied as independent granular construction material in non-prefabricated applications, and between waste materials, which are always applied as filler material or as a gravel alternative in products. In this last category are included: E fly ash, MSWI fly ash, jarosite end slag, ELO-slag, copper slag and chromium slag. The effects of these secondary raw materials on the emission behaviour of the products in which these materials are processed, are dealt with in another section of this report (Part 2). The waste materials which can also be applied independently as unbound material, supplementary material, and/or road base material are MSWI bottom ash, E bottom ash, blast furnace slag and phosphor slag, and are all partly or completely applicable as category 2 construction material. MSWI bottom ash will be almost completely inapplicable in this form. This construction material can then only be applied in the so-called "special category". Mine stone, blast furnace foam slag, granulated blast furnace slag and blast furnace slag sand seem to be mostly applicable as category 1 construction materials.

LD slag is applicable as category 1 construction material after a process change. Some waste materials in category 2 can be applied as category 1 construction materials if they are applied in the road base layers currently used in road building (20 cm).

Products from primary materials

The emissions from products made from primary raw materials are mostly lower than the acceptable emissions. Cement concrete, asphalt cement, rough ceramic products bricks, calcium-silicate bricks and sand cement stabilisation are applicable as category 1 construction materials. These products are applicable in both types A and B applications.

A type A application can be continuously wet, for example, a road base. A type B application is only made wet through rainwater, for example, a roof or a wall aboveground. Aerated concrete blocks is only applicable as a category 1 construction material in type B applications (as part of an outside wall, for example).

Products from primary materials with an addition of secondary materials

Cement concrete and asphalt cement with an addition of filler material of E-fly ash (8% and 50%, respectively), are applicable as category 1 construction materials in types A and B applications. Rough ceramic products, calcium-silicate bricks and aerated concrete blocks with E-fly ash (25%, 37%, and 57% respectively) are suitable for (several) of their usual applications, because the products with E-fly ash can be applied as category 1 construction materials in type B applications. Rough ceramic products with 40% E-fly ash (only if there is less leaching due to higher firing temperatures), and calcium-silicate bricks with 9% E-fly ash (lower percentage E-fly ash), are also applicable as category 1 construction materials in A applications.

Sand cement stabilisation with 73% E-fly ash is not applicable according to the Building Materials Decree. Porous masonry bricks[15] are category 1 construction materials applicable in type B applications. Bricks, aerated concrete blocks and calcium-silicate bricks are usually used in layered constructions (type B application).

Calcium-silicate bricks with lownox E-fly ash or ash lime is applicable as category 1 construction material. Calcium-silicate bricks with fluid bed E fly ash is as category 1 construction material suitable for B applications. Cement concrete and asphalt cement with MSWI bottom ash (8% MSWI bottom ash) are as category 1 construction materials suitable for both types of applications. Asphalt cement with 2% MSWI fly ash is as category 1 construction material applicable in both types of applications. Asphalt cement with 60% phosphor slag is as a category 1 construction material suitable for both types of applications.

[15] These stones are generally not applied outside.

Products of secondary materials

Lightly stabilised phosphor slag and phosphor slag are as category 1 construction materials applicable in type A and type B applications. Stabilised MSWI bottom ash is as a usual category 1 construction material applicable in B applications, and as a category 2 construction material. A small part of the cement stabilised MSWI fly ash is suitable for A and B applications as category 1 construction material. When developing products in which secondary raw materials have been processed, it is suggested to also take into account the second life cycle of a construction material, i.e. a construction recycling material. The resulting aggregate must preferably be usable as a category 1 construction material. In any case, the materials must be investigated and compared with the standard values again before use.

The environmental quality of construction materials applicable in surface water

Crushed natural stone, gravel, sand, phosphor slag, LD slag and concrete elements are applicable as category 1 construction materials. Phosphor slag and LD slag are also applied as "prefabricated" construction materials in waterway construction. These construction materials then fall into the same category as those for applications on or in the soil. Concerning surface waters, the evaluation method which is suggested for the application of construction materials on or in the soil is for the most part adhered to. Category 1 construction materials can be freely applied in surface waters but must be removable. The application of category 2 construction materials and category 1 construction materials in type B applications (only for prefabricated construction materials) remain allowable only under permit of the authorities.

1.6. Re-use

A set of the most important waste materials re-used as construction materials is, for both the situation in 1990 and in 2000, presented by Van Ruiten in his report [6] (Appendix III, Figure A). An agreement has been made with trade and industry (see Appendix 13) that the effect of standard-setting on re-usability and (re-)use is to be calculated with the help of this set of construction materials. This set came into being through an intensive cooperation between industries, and has also been accepted by VROM as the starting-point for comparison.

The set contains both construction materials applied on or in the soil and construction materials applied in the surface water.

The state of affairs in 1993 and further developments

In the policy position paper is announced that when determining the acceptable emission from construction materials, consideration can be taken of the method of the application in the construction. For non-prefabricated construction materials, this is the height of the construction material and for prefabricated construction materials, this is the thickness of the construction material, a correction for exhaustion and ageing by way of the calculated diffusion coefficient. Several construction materials, which are generally applied in layer thicknesses of h=20-30cm (road base layers), will in comparison with the oBB move towards category 1 if this is taken into consideration, i.e. "freely applicable, but with the possibility of being taken back". Construction materials which profit from this are: mix aggregate, E-bottom ash and blast furnace slag mix. In Table 1.6.1., the application heights are counted in the calculation. No calculated diffusion coefficients were available for the prefabricated construction materials; a correction for exhaustion and ageing can therefore not be made. Prefabricated construction materials which are located in category 2 on the grounds of fast leaching compounds will benefit from this and move towards category 1 construction materials.

It was not possible to fit a complete inventoried actual situation of the market in this report. It was important that the shifting which could occur is mentioned so as to make a better evaluation possible in 1993. An important shift is visible; for example, in the implementation plan: Construction and Demolition Waste (branch's document).

The combination of Van Ruiten's calculations and the branch's document "Construction and Demolition Waste" formed the basis for the calculations in this report, of which the results are presented in Tables 1.6.1. (1990) and 1.6.2. (2000).

Table 1.6.1. Expected sales of construction materials (in ktonne) in 1990, based on the set "Van Ruiten/branch document", the adjusted standard-setting according to Part 1 and the agreements made in the policy position note

division according to van Ruiten type of construction material 1990	division according to classes *				
	total	cat.1.	cat.2.	not to be dumped "special category" or applicable in another manner **	to be dumped
N1/V1: expected	7246	6482	764	0	0
N2/V2: expected	4083	3019	351	582	131
others: expected	100	61	39	0	0
total: expected	11429	9562	1154	582	131

* The allowed corrections for prefabricated construction materials are not accounted for in this table.
** MSWI bottom ash applicable under "special category" and E-fly ash are currently fully applied in prefabricated construction materials.

Table 1.6.2. Expected sales of construction materials (ktonne) in 2000, based on the set "Van Ruiten/branch's document", the adjusted standard-setting according to Part 1 and the agreements in the policy position note

division according to van Ruiten type of construction material 2000	division according to classes *				
	total	cat.1.	cat.2.	not to be dumped "special category" or applicable in another manner**	to be dumped
N1/V1: expected	8299	7505	794	0	0
N2/V2: expected	6700	4346	190	1413	751
others: expected	200	161	39	0	0
total: expected	15199	12012	1023	1413	751

* The allowed corrections for prefabricated construction materials are not accounted for in this table.
** MSWI bottom ash applicable under "special category" and E-fly ash is currently fully applied in prefabricated construction materials.

Calculation of the costs

For a detailed description of the method for calculating the costs of dumping, inspection, isolation and quality improvement, refer to Chapter 11. Table 1.6.3. gives the costs for 1990 and for 2000.

Table. 1.6.3. Survey of the costs in guilders per tonne of construction material for 1990 and 2000

type of cost	1990	2000
dumping costs	125	250
inspection costs	0.15 - 0.40	0.15 - 0.40
isolation costs	10	10
isolation "special category"	32	32
quality improvement costs	10 - 100	10 - 100

A comparison is made in our report on the re-usability based on the standards in the oBB, and the standards calculated by the RIVM/RIZA, and possibly adjusted by VROM/V&W. From this can be concluded that by using the adjusted standards for construction materials for the leaching and the organic composition, the total amount of re-usable construction materials in the dump category is reduced by approximately 85% as compared to the oBB. In the policy position note of June 23, 1992, the Minister of VROM indicated that these construction materials could be re-used under a special category in the Building Materials Decree. If it is kept in mind that the MSWI bottom ash is applied under the "special category", and that E fly ash is currently fully applied in prefabricated construction materials, then the reduction is even greater, namely 97%.

Furthermore, a shift of approximately 50% in the direction of category 1 has been realised. MSWI fly ash and asphalt aggregate with tar are still mostly inapplicable as category 1 or 2 construction materials. The RIVM has only taken the environmental demands (re-usability based on environmental grounds) into consideration. Aside from re-usability, aspects such as market acceptance and price-forming also play a role in the quantification of effective re-use. These aspects are not included. The RIVM expects that for many construction materials, enough clarity has now been given concerning their environmental quality, so as to greatly stimulate the market acceptance and thus the re-use of category 1 construction materials.

Conclusions and market effects

In Tables 1.6.4. (1990) and 1.6.5 (2000), a survey is given of the possible costs connected to the Building Materials Decree[16]. Several costs have not been calculated. These are the costs of potential closing down of industries, as well as shifts in the market. Six scenarios are given, in which the expected costs[17] have been included. For the band widths, refer to the chapters in which the various posts are described.

1. First of all, a standard scenario has been calculated. In this scenario it is assumed that a construction material is applied in that category to which it belongs according to its expected quality. This quality, described in Part 2, is based on the available information. If a construction material is applied in category 1 and/or category 2, and/or would have to be partially dumped, then the costs are calculated per category, based on the amount of construction material applied in the category concerned.
2. After this, a scenario was calculated in which all construction materials, or parts of the construction materials which cannot be directly sold as category 1 construction materials, are dumped. In this case, the category 2 construction materials or parts thereof, are not applied isolated, but are dumped isolated. The part falling under category 1 is applied (non-isolated). The net market effect is then Dfl.132 million per year in 1990 in comparison to scenario 1. With an increase in the dumping costs to the incineration charges, the difference can be as high as Dfl. 245 million per year in 2000.
3. Furthermore, the scenario is calculated when all the construction materials which cannot be solely divided into categories 1 or 2 (and are therefore spread over these two categories), are applied isolated. This also pertains to the category 1 parts. In Van Ruiten's set, these are the construction materials mix aggregate, E bottom ash, blast furnace slag mix, phosphor slag and E fluid bed bottom ash. The construction materials which fit completely into category 1 are applied (non-isolated). For 1990 this results in Dfl. 34 million per year more and for 2000, Dfl. 27 million more in comparison to

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[16] It should be mentioned that for both the Building Materials Decree and the acceptance of waste materials at dumpsites, analysis must be done within the same parameters and tests. The analysis costs are therefore barely influenced, either by application or by dumping.

[17] price level 1990, excluding Value Added Tax.

scenario 1[18].

4. The previous scenario is also been included in the calculations when all the construction materials which cannot clearly be placed into one category (and so are divided between categories 1 and 2) are dumped. This concerns both the category 1 and category 2 parts. In Van Ruiten's set, this concerns the construction materials mix aggregate, E bottom ash, blast furnace slag mix, phosphor slag and E fluid bed bottom ash. Only those construction materials which fit completely into category 1 are applied (non-isolated). For 1990 the net market effect would be approximately Dfl. 564 million per year in comparison to scenario 1. The difference can add up to Dfl. 919 million per year by 2000 if dumping costs are equal to burning tariffs.
5. A scenario is then calculated in which sieve sand which must be dumped is processed to be sold as a category 1 construction material. The other construction materials are used according to scenario 1. In this case, the net market effect in 1990 concerning costs is neutral (actually Dfl. -6 million per year) and in 2000, Dfl. -38 million per year cheaper. If the high dumping tariff (Dfl. 250 per tonne) is applicable, then a saving of Dfl. -132 million per year can be achieved.
6. Finally, a scenario is calculated where all stone-like construction waste and demolition waste is treated to form construction materials which are usable as category 1 construction materials. The other construction materials are used according to scenario 1. In comparison to the standard scenario, this costs approximately Dfl. 77 million per year more in 1990, and approximately Dfl. 1 million per year more in 2000. If the dumping charges come to equal the incineration charges, then a saving of approximately Dfl. 77 million per year will be possible in 2000.

The costs for the Building Materials Decree will be around Dfl. 60 million per year in 1990, and Dfl. 160 million per year in 2000. The choice for recycling or for dumping will result in a shift in costs.

The scenarios mentioned as examples here are reproduced in Table 1.6.4. (1990) and in Table 1.6.5. (2000, high dumping charges). The waste material prevention policy is directed

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[18] In the branch's document Construction and Demolition Waste, it is expected that for 2000 all the construction recycling materials will be offered as certified products. Certified construction materials are, in general, of better quality (see Part 1). The result of this is that isolation costs are lower.

towards prevention and re-use, so that the recycling of waste materials is preferable to dumping. By recycling waste materials into re-usable products, the costs may rise to Dfl. 150-175 million per year. From the evaluation it also appears that by guiding tariffs, the recycling of waste materials can be stimulated.

Table 1.6.4 Expected market effects* in million guilders per year for various re-use scenarios (data: 1990)

scenario	category				inspection costs		total
	certainly cat. 1	cat. 2	"special category"	dumping	set v.Ruiten	others	
1. Construction Materials Act 1993	apply	isolation: Mf 12	isolation: Mf 16	dumping: Mf 16	Mf 1.5	Mf 8.5	Mf 54
2. cat. 2 also dumped	apply	dump: cat. 2	isolation: Mf 16	dumping: Mf 16 plus Mf 144 cat. 2	Mf 1.5	Mf 8.5	Mf 186
3. definitely apply only under cat. 1, others in cat. 1 and 2 isolate	apply	isolation : Mf 46 incl. cat. 1 part	isolation: Mf 16	dumping: Mf 16	Mf 1.5	Mf 8.5	Mf 88
4. definitely apply only under cat. 1, others dumped cat. 1 and 2	apply	dump construction materials in cat. 1 and cat. 2	isolation: Mf 16	dumping: Mf 16 plus Mf 576 cat. 2	Mf 1.5	Mf 8.5	Mf 618
5. cat. 2 isolate and recycle construction materials to be dumped	cat. 1: apply and recycle sieve sand:Mf 10	isolation: Mf 12	isolation: Mf 16	see cat. 1	Mf 1.5	Mf 8.5	Mf 48
6. recycle all construction recycling materials	cat. 1 apply and recycle all construction recycling materials Mf 100	isolation: Mf 5 (concerns all remaining construction materials)	isolation: Mf 16	see cat. 1	Mf 1.5	Mf 8.5	Mf 131

*price index 1990, excluding Value Added Tax.

Table 1.6.5. Expected market effects* in million guilders per year for various re-use scenarios (data: 2000) with a waste materials policy in which the dump tariffs increase to Dfl. 250 per tonne

scenario	category				inspection costs		total
	cat. 1	cat. 2	"special category"	dumping	set v.Ruiten	others	
1. Construction materials Act 1993	apply	isolation: Mf 10	isolation: Mf 40	dumping: Mf 188	Mf 1.6	Mf 15	Mf 255
2. cat. 2 also dumped	apply	dumping:	isolation: Mf 40	dumping: Mf 188 plus Mf 256 cat. 2	Mf 1.6	Mf 15	Mf 500
3. definitely apply only under cat. 1, others in cat. 1 and 2 isolate	apply	isolation: Mf 37 incl. cat. 1 part	isolation: Mf 40	dumping: Mf 188	Mf 1.6	Mf 15	Mf 282
4. definitely apply only under cat. 1, others dumped cat. 1 and 2	apply	dump construction materials in cat. 1 and cat. 2	isolation: Mf 40	dumping: Mf 188 plus Mf 929 cat. 2	Mf 1.6	Mf 15	Mf 1174
5. cat. 2 isolate and recycle construction materials to be dumped	cat. 1: apply and recycle sieve sand Mf 56	isolation: Mf 10	isolation: Mf 40	see cat. 1	Mf 1.6	Mf 15	Mf 123
6. recycle all construction recycling materials	cat. 1 apply and recycle all construction recycling materials Mf 100	isolation: Mf 5 (concerns all remaining construction materials)	isolation: Mf 40	see cat. 1	Mf 1.6	Mf 15	Mf 162

* price index 1990, excluding Value Added Tax.

1.7 Testing procedure

For details see RIVM report 771402010 and chapter 11.3

A first initiative for a testing procedure is as follows:

- delimit a batch of 2000 tons of construction material or the entire batch if this is smaller than 2000 tons.
- take at least 12 a-select increments from this batch according to NEN 7300.
- join these increments a-select to at least c=3 mix samples of at least m=4 increments each (each sample the same number of increments).
- measure the sample characteristics to be tested per material according to the NEN 73xx series.
- calculate per material (i) the average ($\bar{x}_i$) of the measurement results of the three or more mix samples.
- reject the sample if $\bar{x}_i$ > rejection factor * testing value for material i (T_i).

Read off the rejection factor in table 2 and the testing value in appendix 1 of the Building Materials Decree in case of 3 or 4 mix samples of 4-20 increments each.

Note: for other values of c and m, the rejection value can be calculated with equation 4:

$$\overline{x}_i \leq AW_i = T_i * AF = T_i * e^{1.282 * VC_{Part} * \sqrt{\frac{1}{n} + \frac{1}{c} * \frac{VC^2_{meas}}{VC^2_{part}}}} \qquad (4)$$

in which n=c*m.

Table 2. Rejection factors (AF) for various c and n for VC_{meas}=0.25.

				number of takings per sample				
category	VC_{rivm}	VC_{part}	VC_{meas}	4	8	12	16	20
				3 samples				
non-prefabricated: leaching and composition (organic)	0.65	0.60	0.25	1.34	1.27	1.25	1.24	1.23
prefabricated: leaching	0.45	0.38	0.25	1.26	1.23	1.22	1.22	1.22
				4 samples				
non-prefabricated: leaching and composition (organic)	0.65	0.60	0.25	1.28	1.23	1.22	1.21	1.20
prefabricated: leaching	0.45	0.38	0.25	1.22	1.20	1.19	1.19	1.18

VC = variation coefficient see for more information chapter 11.3.

2. INTRODUCTION

2.1 Research approach

In 1991, the draft Building Materials Decree (oBB) was published in the Staatscourant [1] for public insight. In the oBB is published a list of compounds with the accompanying leaching and composition standards for construction materials. These indicate under which conditions construction materials may be applied on or in the soil (appendix 2 of the oBB). The supporting standards calculations were at that time (1990/1991) carried out by the National Institute for Public Health and the Environment (RIVM), based on the definition of marginal soil burdening and the knowledge at that time [7].
The evaluation of the consequences of the oBB for the applicability of construction materials and waste materials at that time were based on the Mammoth-study [8] and other studies [9].
In 1992, the RIVM was asked to draw up a report with respect to a definite Building Materials Decree. Based on the choices made, as well as on additional information received, a first version of this report appeared in 1992.
As the result of this report and comments given, the Ministry of VROM has issued a policy position note [2]. The first version of this report, and its related parts in the policy position note, were discussed in four meetings with the construction industries (appendix 13). This report is the final version.

In the oBB, a list is given of those materials which can be applied under certain conditions without being tested according to the standards (appendix 1 of the oBB). According to the oBB, this list would be valid during a certain transition period. After this period, the testing would be carried out according to appendix 2 of the oBB. To divide the construction materials according to appendix 1 of the oBB, composition data and leaching data, achieved through certain tests, was used. The construction industries remarked that there was an insufficient balance between re-use and the protection of the soil. Furthermore, according to the industries, the testing according to appendix 2 would already be casting its shadow because of the limited period of validity of appendix 1. This would be strengthened by the discrepancies between the division of construction materials into the categories in appendix 1, and the division which would be achieved if these construction materials would be divided according to the standards for construction materials as given in appendix 2. This would lead to an undesirable marketing behaviour of construction material users.

Permit-controlling authorities and users would, according to the expectations of the industries, informally test the secondary raw materials which are listed in appendix 1 according to the standards for construction materials as stated in appendix 2, and allow these results to count when making a decision. This is signalled in the report "Quantitative Inventory of Possible Financial-economic Aspects of the Building Materials Decree" [6]. Also, the falling out of secondary raw materials is brought into focus, and the consequences for the necessary dumping room is indicated in above mentioned report. However, it is also stated that the costs and the savings indicated, are necessarily based on many assumptions.

The Directorate General for Environment (VROM/DGM) of the Ministry of Housing, Spatial Planning and the Environment (VROM), has asked the RIVM (January 1992) to give an objective survey of which waste materials streams or parts thereof are not, or are only partially, suitable for re-use, if they would be tested according to the standards for construction materials as stated in appendix 2.

Besides the construction materials mentioned in appendix 1, all the existing forms of construction materials use are included in the evaluation in this study. These methods of use are inventoried in the CUR/CROW/NNI report "Definitions and Applications of Stone-like Construction Materials - Current State of the Art" [5].

Another objection raised by the industries is the difference between leaching in the lab and leaching in actual practice. To be able to compare, to test, and to divide construction materials into categories, testing methods have been developed which, based on lab tests, give insight into the composition and the emission behaviour of construction materials. As a rule, construction materials must be applied in such a way that they do not lead to the burdening of the soil and of the surface water.

In the oBB, a limited burdening of the soil and the surface water is permitted. The standards for the construction materials in appendix 2 are indirectly based on the effects for humans, plants, animals, and the ecosystem [10]. A direct relationship between the standards for the burdening of the environment, and the risks involved, is still too complex to achieve a complete survey of the results per type of activity and per location.

The maximum allowed burdening is defined by the government in the oBB on a product level, based on the criteria of marginal burdening, with the accompanying numerical calculation. The standard setting has as goal to give general standards and rules, which in most of the situations do not lead to a relatively high rise of the burden of the soil with substances in comparison to the target values for soil quality, and the concentrations of substances in the surface water in comparison to the limit value for surface water quality. This goal, and especially the question of whether there is enough protection of the groundwater and the soil, is currently being studied by the RIVM, in cooperation with the LUW (modelling research[19]). It is being researched whether closer study by the RIZA is necessary about the question of enough protection of the surface water. Detailed knowledge about the relationship between the leaching behaviour in the lab and in actual practice is not yet available. A large variety of processes in the construction material and in the soil make this modelling study, and verification of this model through experiments, very complex. The calculations for the oBB actually assume that this relationship is one to one.
In this report, suggestions are made as to how the results of the leaching test can be interpreted, so that these results connect better with the leaching in actual practice. These suggestions are based on the current knowledge and insights.

Finally, in many objections, the composition criteria is questioned. This criteria has two protection goals: it functions as an extra guarantee since there is still little experience with the suggested leaching tests; and it reduces the consequences in case construction materials are not able to be taken back or should become mixed through the soil, despite the prohibition on their being mixed and despite the requirement for their ability to be taken back. This can occur during construction, demolition, or through wear and tear during use. The comments which have been given[20] [11,12,13] are not unanimous. In the report, the possible effects of the composition criteria are evaluated numerically.

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[19] Results are published in 1995. A summary of the results is reported in chapter 10.6.

[20] That is, the suggestions given by the Council for Water, the CRMH, and the Technical Commission Soil

With the appearance of this report, the first version of this report, as well as RIVM report 738504011, is cancelled [7]. Neither of these reports will be distributed anymore.

Definitions focused on standard-setting for construction materials in this study

Immission	burdening a compartment (soil or surface water) with compounds from construction materials, in mg/m^2.
Emission	the discharge of compounds from a construction material to a compartment in mg/kg or mg/m^2.
Accepted immission (I_{max})	burdening a compartment (soil or surface water), which is acceptable to the Dutch Ministry of Housing, Spatial Planning and Environment and indicated in mg/m^2.
Measured emission (E_{meas}) or leaching	leaching of compounds from a construction material in mg/kg or mg/m^2 measured in the laboratory.
Calculated immission (I_c)	an immission derived from leaching in the laboratory and corrected for differences between laboratory leaching and actual leaching (lab/actual differences) in mg/m^2.
Maximum allowable emission (E_{max})	an emission derived from the acceptable immission in which lab/actual differences for prefabricated and non-prefabricated construction materials are taken into consideration in various ways, in mg/kg or mg/m^2.
Compound	inorganic compounds (metals, anions) and organic compounds (PAHs, mineral oil, etc)

PART 1

STANDARDS

3. INTEGRATED WASTE MATERIALS POLICY

The waste materials policy in The Netherlands on the one hand is based on an optimal use of natural materials and secondary raw materials, and on the other hand on the reduction of waste materials which must be dumped. In this policy, key ideas are: prevention of the occurrence of these waste materials; separation of waste materials at the source; re-use; recycling; and useful applications.

Besides volume prevention, there is also qualitative prevention, that is to say improvement in the quality of the waste material, which is of great importance for re-use. The development of the policy must take place within the margins of air quality, soil quality, groundwater and surface water quality, radiation protection, and spreading of harmful substances into the environment. Governments have the task to set standards for the quality of the soil, the water and the air, and to determine the allowable immissions. From there on, it is possible to calculate back to acceptation requirements for waste materials which are respectively re-used or processed through certain removal systems. In these systems, emission-limiting facilities are of importance. The industries can focus in on this by developing technically and economically profitable waste materials processing systems.

Governments can steer by setting tariffs for the various systems, and by giving financial support. The feasibility is determined by the processing costs, the processibility of a product, the energy efficiency, finding a suitable removal method for the concentrated waste materials which occur during the removal, and the selling capacity of the product.

4. POLICY STARTING POINTS: LIMIT VALUES AND TARGET VALUES

In the effects-directed environment policy, interconnected goals can be formulated which must be applied everywhere or in certain areas. In the policy position note "Environment Quality Goals for Soil and Water" (Milbowa) [10], general environment quality goals have been determined.

A difference is made between target values which indicate the final goal, and the limit values which serve as sub-goals. Target values and limit values are connected to the risk margins for humans, plants, animals, and the ecosystem [10]. For target values, there is a negligible risk (VR), and for limit values, there are risks which are less than or equal to the maximum allowable risk (MTR). The target values in the Milbowa are for an important part based on a risk-evaluation which is presented in the RIVM report "Aiming for values"[14].

Based on the current knowledge, it is not possible to just simply set target values for heavy metals, arsenic, and nutrients on the basis of maximum allowable risk levels. The target values for several metals (such as cobalt, molybdenum, tin, and barium), salts, and cyanide are placed on the level of the background values as they have been measured in relatively unburdening terrestrial and aquatic soils in The Netherlands[21]. For more detailed information, refer to the NMP [15], the notice "Handling Risks"[16] and the notice Milbowa [10]. In the cabinet's viewpoint concerning the Milbowa notice, the target values and the limit values are determined according to their use in carrying out the environment policy.

Since target values developed on the basis of ecotoxological risk evaluation have not been developed for every compound mentioned in the oBB, immission standards cannot be directly related to the possible effects on organisms. This relationship does exist indirectly for the background values. The background values for these metals are regarded as a first estimation of a negligible risk level.

The quality of the Dutch surface water is for an important part determined by the quality of the river water which enters the Netherlands.

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[21] The background amounts in the soil and in the sediment are described in the target values already existing (A-values in the Guide for Soil Sanitation, the reference values for soil quality or values for the general environment quality for the sediment bed of surface water). The target values for surface water are converted from the values for soil and sediment with the help of partition coefficients. The background values for groundwater are based on measurements given in the National Groundwater Measurement Network.

In the Third Notice on Water Care [3], it has been chosen by way of policy to use limit values, instead of target values, for the surface water quality. In future policy documents, the level of the target values may be added.

In due time, adaptations in the evaluation of the quality of construction materials, based on the risk approach, may become necessary when the translation of the risks per compound to the various environmental subjects is completed. In The Netherlands, the target values and limit values mentioned in table 4.1. are used.

Table 4.1 Target values for soil and groundwater quality and limit values for surface water quality in The Netherlands.

compound	soil mg/kg	groundwater μg/l	surface water μg/l
As	29	10	10
Ba	200	50	(150)
Cd	0.8	0.4	0.2
Co	20	20	(2)
Cr	100	1	20
Cu	36	15	3
Hg	0.3	0.05	0.03
Mo	10	5	(10)
Ni	35	15	10
Pb	85	15	25
Sb	(2.6)	NA	(2)
Se	(1)	NA	(0.5)
Sn	20	10	(0.25)
V	(68)	NA	(5)
Zn	140	65	20
Br	20	300	8000
Cl	(200)	100000	200000
F	500	500	1500
SO_4	(500)	150000	100000
CN-complex	5	10	(5)
CN-free	1	5	NA

- values taken from the "Policy position note concerning the Milbowa Notice" (Feb. 2, 1992)[10] and the "Third Notice on Water Care"[3], except the values between brackets.
- NA = not available
- antimony, selenium and vanadium from [4].

() concluded from this report.

5. ENVIRONMENT HYGIENIC POLICY STARTING POINTS IN DETERMINING STANDARDS FOR CONSTRUCTION MATERIALS

The following starting points have been determined by VROM/V&W to develop the determining of standards for construction materials:

- The setting of standards must be independent of the national variations of concentrations in a compartment and independent of the diversity in biotopes. This to ensure uniformity in legislation as well as the enforcement of the standards. For construction materials, this means that the standards must be independent of the type of soil or surface water on or in which the construction materials are applied, with the exception of applications on salty or brackish soils.
- In the standard setting, emission contributions from other local and diffuse sources have not been counted, which does not imply, however, that these are not of any importance. It does mean that, when calculating the maximum allowable burdening of the soil, the burdening by compounds from the dry and the wet deposition or from the groundwater are not included in the setting of standards for construction materials. In the same way, when calculating the maximum allowable burdening of the surface water, the burdening by compounds from the deposition, or from surface water which enters the Netherlands (local and diffuse), are not included in the standard setting for construction materials.
- When setting standards, no difference must be made for primary and secondary raw materials.
- The setting of standards must be based on the average concentrations/emissions, and not on the course of the concentration and/or the course of the emission from the source over time. When developing the standards, the course of the concentration, however, can be kept in mind, for example when a peak-burdening occurs. For the setting of standards for the application of construction materials in the surface water, the course of the concentration and/or the course of the emission from the source in time is of great importance, considering the large liquid (L) - solid (S) ratio and the thereby accompanying high initial release of compounds.
- For the sake of the calculations for the standard setting, the emission of compounds from a construction material is regarded as being burdening to one compartment only, that is to say that in the calculations, it is assumed that there is no spreading of the compounds over

more than one compartment.

- The soil and the groundwater under the application must in their potency remain suitable for all their possible natural functions (multifunctionality).
- The surface water around the application must in its potency remain suitable for general functions and goals such as: bringing and removing ice, water and sediment, drinking water supply, nature and landscape, ecology, etc.

Through these policy choices, and by relating the allowed immission to the target values (soil and groundwater) or to the limit values (surface water), and not to the local concentrations in a compartment, the resulting standards are applicable to each construction material and in each area and surface water (WVO area). In protected soil areas, groundwater areas, and surface water areas, provinces can set additional requirements if necessary, on the grounds of the Soil Protection Law.

6. MAXIMUM ALLOWABLE BURDENING

Regarding the burdening of soil by construction materials which are applied on or in the soil and in the surface water, four types of burdening can be distinguished. These are zero burdening, neutral burdening[22], marginal burdening, and stand-still[23]. Besides the policy concerning the soil, groundwater, and surface water, and the policy concerning the spreading of environmentally dangerous compounds, there is also (as part of the waste materials policy and the policy on natural sources) stimulation towards re-use, in order to restrict the exploitation of natural raw materials as much as possible, and to minimize the volume of the waste materials to be dumped.

The application on or in the soil (including the sediment bed of the surface water) of (secondary) raw materials and products in which waste materials have been processed and of which the compound concentrations exceed the target values, or which emit harmful compounds, is generally undesirable from the viewpoint of soil and surface water protection and spreading of harmful compounds. Waste materials which are suitable for re-use as construction material, or products in which waste materials have been processed, as a rule have for one or more compounds, a higher emission and/or composition concentration with respect to the target values for soil quality, or the limit values for surface water quality.

Products and waste materials which do not (lead to zero burdening) or which barely do not emit, are not possible to realize with the current production techniques. The same applies to certain natural raw materials and products made of natural raw materials. As a result of percolating water and along streaming water, chemical compounds leach out in greater or lesser amounts from construction materials. This leads to a certain burdening of the environment.

With an eye on re-use, it has appeared necessary to offer more room than would be applicable with a zero burdening or a neutral burdening. Within the environment policy, rules have been made for actions which lead to local soil burdening and burdening of the surface water. The choice has been made for maximum allowable immissions which are deduced from the definition of marginal soil burdening and surface water burdening.

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[22] Immission in the subject concerned is equal to the emission (input = output).

[23] Stand-still means that the emissions through human action is fixated on the current practice.

For the application of waste materials as construction materials, the ministry of VROM has determined how much burdening of a compartment can be permitted (maximum allowable immission). A general definition of a maximum allowable immission is as follows:

"an immission of a compound which throughout a certain time period may lead to an averaged extra local burdening of a compartment which is permitted 'by way of policy'".

Extra means: aside from burdening from diffuse and other (local) sources.

When determining whether a burdening is marginal, it would be of importance to discover how the calculated "extra" risk is related to the VR and the MTR, keeping in mind the current quality of the environment and the contributions by other sources. This verification is, however, not possible with the current knowledge. The maximum allowable immissions are related to the changing of the current soil quality and the surface water quality respectively, with a fixed value for the target value and the limit value respectively. Adaptations to the target values and the limit values are of immediate influence on the maximum allowable immissions and on the setting of standards for construction materials.

6.1 Soil

For waste materials which in The Netherlands are applied on or in the soil (including the sediment bed of the surface water), for example as secondary raw materials for roadway and waterway construction, the oBB describes the maximum allowable burdening of the soil as a very minute increase of the concentrations of compounds in the solid phase of the soil, and the protection of the groundwater at the level of the target values for groundwater; "marginal soil burdening". The mathematical equation of the policy concept "marginal soil burdening" in the oBB is the following [1]:

"A burdening as the result of leaching from a construction material which leads to a 1% increase of a compound in the solid phase of the soil compared to the target value for soil quality in 100 years averaged over the first metre of a soil considered to be homogeneous."

Furthermore it is accepted that the actual distribution over the compartments does not lead to an unacceptably high burdening for any of them.

6.2 Groundwater

The application of construction materials results in the moving through the soil of compounds which leach from the construction material (via water percolation or via along streaming water). For this reason, in the standard setting, it should be considered whether the burdening is limited to the source and the direct area around the source, or whether it moves further on.

This extra criteria is difficult to quantify. In the explanation of the oBB, three comments can be made regarding the standards:

1. according to the oBB, category 1 construction materials[24] may also be applied in the groundwater and in large streaming surface waters without isolation having to be applied. Just as with applications above the groundwater level, it is not only the soil which is burdened, but also the groundwater and the surface water.
2. The setting of standards for chloride and sulphate is not based on the definition of marginal soil burdening, but does have the same sort of relationship to the target value for groundwater quality.
3. It is stated in the oBB that in the protection of the soil at the level of marginal soil burdening, the groundwater is protected at the level of the target value for groundwater, and that also the large streaming surface waters are protected in an acceptable way with the standards stated in appendix 2.

In the definition for marginal soil burdening, one reads "the top meter". In the oBB explanation of the oBB, it appears that this quantification is not only used as a mathematical unit in the calculation of the standards, but is also indicative for the dimensioning and locating of that part of the soil which is permitted to be burdened "in small amounts" by construction materials. It is, however, not likely, and therefore also not a starting point, that the accumulation of leached compounds take place equally over the first meter.
For the oBB, it is assumed that also with such a spreading (during time), in general no unacceptable situations would result, as long as the total burdening remains within the limits of marginal soil burdening. If the absorption of compounds into the soil is relatively large, and/or the percolation by water very small, then the moving of the compounds will remain

[24] For a description of V and N construction materials and the accompanying demands, refer to the oBB.

relatively small, and the burdening of the soil will be limited for many years to the direct surroundings of the construction material. This situation is for now adopted by the oBB for metals. The acceptance is evaluated in chapter 10.

In practice, then, under the application, local increases of more than 1% can occur, depending on the behaviour of the compounds in the soil; averaged over the first meter, however, is not allowed. These local increases are deemed acceptable by DGM. The localization of the burdening (this can also be more than 1m beneath ground level) is not important for calculating the standards, but it is important for the groundwater. If the compounds do not or barely absorb to the soil, then burdening of the groundwater is already possible with a relatively small percolation. This situation occurs in the case of mobile anions such as chloride and sulphate [17]. This is also apparent in a comparison of the concentrations of these compounds in the rainwater and in the groundwater in the Netherlands (Table 6.2.1.). The oBB lacks a numerical basis regarding the protection of the groundwater, as well as the mathematical working out of the standards for construction materials for chloride and sulphate [17]. Regarding groundwater and surface water, decisions have not been made as to how the principle of "protecting the groundwater and surface water at the target value level" can be realized, nor is it possible to fall back on knowledge about the actual transportation behaviour and the risk-evaluation coupled to this.

Table 6.2.1 Concentrations of compounds in groundwater and rainwater in The Netherlands [18].

compound	depth of the groundwater (15 - 30 m)		rainwater in 1989			
	average conc. mg/l	range mg/l	average mg/m^2 per year	minimum mg/m^2 per year	maximum mg/m^2 per year	average conc. mg/l
As	0.0026	0.00004 - 0.94				
Ba	0.10	0.001 - 1.3				
Cd	0.00014	0.00001 - 0.010	0.1	0.1	0.1	0.0002
Co	0.001	0.00001 - 0.019				
Cr	0.0011	0.00026 - 0.009				
Cu	0.00071	0.00032 - 0.014	1.5	1.0	2.1	0.002
Hg	0.00002	0.000002 - 0.00005				
Mo	0.0004	0.0001 - 0.0021				
Ni	0.0015	0.0003 - 0.029	0.3	0.2	1.0	0.0005
Pb	0.0015	0.00001 - 0.10	4.4	2.3	6.8	0.007
Se	0.000013	0.000005 - 0.0002				
V	0.0008	0.0001 - 0.0034	1.0	0.5	2.6	0.002
Zn	0.025	0.003 - 2.8	14.3	8.0	23.9	0.022
Cl	241	4.6 - 7660	2020.8	992.7	3793.5	3.1
F	0.01	0.01 - 0.02	15.3	5.7	27.8	0.024
SO_4	32	0.1 - 666	2977.9	2401.5	3554.3	4.6
precipitation				647.0	556.0	718.0

In order to make an objective judgment of the standards for Cl and SO_4 for construction materials, a choice is necessary. In order to gain more insight, the RIVM is carrying out research to the behaviour of compounds in the soil which come from construction materials (development of a transportation model). The results of this study will become available in 1995[25]. After this time, on the basis of this study, it will probably be possible to develop an integral standard setting for both the soil and the groundwater[26]; that is to say, a standard for compounds based on one or more target values. It is now not possible to give a general indication of the amounts, nor an indication of when certain compounds from construction materials can enter the groundwater, except for chloride and sulphate for which a burdening of the groundwater can be expected to occur quickly. DGM has stated, in advance of the results of the RIVM studies mentioned, that with regards to chloride and sulphate, the groundwater for these compounds must be protected at the level of the target value for groundwater. The allowable burdening of the groundwater quality by chloride and sulphate is defined as:

> "A burdening as the result of leaching from a construction material which leads to a 100% average increase of the target value for groundwater quality in the first year for chloride and sulphate in the percolate which is, or becomes, groundwater."

Two situations can then occur, namely:

a) The construction material is leached by percolating or along streaming rainwater with relatively low concentrations of chloride and sulphate. In the first year, groundwater is got at the level of the target value, and the concentration decreases in the following years.

b) The construction material is leached by an equal amount of groundwater as mentioned under a) with the quality of the target value. For chloride and sulphate, this results in at the most a doubling of the target value. After that, the concentration decreases, but will stay above the target value for more than ten years.

The actual concentration is determined by dilution and the current concentration of the

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25 A summary of the results of this research is reported in chapter 10.6.

26 This does not mean a simple adding up of both types of burdening, but a standard setting which keeps in mind more the actual behaviour of the compounds in the soil.

groundwater at the site. In chapter 10, this is further worked out.

Protection of the groundwater at the level of the target value for groundwater is in situation b) only possible if the current concentration of a compound in the groundwater is below the target value, because the first percolate generally has a concentration which is higher than the target value.

For the duration of the emissions to the groundwater, the method of emission is of importance. Two methods can be distinguished, namely:

I. an emission which is chiefly the result of the dissolving of compounds. This usually occurs directly after the application of a construction material, and results in a short, relatively high, peak burdening. Concerning the surface water, there is always a peak burdening for granular materials because of the method of application (during the dumping of bulk materials, relatively large amounts of water compared to the amount of construction material).

II. an emission which is the result of the diffusion of compounds. The burdening is more spread out. For prefabricated construction materials, there is usually a long-term burdening brought about by diffusion.

6.3 Surface water

When there is leaching of compounds to the surface water, the pollution is not restricted to the direct environment of the work, but is spread by the along streaming surface water. Since the volume of the water which is burdened with the emitted compounds is replaced by fresh water, the increases which occur are to be seen as temporary. Compared to groundwater, the dilution of the compounds is much greater. In a dynamic system such as surface water, the compounds which come from construction materials will spread over a wide area. As a result, it is now not yet possible, compared to the soil, to determine an acceptable long-term burdening for the application of construction materials. The greater spreading of the compounds which enter the surface water (and by this cause a lower effective increase, but over a larger area), leads to the fact that in general, the marginal burdening of the soil (higher effective increases, but in a more limited area) on the long term will be much more critical with respect to the application possibilities of construction materials.

Also, the processes which describe the exchange of compounds from construction materials into the surface water, are not able to be quantified very well, especially on the long term. It is possible, though, to determine an allowable short-term burdening for the application of construction materials, because the influence of the surface water in the direct surroundings of the application can be taken into consideration. During this short-term period, the amount of dilution is dependent on the speed of the streaming surface water; a factor (flow rate) which has been kept in consideration in the definition of the allowable burdening of the surface waters. The allowable peak burdening is defined as follows:

> "A cumulative burdening from out of the entire work area bordering on the surface water as the result of leaching from a construction material, which at the most leads to an average increase of 10% of the limit value for surface water quality in the long-flowing surface water (flow rate) considered homogeneous for a period of four days."

The averaged tempo in which a construction can be realized (construction tempo) is kept in mind. For construction materials whereby the leaching is determined by washing and dissolving, the leaching reduces greatly in time.

For construction materials whereby the leaching is determined by diffusion, the leaching reduces less strongly over time. In combination with the construction tempo, for the category of construction materials first mentioned, the leaching is the highest during the first 4 days of a total construction period, and for the last mentioned category of construction materials, the leaching is the highest at the end of the construction period (the last 4 days).

There are no dissolving restrictions when the compounds dissolve, due partially to direct contact with large amounts of water. The increase of 10% of the limit value in relation to the period of 4 days and the increase being of temporary nature, makes it possible to relate the calculated increases to the standards for acute toxicity. The measure of the allowable increase with respect to the limit values is such that levels in which acute toxic effects can occur, will not be exceeded. To relate the toxic effects with another, especially longer, time period, detailed knowledge about the duration of exposure and toxicity levels is necessary. This knowledge is available in a qualitative way, but not yet enough in a quantitative way.

6.4 Emission and immission surface area

To calculate the acceptable emission, the surface area of the receiving compartment for which an acceptable immission has been defined is of importance. This surface area is on the one hand defined in the definition for the allowable immission and on the other hand in the definition of the immission surface. For all applications both on the soil and the sediment bed of the surface water as well as in the groundwater and the surface water, the emission surface and the immission surface are seen as equal in the calculations.

For applications of granular construction materials in and on the soil as well as prefabricated construction materials in the soil, this is generally evident.

For a prefabricated construction material on the soil, for example a wall, it is assumed in the calculations that one square meter of wall emits to one square meter of soil surface area. In figure 6.4.1. - 6.4.6., the situations most often occurring are reproduced schematically.

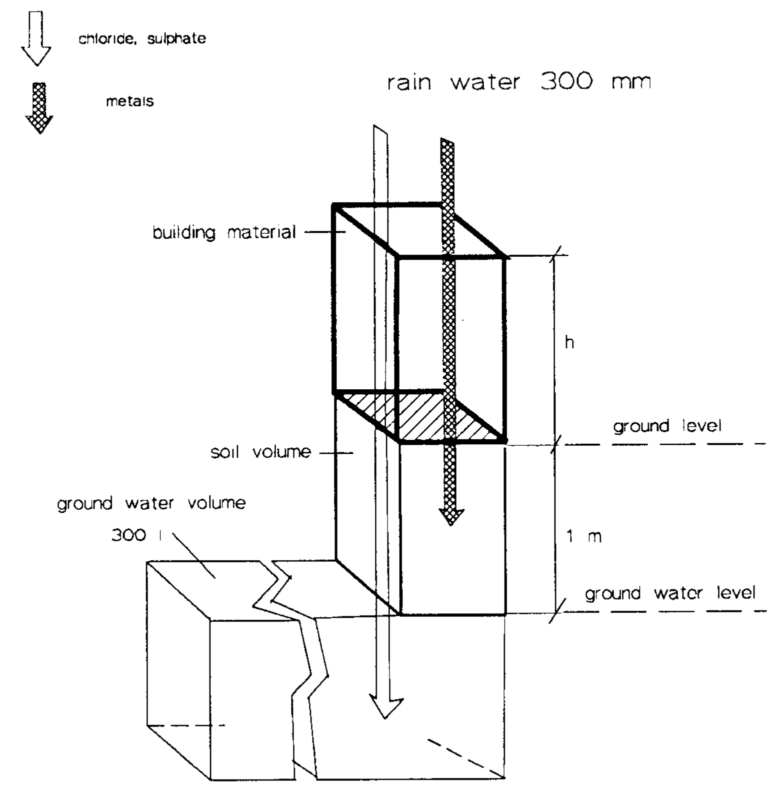

Figure 6.4.1 Granular construction materials above the soil

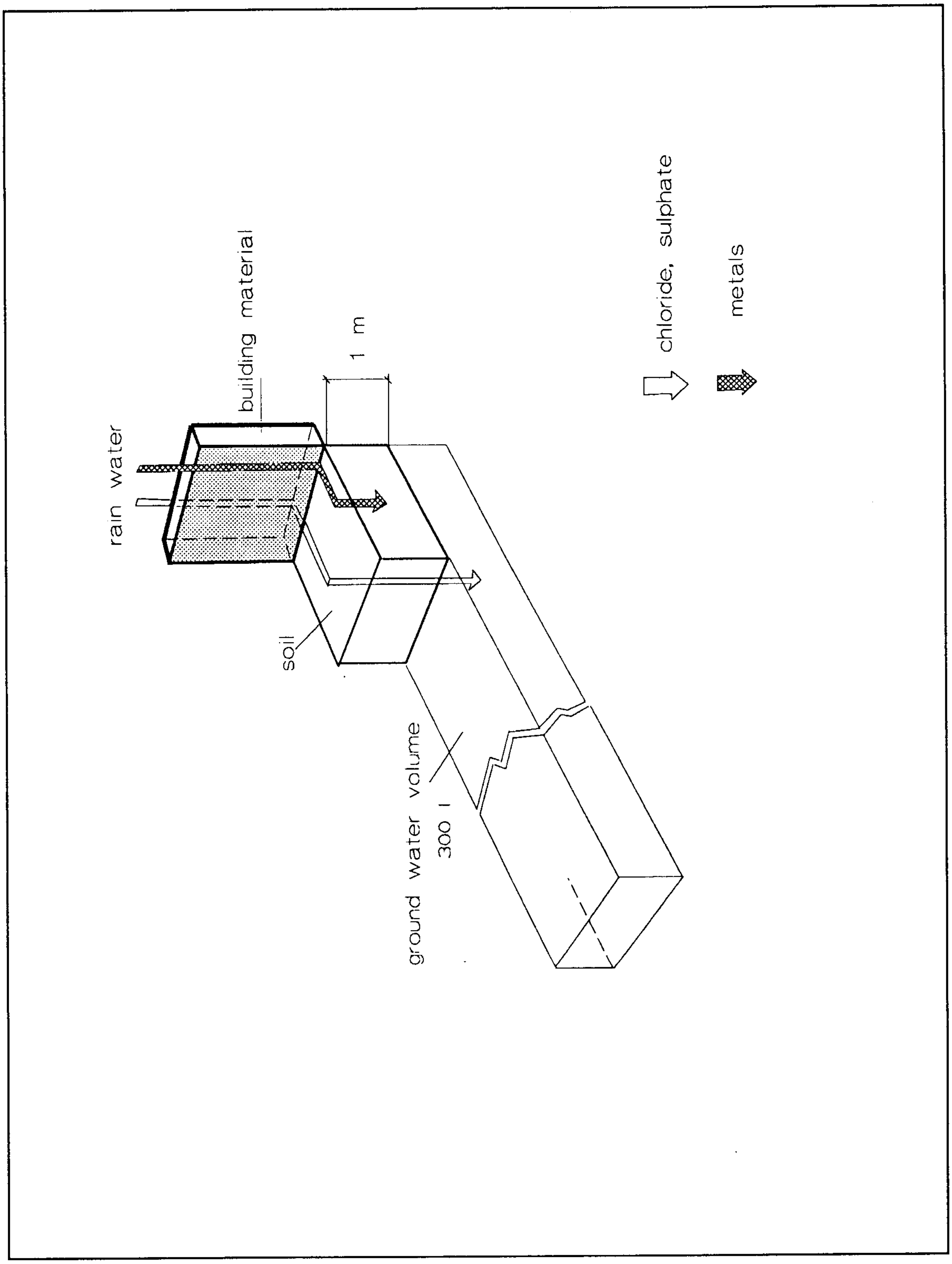

Figure 6.4.2 Prefabricated materials above the soil

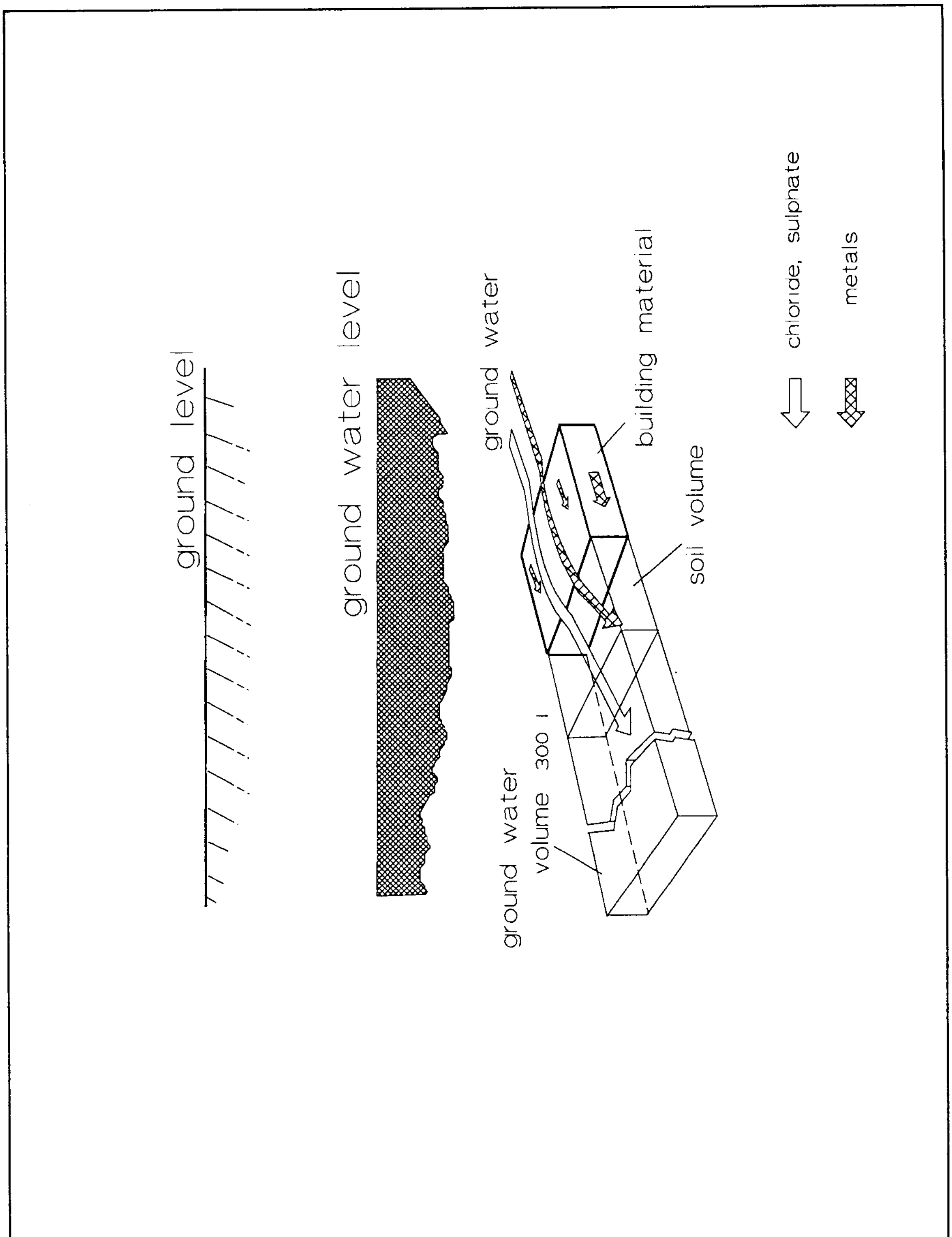

Figure 6.4.3 Prefabricated materials in the soil

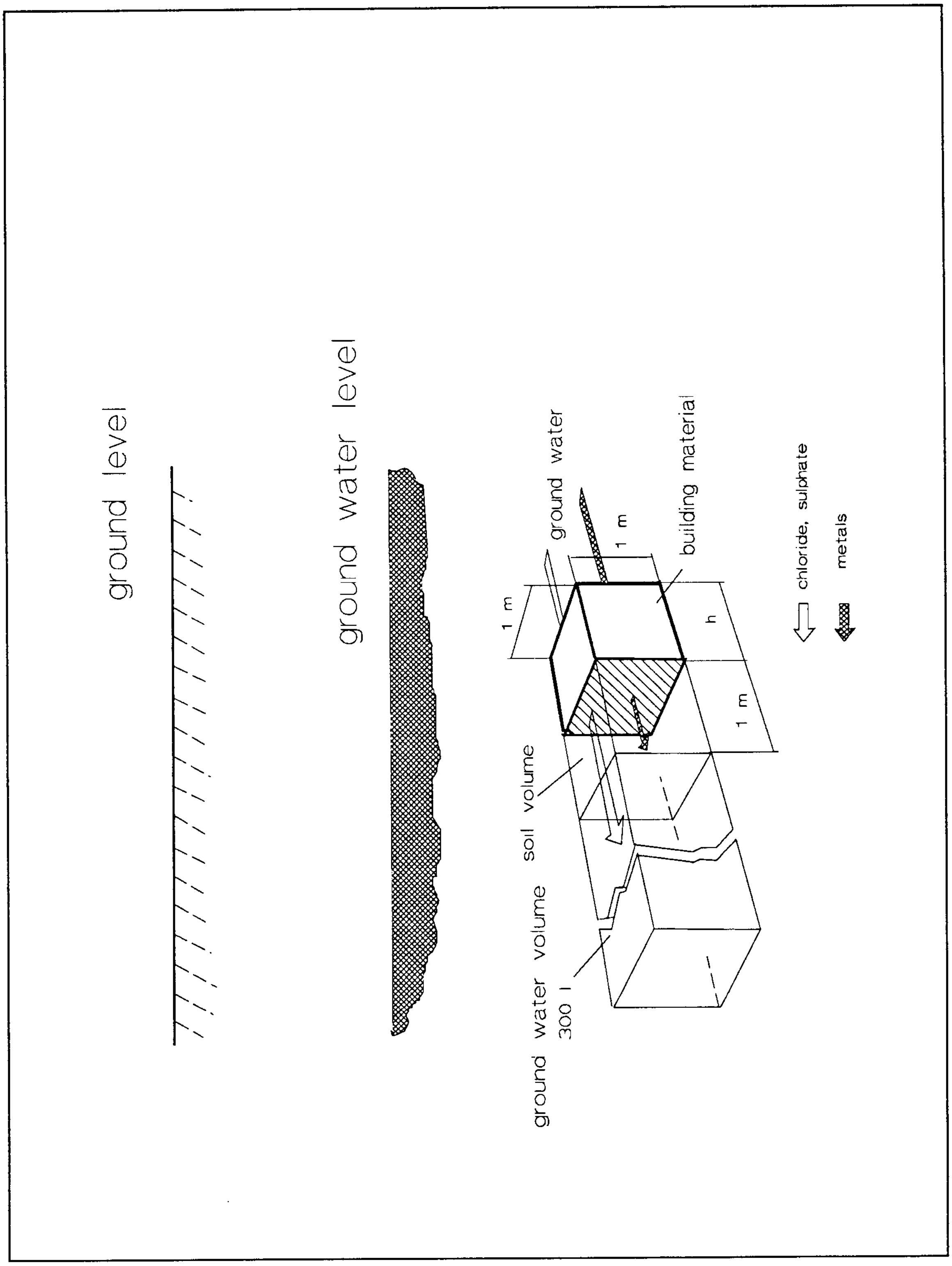

Figure 6.4.4 Granular materials in the soil

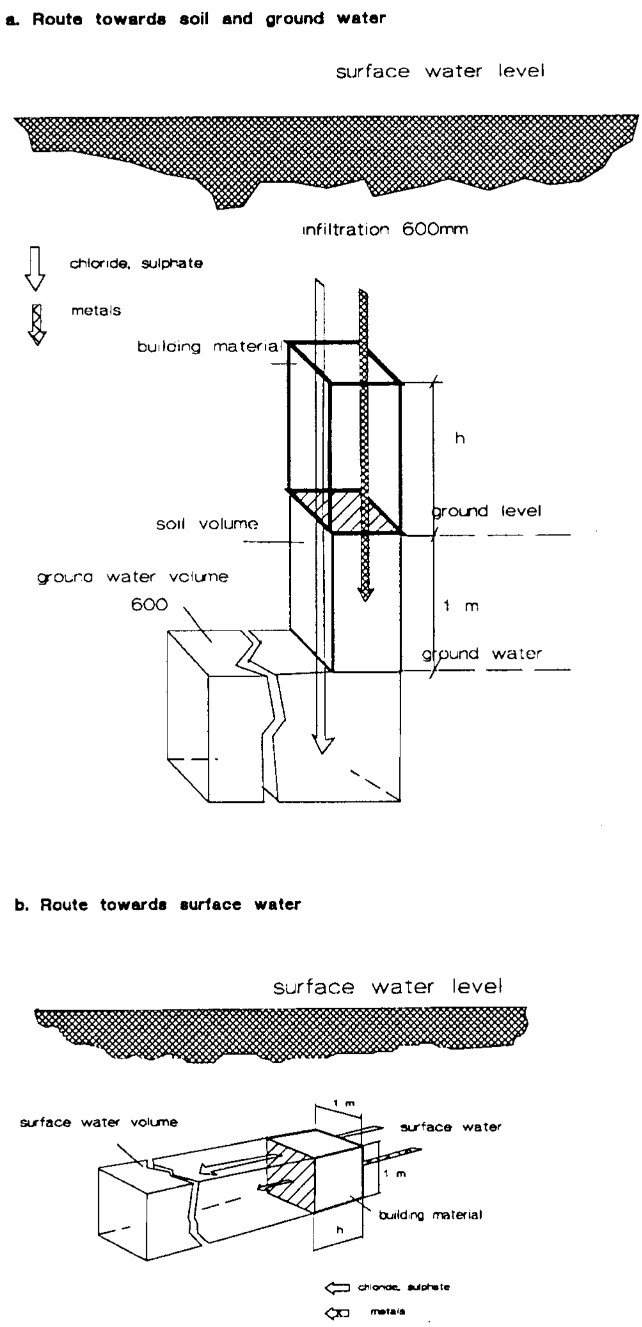

Figure 6.4.5 Granular materials in the surface water

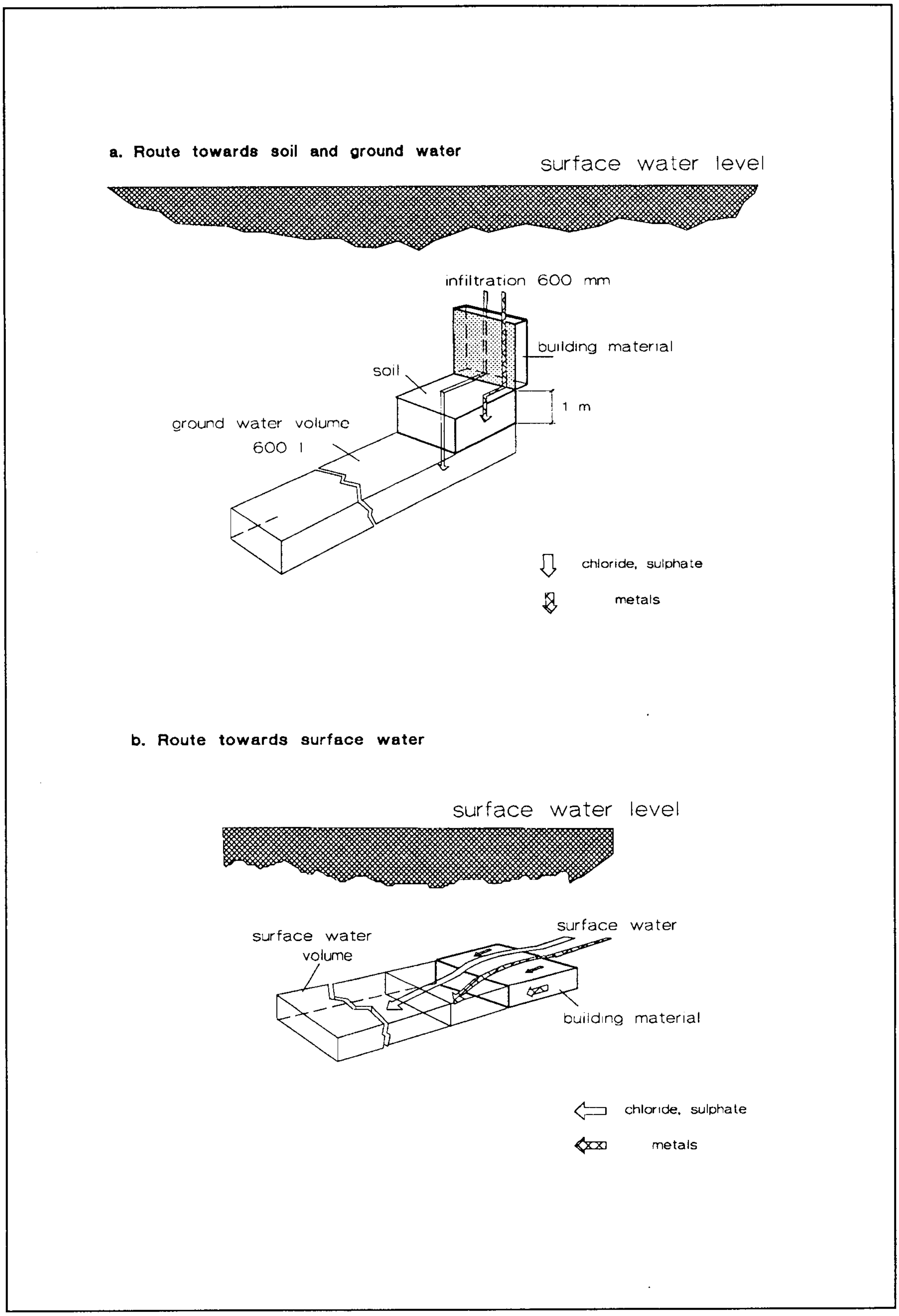

Figure 6.4.6 Prefabricated materials in the surface water

7. CALCULATION OF THE MAXIMUM ALLOWED IMMISSION

The maximum allowed immission (marginal burdening) is composed of a time factor, a dilution and/or volume factor, a concentration, and a receiving environmental compartment. The concentrations of compounds in the various compartments can be very different from place to place. In the calculations it will always be assumed that the receiving (local) part of the soil or groundwater contain the target value quality, and that the surface water contains the limit value quality. The contributions of the compounds in the rainwater are not included in the calculation of the maximum allowed immission, because the standard setting in this general legislation does not keep in mind the contributions from other local or diffuse sources[27] (see chapter 5). The transportation of compounds from an application of a construction material which is applied completely above the average highest groundwater level[28] to a receiving compartment takes place especially through percolating (granular applications) or through along streaming rainwater (prefabricated applications). Transportation by way of diffusion (without percolation) from granular construction materials can also play a role, but, in anticipation of the results of further research, it is accepted that the load of the diffusion-determined transportation of compounds to the soil for the time period considered, is negligible and therefore does not have to be included in the calculation at this point in time. For applications below the groundwater level and in the surface water, the transportation takes place by way of percolating (granular applications) or by along streaming groundwater and surface water (prefabricated applications).

The dissolved compounds spread themselves, depending on the dispersion coefficient, over the solid and the liquid phase. As the result of behaviour in the soil, absorption, dispersion, etc., retardation and dilution will take place. The measure in which these processes manifest themselves determines whether a peak burdening dominates or a continuous burdening. The compounds in the prefabricated construction will diffuse and spread throughout the soil when they come into contact with water.

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[27] The cumulation of emissions will of course be included in the risk evaluation to be carried out in the future.

[28] Completely and acceptably above the average highest groundwater level is defined in the oBB as the lowest point of the construction material in the construction is situated 50cm above the average highest groundwater level.

7.1 Maximum allowable immission in the soil for construction materials

The maximum allowable immission of a compound in the soil during 100 years for a 1 meter thick soil is according to the definition calculated at 1% of the target value for groundwater quality. For constructions above the groundwater level, the rainwater functions as a transporter (figures 6.4.1. and 6.4.2.)

This results in the following formula:

$$I_{max}(J\ yr) = \frac{\alpha}{100} * T_s * \rho_s * h \qquad (mg/m^2.J\ year) \qquad (7.1.1)$$

$I_{max}(J\ yr)$ = maximum allowable immission into the soil of compound M in J years (mg/m^2.J years).
α = 1; the factor for marginal burdening of the soil (%/J years).
T_s = target value soil quality of compound M (mg/kg, table 4.1.).
ρ_s = 1500 kg/m^3; average dry density of soil.
h = 1 m; thickness of layer of soil (m).
J = 100 years; number of years in which immission may be achieved (yr).

If the construction is located in the groundwater or in the surface water (figure 6.4.3, 6.4.4., 6.4.5., and 6.4.6.), then the groundwater functions as transporter instead of the rainwater. Also now, the amount of groundwater or surface water which streams through or along the construction, is not important for the calculation.

Formula 7.1.1., therefore, does not change and is also applicable to the sediment bed of the surface water. In formula 7.1.1., the dry density of the undisturbed soil is given (ρ_g). This is defined as the mass of soil dried at 105°C, divided by the volume which the soil had in its original situation. In chapter 5 about the environmental policy starting points for the setting of standards, it was chosen to use a standard setting which is independent of the type of soil on which or in which the construction/building is realized. This means an implicit choice for a dry density of soil (ρ_s). RIVM has calculated this density to be 1500 kg/m^3. This values is a weighed average, based on the existing soil types in The Netherlands [19].

In table 7.1.1., a survey is given of the soil types which exist in The Netherlands, and their accompanying density. The dry density of the soil is calculated from γ_{sat} (the volume weight of a water-soaked soil) according to NEN 6740 [20] as kN/m^3 and from the pores-fraction (φ_p in %v/v) [21]. the calculated dry densities of soils are tested according to the actual practice experiences of Grond Mechanica Delft [22]

Table 7.1.1. Survey of the existing types of soil in The Netherlands with their accompanying density from [19].

Description according to NEN 6740 — Principle name	Additional mix	horizontal -	pore contents φ_p in %v/v	γ_{sat} from NEN 6740 in kN/m^3 *	dry density of the soil ρ_s in kg/m^3	Existence in The Netherlands in 10^6 m^2
Sand	clean	1	38	21	1720	16200
	weakly loam	9	36	21	1740	
	strongly loam	10	36	21	1740	
Loam	weakly sandy	12	38	21	1720	770
	strongly sandy	11	38	20	1620	
Clay	clean	20	49	19	1410	12582
	weakly sandy	18	48	20	1520	
	strongly sandy	15	44	20	1560	
Peat	-	8	89	10	110	2616
Range based on weighed average			43-46		1470-1540	32168

* earthly speed increase g = 10 m/s^2.

In Table 7.1.2. is shown which influence the choice for another dry density of the soil has on the I_{max}, calculated with respect to I_{max} (ρ_s = 1500 kg/m^3). The range, based on the weighed average, was researched (table 7.1.2.). The densities of the various types of soil vary much more.

Table 7.1.2. The influence of the dry density on I_{max}.

dry density of the soil (kg/m^3)	Change in I_{max} in % with regards to $I_{max}(\rho_s$ =1500 kg/m^3).
1470	-2
1500	-
1540	+3

7.2 Maximum allowable immission of chloride and sulphate in the groundwater for construction materials.

For chloride and sulphate there is an acceptable emission as the result of leaching from a construction material which leads to an average increase of chloride and sulphate in the leaching medium which is or becomes groundwater of 100% of the target value groundwater quality in the first year. This results in the following formula:

$$I_{max}(J\ yr) = \frac{\beta}{100} * T_{gw} * Q_w * J \qquad (mg/m^2 J\ years) \qquad (7.2.1)$$

$I_{max}(J\ yr)$ = maximum allowable immission of compound M into the groundwater in J years (mg/m^2.J years).
β = 100; the factor for the marginal burdening of the groundwater per J years (%/J years).
T_{gw} = target value groundwater quality of compound M (mg/l, see Table 4.1.)
J = 1 year; number of years in which the immission may take place.
Q_w = flux; 300 mm rain- or groundwater /m^2.year (appendix 4),
600 mm surface water infiltration /m^2.year (chapter 9.1.2.4).

For application in the groundwater, there is a volume of percolating groundwater or along streaming groundwater which is equal to the volume of infiltrating rainwater per m^2.
In the above formula, the infiltration flux (appendix 4) and/or the stream velocity of the groundwater appears. The RIVM has set these at 300 mm/year for groundwater. In table 7.2.1., the influence of another choice for the size of I_{max} is indicated.

Table 7.2.1. The influence of the infiltration flux and/or the flow rate of the groundwater on I_{max}.

infiltration flux and/or flow rate of the groundwater (mm/year)	change in I_{max} in % with regards to $I_{max}(Q_w=300$ mm/year).
200	-34
300	-
400	+33

7.3 Maximum allowable immission in the surface water for construction materials

An allowed immission as the result of leaching from construction materials which leads to an average increase in the surface water streaming along of 10% of the limit values for surface water quality during a period of 4 days. This results in the following formula:

$$I_{max}(D\ days) = \frac{\gamma}{100} * L_{surf} * D * \frac{Q_{surf}}{O_w} \qquad (7.3.1)$$

I_{max}(D days)	=	maximum allowable immission of compound M into the surface water in D days (mg/m^2.D days).
γ	=	10; the factor for marginal burdening of the surface water in D days (%/D days).
L_{surf}	=	Limit value surface water quality of compound M (mg/m^3).
D	=	4 days; number of days in which the emission may take place.
Q_{surf}	=	flow rate of the receiving surface water (m^3/day).
O_w	=	surface of immission (m^2).

For the limit value for surface water, the value which belongs to the total of the dissolved fraction, and bound to the floating matter in the surface water. The compounds released through leaching spread themselves over both fractions. For the limit value for surface water, a standard surface water with 30mg/l of floating matter, 20% organic matter, and 40% lutum[29] is used. In chapter 5 about the policy starting points for the standard setting, a standard setting which is independent of the type of surface water in which the application is realized, is chosen for. This implicitly means a choice for the amount of floating matter in surface water and the composition of this floating matter with regards to organic matter and lutum.

7.4 Survey of maximum allowable immissions

Using the definitions for the maximum allowable soil burdening, the rounded off maximum allowable immissions given below can be calculated using the previous calculation methods (table 7.3.1.). These immissions will serve as starting points for the calculating of the maximum allowable emissions from construction materials.

It must be mentioned that the maximum allowable immissions for the surface water is dependent on the flow rate and the surface of the construction/building which is in contact with the surface water. For a surface of 5000m^2 and for the flow rates 5 and 25 m^3/s, the immission values are given in table 7.4.1.

[29] lutum: grain size smaller than 2 µm.

Table 7.4.1. Maximum allowable immisions in the soil, the groundwater and the surface water calculated on the basis of the definitions for marginal burdening.

compound	soil	groundwater	surface water	
	max. allowable immission mg/m² per 100 years	max. allowable immission mg/m² per 1 year	max. allowable immission if Q_{surf} = 5 m³/s mg/m² per 4 days	max. allowable immission if Q_{surf} = 25 m³/s mg/m² per 4 days
As	435		346	1728
Ba	3000		5184	25920
Cd	12		7	35
Co	300		69	346
Cr-tot	1500		691	3456
Cu	540		104	518
Hg	4.5		1.0	5.2
Mo	150		346	1728
Ni	525		346	1728
Pb	1275		864	4320
Sb	39		69	346
Se	15		17	86
Sn	300		9	43
V	1020		173	864
Zn	2100		691	3456
Br	300		276480	1382400
Cl		30000 en 60000*	6912000	34560000
F	7500		51840	259200
SO_4		45000 en 90000*	3456000	17280000
CN-tot	75		173	864
CN-free	15			

* The first value concerns the application of construction materials on or in the "dry" soil with an infiltration of rainwater or a groundwater stream of 300 mm/year, the second value concerns applications of construction materials in the "wet" waterway construction with an infiltration of surface water or a groundwater stream of 600 mm/year.

7.5 Survey of the standards for construction materials which may become soil

In the Building Materials Decree, a difference is made between construction materials which may become soil, and other construction materials. For construction materials which may become soil, only the composition needs to be tested according to the target value soil quality. In table 7.5.1., the target values for the soil quality for soil from the MILBOWA notice are mentioned. There are no target values given for chloride and sulphate for soil.

Table 7.5.1. Target values for soil quality in the Netherlands.

type of construction material:	SOIL
type of standard:	composition
level:	target value
unit:	mg/kg
1. METALS	
Cr (Chrome)	50 + 2Lu
Co (Cobalt)	20
Ni (Nickel)	10 + Lu
Cu (Copper)	15 + 0.6(Lu + Hu)
Zn (Zinc)	50 + 1.5(2Lu + Hu)
As (Arsenic)	15 + 0.4(Lu + Hu)
Mo (Molybdenum)	10
Cd (Cadmium)	0.4 + 0.007(Lu + 3Hu)
Sb (Antimony)	--
Se (Selenium)	2
Sn (Tin)	20
Ba (Barium)	200
Hg (Mercury)	0.2 + 0.0017(2Lu + Hu)
Pb (Lead)	50 + Lu + Hu
V (Vanadium)	--
2. Inorganic COMPOUNDS	
F tot.	175 + 13Lu
CN -tot.free (Cyanide)	1
CN -tot.complex	5
S (total sulphides)	2
Br (Bromide)	20
Cl (Chloride)	(200) see context *
SO_4 (sulphate)	(150) see context *

type construction material:	SOIL
type of standard:	composition
level:	target value
unit:	mg/kg
3. AROMATIC COMPOUNDS	
Benzene	0.05
Ethylbenzene	0.05
Toluene	0.05
Xylene	0.05
Phenols	0.05
Aromatics (total)	--
4. PAHs	
Naphthalene	0.01
Phenanthrene	0.1
Anthracene	0.1
Fluoranthene	0.1
Chrysene	0.01
Benzo(a)anthracene	1
Benzo(a)pyrene	0.1
Benzo(k)fluoranthene	1
Indeno(1,2,3cd)pyrene	1
Benzo(ghi)perylene	1
PAHs (total 10 PAHs)	1
5. OTHER ORGANIC COMPOUNDS	
PCBs total	0.01
EOCl total	0.1
Pesticides containing organic chloride (total)	0.01
Non-chloride pesticides(tot)	0.01
Mineral oil	50

* product standard
Lu = Lutum content in % ; Hu = Humus content in %.

As the result of high mobility, the amounts of these compounds in the soil are low. For the application of construction materials such as de-silted sea sand (in which relatively high concentrations of chloride and sulphate appear) which may become soil, it is desirable to make a distinction between the applications on salty and brackish soils and applications on soil with sweet groundwater. It has been researched whether, from the target value groundwater quality and the concentrations of these compounds in the seawater, it is possible to deduce a standard for these compounds for construction materials which are allowed to become soil.

In the formula below, the sulphate and the chloride in the groundwater and the seawater respectively is imputed to the fixed level of the soil. A water-soaked soil contains approximately 30% (g/g) water; this is 0.3 l water per kg of soil. This results in a composition standards for these compounds, which will be on a level comparable to the target values soil quality.

$$\textit{compositionstandards (compound)} = C(S)_{water} * G_{water} \quad (mg/kg) \qquad (7.4.1)$$

$C(S)_{water}$ = target value groundwater quality Cl of SO_4^{2-} of average concentration Cl and SO_4^{2-} in seawater (mg/l)[30].

G_{water} = 0.3 l/kg; percentage (g/g) of water in water-soaked soil.

Another approach for soil with sweet groundwater is a composition standard for construction materials which may become soil, to be deduced from the maximum allowable emission for category 1 construction materials according to the definition in chapter 7.2. (marginal groundwater burdening); that is to say, that the maximum Cl and SO_4 which is allowed to leach from a category 1 construction material, may also be only maximum present. These compounds are so mobile that they leach out fairly quickly in the column test. This approach, however, has, for construction materials which may become soil, as result a burdening of the underlying soil which is maximum equal to the marginal surface water burdening.

Both approaches are presented in 7.5.2.

[30] Given according to Rijkswaterstaat.

Table 7.5.2. Composition standard for chloride and sulphate for construction materials which may become soil in a sweet water environment and a salty/brackish environment.

compound	target value groundwater quality (mg/l)	concentration in seawater [23] (mg/l)	standard value for soil with sweet water in (mg/kg)		standard value for salty and brackish soil according to the formula 7.4.1 (mg/kg)
			according to the formula 7.4.1 deduced from the target value for groundwater quality	deduced from maximum allowable emissions from category 1 construction materials	
Cl	100	19354	30 (*)	230-260	5800
SO_4	150	2712	45	550-605	815

* According to Edelman [24], the average chloride content of unburdened soils is connected to humus and lutum. The 90 percentile becomes {Cl = 90 + 10*Hu + 2.6*Lu mg/kg ($p<0.0001$)}. The chloride content then becomes 225 mg/kg (with 10% Hu and 25% Lu).

For areas inside dykes and outside of dykes and having sweet groundwater or surface water, DGM has deduced a chloride composition standard of Cl = 200 mg/kg for construction materials which may become soil. For areas outside of dykes with brackish or salty groundwater or surface water, a Cl value is not defined. Areas with brackish or salty groundwater are defined as areas with groundwater or surface water having a Cl concentration greater than 5000mg/l.

PART 1A

STANDARD SETTING FOR THE APPLICATION OF CONSTRUCTION MATERIALS ON OR IN THE SOIL

8. FROM IMMISSION REQUIREMENTS TO EMISSION STANDARDS FOR CONSTRUCTION MATERIALS

In the Building Materials Decree, rules are given for the application of construction materials in an environmental responsible manner, while the accompanying ministerial regulation provides more in-depth information concerning the evaluation of these rules according to the environmental standards for construction materials. This method is necessary for both the construction material user as well as the inspectorate.

The user of a construction material must prove that the emission of harmful substances from his product or construction does not burden the soil or the surface water more than marginally (immission requirement). Since large investments are necessary to realize a construction, it is of great importance that a trustworthy estimation of the actual emission behaviour after the realization of the construction is available[31].

Generally, the emission from a construction material is measured by way of standardized leaching tests (appendix 3) in the lab[32]. One can ask whether the leaching tests carried out in a lab situation predict the actual practice emission from a construction material correctly. The translation of the leaching during the column test into actual practice appears to be a complex subject. A number of factors which are location-specific, must be looked at, namely:

- the measure of contact with water
- infiltration
- the percolation rate
- temperature
- acidity
- redox potential
- aging of a material/mineral forming

A construction material can only leach when it comes into contact with water in some way or other. For constructions, this can be rainwater, groundwater, or surface water. Water

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31 A construction which is proven to pollute the soil have to be removed and the soil would have to be cleaned according to the current regulations (Soil Protection Law).

32 Testing the emission requirement by way of proof projects is often extremely costly and time-consuming, and the results are difficult to interpret

contact can be prevented by ensuring a certain distance between the construction and the average highest groundwater level, perhaps combined with diffusion-limiting layers and isolation of the construction. Isolation prevents that a large part of the rainwater, groundwater, or surface water percolates through the application or flows along it. The effectiveness of the isolation is therefore also of crucial importance.

In setting up regulations, it is generally stated that the isolation must be carried out in such a way that - also on the long term - there is prevention of a greater than marginal burdening of the soil with harmful substances. In the regulations, this can be realized by way of a middle requirement or a performance requirement. In the oBB, it is assumed that a good isolation will achieve enough protection of the soil if the emission is not greater than 10 times the maximum with unisolated applications. For prefabricated construction materials, this is fixed at 5 times the maximum, taking into account the levels at which leaching takes place.

Concerning the influence of the redox potential, it is known that anionogeneous metals such as arsenic, vanadium, and molybdenum are virtually immobile in an oxidizing environment, while in a reducing environment these metals can be very mobile. Since many metals (zinc, copper, lead, mercury, and iron) can form badly dissolving sulphide precipitations, the mobility under reducing conditions is also dependent on the presence of sulphide. Aside from this, the aging of the construction material and the forming of new compounds would cause the mobility of metals to be reduced. Qualitatively, therefore, certain things are known. Research on the quantitative influence of these factors on the leaching behaviour during the column test and in actual practice, however, is first of all scarce, secondly not uniform, and finally very expensive. Also, it will not be easy, based on several proof projects with a few construction materials, to come to general conclusions which are useful for a more detailed development of general standards for construction materials. Tests with MSWI bottom ash in actual practice showed a limited correlation between the emissions measured in the lab test and the emissions measured in the actual practice. This could mean that:

1. the emission from MSWI bottom ash is not correctly predicted for actual practice in the leaching test in lab situations.
2. the actual emission from MSWI bottom ash is correctly predicted in the lab test, but:
   a. the emission cannot be correctly determined in actual practice and/or
   b. the conditions chosen in the lab do not correspond with the conditions in actual practice.

In actual practice, it appears to be very difficult to correct for effects which are caused by the percolate receiving system, such as absorption of metal to the sand in the drainage sand layer. Such effects are also observed in the lab [17]. In this report, an attempt is nevertheless made to correct for as many factors as possible which are quantifiable and which can influence the translation of the measured emission in the lab into the actual emission in practice.

With the help of calculation rules, the emission can be estimated in actual practice. For non-prefabricated construction materials and prefabricated construction materials, the emission in the column test and the diffusion test respectively is extrapolated and/or interpolated to an emission during a 100 year period. With the column test, the measured emission is a function of the amount of percolating water, and with the diffusion test, it is a function of the time. With the extrapolation and/or the interpolation, therefore, for the non-prefabricated construction materials the measure of wetting (effective infiltration) is taken into account, and for the prefabricated construction materials, the wetting time. Then, for prefabricated construction materials, a correction made for the factors temperature, exhaustion, and aging. For non prefabricated construction materials, a correction factor is deduced from the difference between the leaching of soil in the lab and in actual practice. The difference in the approach of non-prefabricated and prefabricated construction materials is on the one hand due to the nature of the construction material, and on the other hand due to the current scientific knowledge.

The following paragraphs gives a detailed look at the translation of the emission measured in the lab into the actual practice emission.

8.1 Non-prefabricated construction materials

8.1.1 The relationship between the maximum allowable immission in the soil and the emission measured in the column test

Using the maximum allowable immissions (table 7.4.1.) as a starting point, a calculation method is worked out for the evaluation of non-prefabricated construction materials based on the leaching behaviour of inorganic compounds in the lab.

The relationship between emission from a non-prefabricated construction material and the immission in the soil is described by the following equation:

$$E_{max}(J\ yr) = \frac{I_{max}(J\ yr)}{d_c * h} \qquad \textbf{(8.1.1)}$$

$E_{max}(J\ yr)$ = maximum allowable emission per J years (mg/kg)
$I_{max}(J\ yr)$ = maximum allowable immission per J years (mg/m^2)
d_c = dry density of the construction material (kg/m^3)
h = total thickness of the construction layers which consists of roughly the same construction material (m)

To estimate the emission from non-prefabricated construction materials during a period of J years, the column test is used (appendix 3). With this test, the leaching of a construction material is determined as a liquid-solid ratio (L/S ratio) of 10, which usually is equal to J years in actual practice.
The leaching with an L/S ratio of 10 must therefore be extrapolated and/or interpolated to an L/S ratio which is equal to J years.

$$E_{max}(J\ yr) = E_{max}(L/S=10) * f_{ext,n}(h,N_i,\kappa) \qquad \textbf{(8.1.2)}$$

$f_{ext.n}$ (h,N_i,κ) = extrapolation respectively interpolation factor from L/S=10 to J yr, in which the total thickness of the layer (h), infiltration (N_i) and constant κ have been quantified.
$E_{max}(L/S=10)$ = maximum acceptable emission till L/S=10 (mg/kg)

From formula 8.1.1 and 8.1.2. follows:

$$E_{max}(L/S=10) = \frac{I_{max}(J\ yr)}{d_c * h * f_{ext,n}} \qquad \textbf{(8.1.3)}$$

The translation of the leaching during the column test to the actual practice leaching appears to be a complex subject. Nevertheless, an attempt has been to correct for as many quantifiable factors as possible which can influence the translation of the measured emission in the lab into the actual practice emission. Data concerning the quantitative influence of the factors is first of all scarce, and secondly, not uniform.
Research shows that in general the leaching of compounds from natural soils to the groundwater under natural conditions is small in comparison to the leaching in the lab (<10%). For this reason, a choice has been made to correct the maximum allowable emissions, which are related to the marginal soil burdening, with the leaching value for soil in the lab (E_{soil}).

With the help of the next equation, the relationship between the maximum allowable immission in the soil and the emission measured in the column test can be described.

$$E_{max}(L/S=10) = E_{soil} + \frac{I_{max}(J\ yr)}{d_c * h * f_{ext,n}(h,N_i,\kappa)} \qquad \textbf{(8.1.4)}$$

The equation above is defined more closely in the following paragraphs.

8.1.2 Extrapolation and/or interpolation of E_{max}(L/S=10) to E_{max}(J yr)

To calculate the extrapolation/interpolation factor, the leaching curve is described by way of a leaching model in which the concentration reduces exponentially with an increasing L/S ratio according to the next equation. It has been shown by way of experiments that the leaching concentration usually reduces monotonous with the L/S ratio without clear maximums or minimums.

$$c = c(0) * e^{-\kappa * L/S} \qquad \textbf{(8.1.5)}$$

c(0) = initial concentration (mg/l)
κ = constant (measure of the rate of leaching)
L/S = Liquid-Solid-ratio (l/kg)

The constant κ is a measure for the rate of leaching and therefore determines the form of the leaching curve. In this method, it is assumed that the form of the leaching curve is independent of factors such as percolation rate, temperature, redox, etc. In other words, only the size of the leaching emission changes, but not the form of the leaching curve, if leaching takes place with another values of the above mentioned factors. The influence on the leaching curve on the changing of the factors during the leaching is not included in this report.
The cumulative emission is described by integrating the course of the concentration.

$$E(L/S) = \int_{L/S=0}^{L/S} c(L/S)\ d\ L/S = (\frac{c(0)}{\kappa})\{1 - e^{-\kappa * L/S}\} \qquad \textbf{(8.1.6)}$$

With the help of equation 8.1.2. and 8.1.6., the extrapolation and/or the interpolation factor can be described as follows:

$$f_{ext,n}(h,N_i,\kappa) = \frac{E_{max}(J\ yr)}{E_{max}(L/S=10)} = \frac{(\frac{c(0)}{\kappa})\{1 - e^{-\kappa * L/S}\}}{(\frac{c(0)}{\kappa})\{1 - e^{-\kappa * 10}\}} = \frac{1 - e^{-\kappa * L/S}}{1 - e^{-\kappa * 10}} \quad (8.1.7)$$

In order to be able to calculate the extrapolation and/or the interpolation factor, the L/S ratio, equal to J years, is calculated according to the following formula:

$$L/S\text{-}ratio = L/S = \frac{J * N_i}{d_c * h} \quad (8.1.8)$$

L = volume of the percolate (l)
S = mass of the construction material (kg)
J = time (yr)
d_c = dry density of the construction material (1550 kg/m^3)
h = total thickness of the construction layers consisting of roughly the same construction material (m)
N_i = infiltration (mm/yr)

With the help of formula 8.1.3., 8.1.7., and 8.1.8, the maximum allowable emission for the column test can be described as follows:

$$f_{ext,n}(h,N_i,\kappa) = \frac{1 - e^{-\kappa * \frac{J * Ni}{d_c * h}}}{1 - e^{-\kappa * 10}} \quad (8.1.9)$$

From this, it appears that this factor is only dependent on the constant κ and the L/S ratio. The extrapolation method used must be seen as a temporary solution. Based on the modelling study of leaching behaviour currently being done by RIVM and LUW, more specific pronouncements concerning this will be possible in the future.

8.1.2.1 The constant κ

For the calculation of the constant κ, the non-linear leaching model (formula 8.1.5.) is transformed to a linear model with the help of the natural logarithm, with the following function:

$$\ln(c) = \ln(c(0)) - \kappa * L/S \quad (8.1.10)$$

From the accepted leaching model follows a linear relationship between the natural logarithm of the concentration and the L/S ratio in which the constant κ is the regression coefficient.

For the available construction materials, which have undergone a column test and in which a detection margin was measured for at the most three fractions of the column test, the constant κ is calculated per compound with the help of the linear regression analysis.
With this analysis, it is taken into account that an average concentration over an L/S range is measured. In the regression analysis, the average L/S ratio of the L/S range concerned is responsible for the concentrations (see figure 8.1.1.)

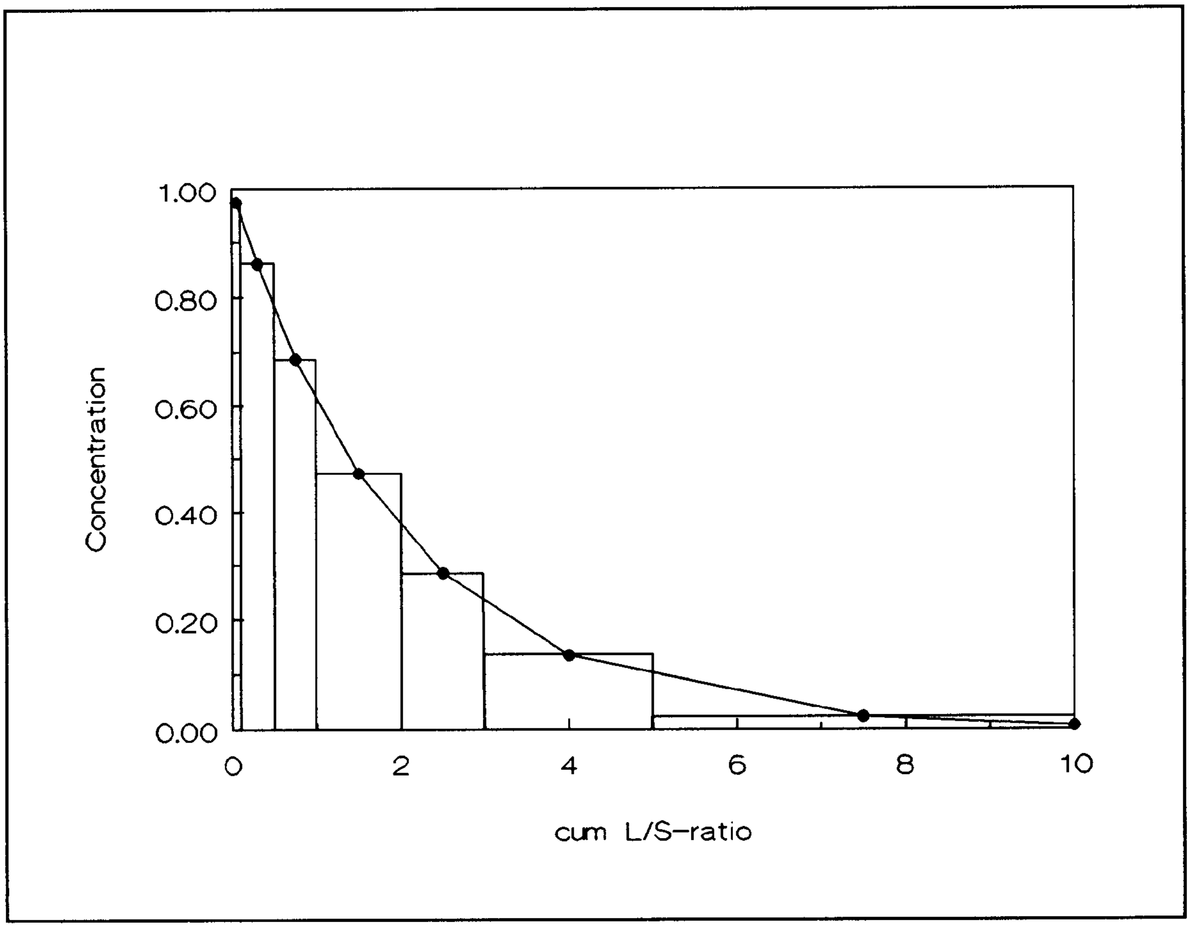

Figure 8.1.1 Concentration shown over against the L/S for the regression analysis.

The constant κ is in principle dependent on both the compound as well as the construction material out of which the compound leaches. Due to the absence of enough data per construction material, however, only the average constant κ and the 95% confidence interval of the average are calculated. This data is shown in table 8.1.1.
For the components bromide, cyanide complex, and cyanide free, the constant κ cannot be

calculated because of the absence of data. For these components, an average of the constants κ of the anions chloride, fluoride, and sulphate are used as estimates in the calculation of the extrapolation factor.

For some components, this calculation method results in a relatively large spreading compared to the average (table 8.1.1). In 8.1.6., the sensitivity of the standard setting for the uncertainty in the constant κ is discussed. The absence of sufficient data does not make this possible at the moment.

Table 8.1.1 Average and 95 % confidence interval of the constant κ of each component.

component	n	average	component	n	average
As	44	0.03 ± 0.05	Se	10	0.38 ± 0.18
Ba	55	0.15 ± 0.04	Sn	5	0.19 ± 0.13
Cd	37	0.50 ± 0.10	V	40	0.05 ± 0.06
Co	10	0.20 ± 0.08	Zn	41	0.28 ± 0.05
Cr	82	0.18 ± 0.03	Br*	-	0.35
Cu	90	0.28 ± 0.03	Cl	45	0.57 ± 0.07
Hg	5	0.05 ± 0.03	F	6	0.22 ± 0.14
Mo	76	0.35 ± 0.04	SO_4	49	0.33 ± 0.05
Ni	37	0.29 ± 0.05	CN-complex*	-	0.35
Pb	52	0.27 ± 0.06	CN-free*	-	0.35
Sb	33	0.11 ± 0.07			

* Average κ of the anions Cl, F, and SO_4

For each component, the average as stated in table 8.1.1. is used as the best estimator for the constant κ for the calculation of the extrapolation and/or the interpolation factor. It is more correct to relate the κ value to the amount of applied construction material in The Netherlands and to calculate the constant κ as a weighed average. Due to the lack of available data, this is not possible at the moment.

8.1.3 Effective infiltration

For the standard setting of category 1 construction materials, the model situation is an open application which is freely accessible to rainwater and/or groundwater during a period of 100 years and/or 1 year. When calculating the maximum allowable emission for category 1 construction materials, an effective infiltration and/or percolation of 300 mm per year is used. For the standard setting of category 2 construction materials, the model situation is an isolated construction/building which lies above the groundwater and is not freely accessible to groundwater and rainwater. During construction, maintenance and removal of the construc-tion/building, there are phases, however, in which there is contact with rainwater. Also, a certain amount of water infiltration through an isolation layer must be assumed, and the risk of a leakage through isolation layer must be taken into account. Research as to the (actual) passage of water through various types of isolation materials in various constructions is still underway. In this area, insight has been gained into the isolation value of isolation materials which are used for the isolation of dump sites [25,26]. Using this knowledge, DGM has calculated an effective maximum of 6 mm/year for the transportation of water through an isolation layer as a value for the mathematical basis for determining the acceptable emission for category 2 construction materials.

It is suggested that more research be done into the "actual" value for the transportation of water through an isolation layer.

In 8.1.6., the sensitivity of the standard setting to the uncertainty in the effective infiltration by category 1 and category 2 applications, is more closely examined.

8.1.4 Correction factor from lab into actual practice

In the line of the projects "Evaluation Methods for Cleaned Soil (PCTB) [27]" and "Supporting Legislation", the RIVM and IWACO B.V. have carried out research on the leaching behaviour of various compounds in the reference soils. Cyanide is not measured in this research. A reference soil in this case is the soil of a natural areas in the Netherlands which is influenced as little as possible by man. In total, soil samples of 19 various areas scattered across The Netherlands are involved in the research mentioned. The leaching behaviour is researched using the standardized column test.

For the compounds arsenic, cadmium, nickel, lead, zinc, and mercury, it appears that 10 to 40% of the cumulative emission (E(L/S=10)) of the soil samples researched, exceed the U1 standard of the oBB. Also, there appears to be a relationship between the E(L/S=10) on the one hand, and the lutum content and the content of organic carbon on the other hand. Based on the leaching data from this research, linear regression lines have been calculated which

indicate the connection between the measured leaching on the one hand and the organic carbon and the lutum content of the soil on the other hand.

The regression lines found are indicated in table 8.1.2. Only for nickel it appeared that, besides a relationship with the organic carbon content, there is also a relationship with the lutum content. For the compounds antimony, selene, tin, cobalt, copper, mercury and molybdenum, no significant relationships were found with either the lutum content nor the organic carbon content. For this reason, the average values for these compounds are given in table 8.1.2.

Table 8.1.2. Significant ($p<0.05$) regression lines for compounds in soil which are leached in the column test with lutum (Lu) and/or humus (Hu) as explaining parameters.

compound	regression-line	average value	compound	regression line	average value
As	0.02Hu	-	Sb	-	0.004
Ba	0.2+0.03Hu	-	Se	-	0.01
Cd	0.005+0.0006Hu	-	Sn	-	0.007
Co	-	0.05	V	0.02Hu	-
Cr	0.004Hu	-	Zn	0.1Hu	-
Cu	-	0.12	Br	0.12Hu	-
Hg	-	0.005	Cl	1.9Hu	-
Mo	-	0.02	F	0.1Hu	-
Ni	0.02Hu+0.007Lu	-	SO_4	7.6Hu	-
Pb	0.03Hu	-			

- no significant regression. In this case, the average value is given.

Analogous to the current target values soil quality, leaching values to which more than 90% of the natural soils conform, have been calculated. These values concern the leaching of compounds from the soil during the column test under standard lab conditions. In table 8.1.3., the leaching values calculated for compounds in the soil are reported.

Table 8.1.3. The upper limit of the 90% confidence interval for the leaching values of natural soils in mg/kg, the calculated average concentrations in the percolates of the column test in µg/l, and the average concentration in the deep groundwater in µg/l.

compound	leaching value (mg/kg)	standard soil Hu=10%, Lu=25% (mg/kg)	average concentration column test (µg/l)	concentration in deep groundwater (µg/l)
As	0.5+0.02Hu	0.7	70	3.7
Ba	0.6+0.03Hu	0.9	90	100
Cd	0.015+0.0006Hu	0.021	2.1	0.17
Co	0.18	0.18	18	*1.3*
Cr	0.05+0.004Hu	0.09	9	1.8
Cu	0.25	0.25	25	1.7
Hg	0.016	0.016	1.6	*0.03*
Mo	0.15	0.15	15	*1*
Ni	0.25+0.02Hu+0.007Lu	0.63	63	5.1
Pb	0.5+0.03Hu	0.8	80	2.7
Sb	0.02	0.02	2	*0.13*
Se	0.03	0.03	3	*0.04*
Sn	0.03	0.03	3	-
V	0.2+0.02Hu	0.4	40	*2*
Zn	1+0.1Hu	2	200	21
Br	1.4+0.12Hu	2.6	260	-
Cl	32+1.9Hu	51	5100	61000
F	0.5+0.1Hu	1.5	150	20
SO_4	42+7.6Hu	118	11800	64000

In table 8.1.3, the concentrations in the deep groundwater (15-30 m below g.l), to which most (>90%) of the natural soils conform [18], are mentioned. In the case of absence of these data, concentrations in the groundwater, to which most (>90%) of the soils in The Netherlands conform, are mentioned. These values are printed cursively in the table above. Analogous to the target value soil quality and the calculated leaching values, the 90 percentile are used for the concentrations in the groundwater.

From table 8.1.3, it appears that in general the leaching of these compounds from natural soils into the groundwater under natural circumstances is minor in comparison to the leaching in the lab (<10%). The compounds Ba, Cr, Cl, F and SO_4 are exceptions to this. Since a soil has been in contact with its natural environment for a long period of time, conversions and new mineral formations have developed a system whereby the dissolving is minimized. By removing a soil from its natural environment and conducting a column test on it, the system is disturbed in such a way that the dissolvability will change temporarily (usually increase). Aside from this, the deviating circumstances (temperature, pH, etc.) in the lab compared to the circumstances in actual practice are of such an influence that they increase the leaching. It is suspected that these phenomena also occur with other construction materials. No data is available, however, as to the measure in which these phenomena are found with the various construction materials.

Since the column test is prescribed in the Building Materials Decree as the method to predict the leaching from construction materials during a time period of 100 years, a correction is necessary for the translation of the leaching in the lab into actual practice. The RIVM suggests that the leaching values for metals in the soil (table 8.1.3.), corrected for the concentrations in the groundwater, be used as temporary correction factor for the leaching in the lab into actual practice. Taking into account the temporary nature of this correction factor, VROM/V&W waives a refining of the translation from the lab into actual practice by way of the correction of the leaching values for the metals already present in the groundwater. The correction of the leaching in the lab into actual practice with a factor can be applied in various ways, for example a factor as sum term, multiplication term, or term in e-power. Based on the current knowledge, it is unclear as to which manner of correction is the right one. In the future, more precise recommendations can be made on the basis of the modelling study of leaching behaviour currently still underway at the RIVM and LUW. It is expected that the difference between the leaching in the lab and actual practice can be subscribed for the greatest part to the disruption of the system which results in a temporary increase in leaching. A choice has therefore been made to apply the correction factor as a sum term. This means that the maximum allowable emissions, which are related to the marginal soil burdening, are increased by the leaching values for the soil.

With the help of formula 8.1.9, the relationship between the maximum allowable immission in the soil and the emission with the column test can be described with the following equation.

$$E_{max}(L/S=10) = E_{soil} + \frac{I_{max}(J\ yr) * (1 - e^{-\kappa * 10})}{d_c * h * (1 - e^{-\kappa * \frac{J * Ni}{d_c * h}})} \qquad (8.1.11)$$

The correction factor can be adjusted as soon as more data concerning the lab - actual practice translation for various construction materials is available.

8.1.5 Maximum allowable emissions for construction materials

The standards for construction materials are calculated for several discreet layer thicknesses. If the calculations are followed into the extreme, strongly leaching construction materials can be applied in very thin layers and meet the allowed immission requirements.

With an eye on the spreading of harmful compounds into the environment, one can ask whether extremely small layer thicknesses are desired. A possible consideration is the determining of a minimum layer thickness. When determining these minimum layer thicknesses, it should be decided which layer thickness is still functional. For road base materials, this seems to be around 20 cm [28]. In many cases, the non-prefabricated construction materials seem to be applied in a layer thickness of 20 - 50 cm. Only a few construction materials (sand, dredging sludge or substitutes thereof) are applied up to a few meters (additions, raisings, dikes, etc.). For the density of a construction material, an average value of 1550 kg/m^3 has been filled in.

8.1.5.1 Maximum allowable emissions for category 1 construction materials

In table 8.1.4., the calculated standards for category 1 construction materials with various application heights are reproduced.

Table 8.1.4. Maximum allowable emissions (mg/kg) for category 1 construction materials for the column test in relation to the application height h (infiltration or percolation 300 mm/yr.).

	APPLICATION HEIGHT (h)						
	0,2 m	0,5 m	0,7 m	1 m	2 m	3 m	10 m
As	1.1	0.91	0.88	0.87	0.84	0.84	0.83
Ba	8.4	3.9	3.1	2.5	1.9	1.7	1.5
Cd	0.059	0.036	0.032	0.029	0.025	0.024	0.022
Co	1.0	0.52	0.42	0.35	0.28	0.26	0.23
Cr	4.1	1.7	1.3	0.92	0.58	0.48	0.37
Cu	1.9	0.90	0.72	0.58	0.43	0.38	0.33
Hg	0.022	0.019	0.018	0.018	0.017	0.017	0.017
Mo	0.62	0.34	0.28	0.24	0.20	0.19	0.17
Ni	2.2	1.3	1.1	0.95	0.80	0.76	0.71
Pb	4.6	2.3	1.9	1.6	1.2	1.1	0.99
Sb	0.10	0.054	0.045	0.039	0.033	0.031	0.029
Se	0.077	0.049	0.044	0.039	0.035	0.033	0.032
Sn	0.85	0.36	0.27	0.20	0.13	0.11	0.08
V	1.7	1.0	0.89	0.82	0.74	0.71	0.68
Zn	8.4	4.5	3.8	3.3	2.7	2.5	2.3
Br	3.5	3.0	2.9	2.8	2.7	2.7	2.6
Cl	278	246	240	236	231	229	227
F	23.0	10.1	7.7	5.9	3.9	3.4	2.7
SO_4	629	584	576	570	563	560	557
CN-tot	0.24	0.094	0.067	0.047	0.024	0.017	0.010
CN-free	0.047	0.019	0.013	0.009	0.005	0.003	0.002

8.1.5.2 Maximum allowable emissions for category 2 construction materials

In table 8.1.5., the standards calculated for category 2 construction materials for various application heights are reproduced.

Table 8.1.5. Maximum allowable emissions (mg/kg) for category 2 construction materials for the column test in relation to the application height h (infiltration or percolation 6 mm/yr.).

	APPLICATION HEIGHT (h)						
	0.2 m	0.5 m	0.7 m	1 m	2 m	3 m	10 m
As	7.2	7.0	7.0	7.0	7.0	7.0	7.0
Ba	30.7	28.3	27.9	27.6	27.2	27.1	26.9
Cd	0.083	0.069	0.066	0.065	0.063	0.062	0.061
Co	2.8	2.5	2.5	2.4	2.4	2.4	2.4
Cr	13.8	12.5	12.3	12.0	11.8	11.8	11.7
Cu	4.1	3.6	3.5	3.4	3.4	3.3	3.3
Hg	0.078	0.076	0.076	0.076	0.075	0.075	0.075
Mo	1.1	0.94	0.91	0.89	0.87	0.86	0.85
Ni	4.4	3.8	3.7	3.6	3.6	3.5	3.5
Pb	10.2	8.9	8.7	8.5	8.3	8.3	8.2
Sb	0.46	0.43	0.43	0.42	0.42	0.42	0.42
Se	0.12	0.10	0.10	0.10	0.10	0.10	0.10
Sn	2.7	2.4	2.4	2.4	2.3	2.3	2.3
V	14.4	14.0	14.0	13.9	13.8	13.8	13.8
Zn	17.2	15.0	14.7	14.4	14.0	14.0	13.8
Br	4.5	4.2	4.1	4.1	4.0	4.0	4.0
Cl	8842	8813	8807	8803	8798	8797	8795
F	63.5	56.4	55.2	54.2	53.1	52.7	52.2
SO_4	22077	22035	22027	22021	22014	22012	22008
CN-tot	0.48	0.40	0.38	0.37	0.36	0.35	0.35
CN-free	0.10	0.080	0.076	0.074	0.072	0.070	0.070

8.1.6 Sensitivity analysis

To gain some insight into the uncertainty of the calculated allowable emissions, a sensitivity analysis is carried out for 3 parameters. These are:

- the effective infiltration (N_i)
- the density of the construction material (d_c)
- the kappa of the compounds (κ).

The presented standard setting is based on an effective infiltration and/or percolation of 300 mm and 6 mm for category 1 and category 2 construction materials respectively, an average density of 1550 kg/m^3 and an average kappa per compound (see table 8.1.1.). The following values for the parameters are calculated to determine the sensitivity of the standard setting per parameter:

- effective infiltration: 200 and 400 mm for category 1 construction materials, 4 and 8 mm for category 2 construction materials
- density: 1250 and 1850 kg/m^3
- kappa of the compound: upper and lower limit of the 95% confidence interval (table 8.1.1.)

In the tables below, the average influence (%) on the allowable emission from construction materials, as mentioned in table 8.1.4. and 8.1.5., are reproduced per parameter for various application heights (0.2, 0.7, and 10 m).

Table 8.1.6. Sensitivity analysis of the allowable emission for category 1 construction materials for various constants.

	APPLICATION HEIGHT (h)		
	0.2 m	0.7 m	10 m
N_i = 200 / 400 mm	3% / -2%	6% / -2%	16% / -8%
d_c = 1250 / 1850 kg/m^3	17% / -11%	12% / -8%	2% / -1%
κ = upper and lower limit	-15% / 8%	6% / 3%	7% / -4%

Table 8.1.7. Sensitivity analysis of the allowable emission for category 2 construction materials for various constants.

	THICKNESS OF THE LAYER (h)		
	0.2 m	0.7 m	10 m
N_i = 4 / 8 mm	37% / -18%	42% / -21%	44% / -22%
d_c = 1250 / 1850 kg/m^3	4% / -3%	1% / -1%	0.1% / -0.1%
κ = upper and lower limit	19% / -12%	23% / -14%	25% / -15%

In the tables above, it appears that the standard for category 2 construction materials is sensitive to the effective infiltration and the kappa. It is of great importance, therefore, to estimate both parameters correctly. It is recommended to research as to how much both parameters coincide with actual practice.

8.2 Prefabricated materials

8.2.1 The relationship between maximum allowable immission and emission by way of the diffusion test

The emission from prefabricated materials, just as the emission from non-prefabricated materials, may at the most cause a maximum allowable immission in the soil. The maximum allowable immission in the soil is determined by VROM/V&W on the basis of the principle of "marginal burdening of the soil over a period of 100 years" (7.1). For chloride and sulphate, VROM/V&W has determined that the groundwater must be protected, and the allowable immission is defined during a one year period (7.2). The calculated maximum allowable immissions during a period of 100 years and 1 year respectively for chloride and sulphate, are reproduced in table 7.4.1.

The relationship between the emission from a construction material and the immission in the soil is shown in the following equation:

$$E_{max}(J\ yr) = I_{max}(J\ yr) \qquad (8.2.1)$$

E_{max}(J yr) = maximum allowable emission of a compound per J years (mg/m^2);
I_{max}(J yr) = maximum allowable immission into the soil per J years (mg/m^2).

The following basics are used in this relationship between the emission and the immission:

- the total amount of along flowing water which flows to the soil (no correction for rainwater drainage by way of rain pipes, etc.);
- the emission per unit of surface area construction material is equal to the immission per unit of surface area soil.

For the estimation of the emission from prefabricated construction materials during a period of J years (E_{max}(J yrs)), the diffusion test is used (appendix 3). In this way, the emission from a construction material during 64 days is determined. The emission during 64 days must then be extrapolated to a period of 100 years and 1 year respectively.

In this paragraph, a calculation method is worked out for the "translation" of the maximum allowable soil burdening (immission) during a 100-year period and a 1 year period respectively, into an emission during 64 days, which is determined in the lab. In this report, an attempt is made to correct for as many factors as possible which can influence the translation of the emission measured in the lab into the actual practice emission and which are quantifiable. A correction is made for exhaustion, effective diffusion coefficient change, the period of wetting, and the temperature difference. The factors exhaustion, effective diffusion change, and period of wetting can be included in the diffusion equation, which is also used for the extrapolation of E(64d) to E(J yrs). These factors are then also quantified in the extrapolation factor.

The emission (during 64 days) is related to the maximum allowable immission (during J years) according to the equation below:

$$E_{max}(64d) = \frac{I_{max}(J\ yr)}{f_{ext.v}(h,x\%,D_e) * f_{tem}} \qquad (8.2.2)$$

E_{max}(64d)	= maximum allowable emission in 64 days (mg/m^2);
I_{max}(J yr)	= maximum allowable immission in J years (mg/m^2);
$f_{ext.v}$(h,x%,D_e)	= extrapolation factor for the extrapolation from 64 days to J years in which depletion depth (h), wetting period(x%) and D_e-change have been quantified;
f_{tem}	= correction factor for the difference between the temperature in laboratorium and the temperature in practice;

The equation above is discussed further in the following paragraphs.

Emission (E(64d)) determining by way of the diffusion test

The leaching emission for prefabricated materials is determined in the lab with the diffusion test according to NEN 7345 (appendix 3). With this test, the emission (in mg/m^2) from a construction material during 64 days is determined, and it is researched whether the emission from a construction material is determined by diffusion.

If the release is determined by diffusion, then the effective diffusion coefficient (D_e) and the pD_e (negative logarithm of D_e) can be calculated. The pD_e is a measure for the mobility of the compound in the construction material.

The following applies: $pD_e>12$: compound with a low mobility

$10.5<pD_e<12$: compound with an average mobility

$pD_e<10.5$: compound with a high mobility

With the help of the D_e, the calculated emission as the result of diffusion during a period of 64 days can be determined. This calculated emission is the result of diffusion and allows for the extrapolation to longer periods. The initial emission as a result of flushing is not included here.

The calculation method for the evaluation of prefabricated materials is based on the calculated emission with the D_e. There is no correction for the initial emission as the result of flushing. From the Mammoth research, it appears that when flushing takes place, the emission as the result of flushing comprises only a few percents (approx. 2%) of the emission by diffusion during a period of 100 years.

With the help of the diffusion test, the measured emission can also be determined. In the measured emission, however, the first emission as the result of flushing is included. Extrapolation of this measured emission leads to an overestimation of the emission during a longer period. If the calculated emission is not determined, but there is a leaching determined by diffusion, then the measured emission can often be used as "worst case". This measured emission cannot be used if exhaustion has already occurred during the diffusion test.

The evaluation of whether the emission is determined through diffusion, takes place on the basis of the direction coefficient (r.c.) from the double logarithmic graph of the time and the emission. If it appears from the diffusion test that the emission from a construction material is not determined by diffusion, because the direction coefficient <0.35, then the measured emission can be used as "worst case" in the comparison with the standards for construction materials (see for details NEN 7345). This is valid only if no exhaustion of the available amount occurs during the diffusion test.

If the r.c. <0.35 because of exhaustion during the diffusion test, then a calculation of the diffusion coefficient cannot take place according to the NEN 7345, and therefore there can be no comparison with the standard setting for prefabricated construction materials, so that the test must be repeated with a larger sample.

In the other cases in which the leaching is not determined by diffusion, the emission can be determined with the column test according to the NEN 7343. The emission found in this way must then be compared with the leaching standards for construction materials for non-prefabricated materials. The above- mentioned is summarized in the scheme below.

r.c. >0.6: The emission is not determined by diffusion and the diffusion coefficient cannot be calculated. There is a great dissolving of compounds in the construction material. This type of emission corresponds better with the NEN 7343 (column test).

0.35>r.c.<0.6: The emission is determined by diffusion (and depending on the pD_e a correction can take place).

r.c.<0.35: There is mainly a (rapid) flushing and/or a rapid exhaustion. In the first case, the measured emission (E(64d)) can be used as "worst case" or the emission can be measured with the column test. In the case of rapid exhaustion, the test can better be repeated with a larger test sample.

8.2.2 Extrapolation of E_{max}(64d) to E_{max}(J years)

In the diffusion test, the emission is determined during a 64-day period. In this paragraph, a calculation method is worked out for the extrapolation of the emission during 64 days (E(64d)) to the emission during 100 years (E(100yrs)).

The emission during 100 years can be calculated with the following equation (the law of Fick):

$$E(t) = E_{avail} * d_c * \sqrt{D_e/\pi} * \sqrt{t} \qquad (8.2.3)$$

E(t) = emission during t units of time (mg/m^2);
D_e = coefficient of effective diffusion (determined with the diffusion test) (m^2/s);
t = time (s);
E_{avail} = the availability of compounds for leaching (determined with the test for the determination of the availability of inorganic components for leaching (NEN 7340) (mg/kg);
d_c = dry density of the construction material (kg/m^3).

The extrapolation factor is then the quotient of the emission during 100 years and the emission during 64 days:

$$f_{ext.v} = \frac{E_{avail} * d_c * \sqrt{D_e/\pi} * \sqrt{100*365*24*3600}}{E_{avail} * d_c * \sqrt{D_e/\pi} * \sqrt{64*24*3600}} = 24 \qquad (8.2.4.a)$$

If, however, the concentrations (available for leaching) of the compounds to be researched, or the effective diffusion coefficient, changes during the 100 year period, then this model does not give a correct estimation of the emission during 100 years.
In the following paragraphs, these two processes are quantified separately, and in 8.2.5., a survey is given of the extrapolation factors which are corrected for D_e changes and/or exhaustion. These extrapolation factors are valid for construction materials in applications which are (almost) continually wet during 100 years.
For construction materials in applications which are only periodically wet, the extrapolation factor is corrected for the period of wetting.

$$f_{ext.v}(h,x\%,D_e) = \frac{E_{h,x\%,D_e}(100yr)}{E(64d)} \qquad (8.2.4.b)$$

The numerical values of this extrapolation factor, which is corrected for D_e changes, exhaustion, and period of wetting during 100 years, is reported in table 8.2.3 (see chapter 8.2.6.).

8.2.3 Exhaustion

Exhaustion means: The reduction of the emission of a compound because of the reduction of the content available for leaching in the construction material, so that the driving force for diffusion (that is, the concentration difference) reduces. The general solution of the diffusion comparisons of Fick, in which exhaustion is discounted, is reproduced in the following comparison:

$$\frac{E(t)}{c_0 * h} = 1 - \frac{8}{\pi^2} * \sum_{n=0}^{\infty} \left(\frac{1}{(2n+1)^2} * 10^{\left(\frac{-D_e * t}{h^2} * \frac{\pi^2}{16} * (2n+1)^2\right)} \right) \quad (8.2.5)$$

E(t) = emission during t units of time (mg/m^2);
h = thickness of the layer (m);
c_0 = E_{avail} * d_c ;
D_e = coefficient of effective diffusion (m^2/s);
t = time (s);
E_{avail} = the availability of compounds for leaching (mg/kg);
d_c = dry density of the construction material (kg/m^3).

From this follows that for a one-dimensional diffusion model, exhaustion can occur, dependent of the application height/thickness (h) and pD_e. With the help of this equation, the extrapolation factor is calculated for the various application heights and application thicknesses, and pD_e. For compounds with a pD_e>11, no exhaustion occurs with these application heights/thicknesses. In table 8.2.1. the extrapolation factor, in which only the exhaustion is quantified, is showed.

Table 8.2.1. Extrapolation factor for exhaustion

pD_e	f							
	THICKNESS OF THE CONSTRUCTION MATERIAL (h)							
	0.1 m	0.2 m	0.3 m	0.5 m	0.7 m	1 m	2 m	10 m
5	1	1	1	1	1	1	1	2
6	1	1	1	1	1	1	1	5
7	1	1	1	1	1	2	3	16
8	1	1	2	2	3	5	10	24
9	2	3	5	8	11	16	23	24
10	5	10	15	21	23	24	24	24
11	16	23	24	24	24	24	24	24
12-19	24	24	24	24	24	24	24	24

* f = E(100yr)/E(64d)
* pD_e = - log(D_e)
* pD_e = 10 : pD_e-range van 9.5 tot 10.4
pD_e = 9 : pD_e-range van 8.5 tot 9.4
etc.

8.2.4 Diffusion coefficient changing

With the extrapolation of a period of 64 days to a period of 100 years, it must be kept in mind that a compound does not have to be present in the construction material in one chemical form. The cumulative emission during 100 years will be the result of the emissions of the various chemical forms of a compound, each with its own mechanism of leaching and its own mobility. The pD_e is calculated on the basis of the emission measured during 64 days (dominated by the form(s) with the highest mobility) and the total availability of a compound (including forms with a lower mobility). The measured pD_e which is the result of the emissions of the various chemical forms of a compound, can thereby be greater than the pD_e of the leaching form with the highest mobility. If the last mentioned is $pD_e<11$, then this chemical form can become exhausted within 100 years (depending on the h), and a slower leaching form of the compound will dominate the diffusion. After this, the slower form can then in turn become exhausted (depending on the pD_e and h). An even slower form will then dominate the diffusion.

If the pD_e becomes greater, then the emission reduces in comparison with the emission at the initial pD_e. Out of this follows that with extrapolation of the emission measured during 64 days to an emission during a period of 100 years, a greater reduction of the emission than is to be expected based on the diffusion test can be taken into account. The emission of a compound can also reduce more over time as the result of changes in the matrix. For example, by reduction of the pore volume of the construction material, the formation of a precipitation, the forming of a "bottle neck" in the pore, so that the effective diffusion coefficient (D_e) reduces. Through breakage or tearing, the diffusion can take place again temporarily with the original D_e. Weathering can have the opposite effect because it can cause the pores to become larger.

For the situations mentioned above, that is, changing of the diffusion dominating-chemical form of a compound, and/or changing of the matrix, measurement data is lacking from which the changing of the diffusion during a longer period of time can be quantified. There are indications that the D_e reduces during time.

For the construction materials and the compounds in the Mammoth research, the course of the D_e during 64 days is researched. 83% of these compounds shows a (light) decrease of the D_e. Further research is desired to better specify the reduction of the D_e during a 100-year period, so that also the emission during a period of 100 years can be determined.

For now, the correction is done by way of a mathematical increase of the negative logarithm of the effective diffusion coefficient (pD_e) with one pD_e value in a period of 100 years. The emission is then calculated with the help of the equation from 8.2.2:

$$E(t) = E_{avail} * d_c * \sqrt{D_e / \pi} * \sqrt{t} \qquad \textbf{(8.2.3)}$$

The emission during 100 years is achieved from the sum of the emissions per year. The emission per years is calculated by increasing the pD_e(-log D_e) by a 1/100 unit each year. The extrapolation factor is the quotient of the emission during 100 years and the emission during 64 days, and is calculated in the above-mentioned way:

f=15

8.2.5 The extrapolation factor in which exhaustion and changing of the diffusion coefficient are included

With the extrapolation of the emission during 64 days to an emission during a period of 100 years, exhaustion and changes in the effective diffusion coefficient can be of influence. For compounds with $pD_e>11$, no exhaustion occurs with these application thickness (h). For these compounds, the extrapolation is carried out by multiplying by the extrapolation factor in which changing of the effective diffusion coefficient is quantified (8.2.4.). For the extrapolation of compounds with $pD_e<11$, both processes can play a role. With regards to the emission, the processes work against eachother. It is suggested to take one process into account, and to use the lowest extrapolation factor. The extrapolation factors are showed in table 8.2.2.

Table 8.2.2. Extrapolation factor for the exhaustion of and the changes in the diffusion coefficient.

pD_e	$f_{ext.v}$							
	THICKNESS OF THE CONSTRUCTION MATERIAL (h)							
	0.1 m	0.2 m	0.3 m	0.5 m	0.7 m	1 m	2 m	10 m
5	1	1	1	1	1	1	1	2
6	1	1	1	1	1	1	1	5
7	1	1	1	1	1	2	3	15
8	1	1	2	2	3	5	10	15
9	2	3	5	8	11	15	15	15
10	5	10	15	15	15	15	15	15
11-19	15	15	15	15	15	15	15	15

* $f_{ext.v}$ = E(100yr)/E(64d)
* see footnote table 8.2.1.

For chloride and sulphate, the maximum allowable immission is defined during a period of 1 year (chapter 7.2). The extrapolation factor from 64 days to 1 year is: $f_{ext.v}$=2.4. The period of 1 year is considered to be too short to correct for exhaustion or changes in the diffusion coefficient.

8.2.6 Correction for wetting; type A and type B applications

In the diffusion test, the construction material is constantly wet during 64 days. In actual practice, the construction material is usually wet during a fraction of time, and emission will take place during a part of the time. The fraction of the time in which the construction material is wet, is dependent on the construction material and the method of application. Since a precise estimation for all materials and for all methods of application is very complex, two types are distinguished, namely:

A. A construction material in a type A application is virtually constantly wet. Examples of this type of application are an embankment/bank/quay, a road base, a street or (part of) a wall which can be wetted by surface water or groundwater (also through capillary action of the soil). Since this type of application will be almost constantly wet, there is no correction for a partial wetting period (x=100%). For these A-type applications, the extrapolation factors in table 8.2.2. are valid.

B. A construction material in a type B application is periodically wet through atmospheric conditions. Examples of this type of application are: a roof, a closed road surface or (the top part of) a wall, as long as the application cannot be wetted by the (capillary action of) groundwater or surface water.

In this type of applications, there is a correction for the fraction of the time during which the construction material is wet. With intermittent wetting, the following factors play a role. The construction material is still wet for a time at the end of a wet period and must be wetted at the beginning of a wet period. There is a difference between wet on the outside but not necessarily wet in the pores (flushing, but no diffusion in the construction material), and water present in the pores but dry on the outside (diffusion in the construction material). Crust formation as the result of drying possibly causes flushing with wetting. Tests have been carried out on two, always equal, construction materials (on a limited amount of compounds) in which the intermittent and the continuous wetting are compared. The intermittent wetting is fairly even to the continual wetting (after correction for equal wetting time) [29]. Further research is necessary to verify this relationship in actual practice situations. The leaching from this type of applications can mainly be determined by: diffusion (possibly dependent on the amount and manner of wetting), the transportation of water with dissolved compounds from inside to outside, percolation or flushing, or a combination of processes. If the leaching is determined by diffusion, then the emission is related to $\sqrt{t}$ (see equation 8.2.3.).

According to the KNMI (Dutch Meteorological Institute), precipitation takes place approximately 10 to 14% of the time. If measurement is carried out with a threshold value for the intensity of the precipitation per hour, then this is 7% of the time. Atmospheric conditions, by which the above-ground constructions are wetted, also occur with a relative humidity greater than 98%, and this occurs 7% of the time (examples: dew, mist). According to the KNMI, there is a small overlap between both wetting conditions [30,31,32].

The time fraction during which the above-ground constructions in The Netherlands are wetted by atmospheric conditions will lie between 7 and 14% (average ≈ 10%). If the construction material is wetted x% of the time, then in 100 years a diffusion determined emission occurs only during a period of x years:

$$E_{x\%}(100yr) = E_{avail} * d_c * \sqrt{D_e/\pi} * \sqrt{x} \qquad (8.2.6)$$

x = number of years during a period of 100 years in which a construction material is wet (yr).

The extrapolation factor is the quotient of the emission during 100 years and the emission during 64 days. For type B applications, there is a correction for the wetting period by filling in t='x years' in the extrapolation factor[33]; x% is fixed on 10%. Also with the type B application, there is a correction for exhaustion and changing in the diffusion coefficient. In table 8.2.3., the extrapolation factors for this application are reproduced.

Table 8.2.3. Extrapolation factor, in which the wetting period is also discounted

pD_e	$f_{ext.v}$					
	THICKNESS OF THE CONSTRUCTION MATERIAL (h)					
	0.1 m	0.2 m	0.3 m	1 m	2 m	10 m
5	1	1	1	1	1	2
6	1	1	1	1	1	5
7	1	1	1	2	3	5
8	1	1	2	5	5	5
9	2	3	5	5	5	5
10	5	5	5	5	5	5
11-19	5	5	5	5	5	5

* $f_{ext.v}$ = E(100yr)/E(64d)
* see footnote table 8.2.1.

For chloride and sulphate, the extrapolation factor of 64 days to 1 year is corrected for partial wetting:

$$f_{ext.v} = 0.8$$

33 In a notice from the Royal Dutch Brick Union (KNB, dated 3-3-93), it is assumed that the release is mainly determined by diffusion with total water soaking. In this model, it is calculated as to when the requirements are met for complete water soaking for a vertical wall, keeping in mind the direction of the wind, water intake, etc. The estimated release through flushing is then included and the correction factor for wetting is estimated at a value between 0.005 and 0.01. The diffusion determined emission is related to √t, so that the correction factor resulting from this model lies between 0.07 and 0.1. Despite the fact that this model assumes complete water soaking, this value does not differ much from the factor maintained by the RIVM for diffusion.

8.2.7 Correction isolated applications

This concerns construction materials which, as the result of precautionary measures, do not come into direct contact with precipitation or groundwater, for example by application of the isolation regulations for category 2 construction materials in the oBB. The construction material may be wetted during the construction, during maintenance, and during removal of the building/construction. At the same time, the measure of isolation must be kept in mind. In the Mammoth research, road base materials were researched, which were applied under an asphalt layer with a strip of grass applied on either side [33]. In this research, it appeared that the road base material beneath the asphalt layer was wet in its totality.
The measure of wetting is not equal over the entire construction. Despite the fact that a road construction is (much) wider than the semi-actual practice tests, so that the sideways (capillary) action will be less, a road base material can also be wetted in actual practice by capillary risings from out of the groundwater. No measurings are available which indicate the time fraction in which the isolated construction materials are wet, and if the diffusion speed is dependent on the measure of wetting. For now, it is suggested to use the same extrapolation factor as used for a type B application for an isolated type A application which is wet only part of the time due to atmospheric conditions (chapter 8.2.6.).
It is of importance, however, that the isolation of a construction material takes place in such a way, that the construction material is any case not wet for a greater time fraction than this. It is suggested to research as to what the average wetting period is for isolated construction/building in actual practice, and whether the diffusion speed is dependent on the measure of wetting of the construction material.

8.2.8 Correction factor for the temperature (f_{tem})

In the lab, the diffusion test is carried out with an average temperature of 20°C. In actual practice, the temperature to which the construction material is exposed is 10°C [32]. The diffusion process in the material can be influenced by the temperature:

* the diffusion coefficient and the viscosity of the water are dependent on the temperature;
* the matrix can change under the influence of a temperature increase (thermal expansion, and thereby the pore characteristics change).

Little research has been done as yet as to the effect of temperature change on the leaching emission. In the Mammoth research, one measurement is done with two temperatures. This concerns one measurement for asphalt cement at 4°C and one measurement at 20-25°C [29]. With the help of this information and the "Arrhenius relationship", the reduction of the emission with the changing of 20°C to 10°C can be calculated. The relationship between the diffusion coefficient and the temperature is shown by the following comparison (Arrhenius relationship):

$$pD_{e1} - pD_{e2} = y \left(\frac{1}{T_1} - \frac{1}{T_2}\right) \qquad (8.2.7)$$

pD_{e1}, pD_{e2} = negative logarithm of the coefficient of effective diffusion at T1 resp. T2;
y = factor (= $-E^a/k$, where E^a is the energy of activation for diffusion and k is the constant of Boltzmann);
T_1, T_2 = temperature 1 respectively temperature 2 (K).

In the Mammoth research, the emission and pD_e values of the compounds calcium, sodium, potassium, arsenic, barium, copper, and zinc are measured at 4°C and (approximately) 23°C. The average factor y is determined for the various compounds from the pD_{e1} and the pD_{e2} values.

The filling in of this average y, T_1=293 K (20°C) and T_2 =283 K (10°C) in the comparison above gives the average difference between the pD_e values of T_1 and T_2. In the comparison below, the average difference between pD_{e1} and pD_{e2} is filled in, so that the difference in emission at 10°C and at 20°C is found.

$$f_{tem} = \frac{E(t)_1}{E(t)_2} = \frac{E_{avail} * d_c * \sqrt{D_{e1}/\pi} * \sqrt{t}}{E_{avail} * d_c * \sqrt{D_{e2}/\pi} * \sqrt{t}} = \sqrt{10^{-(pD_{e1} - pD_{e2})}} \qquad (8.2.8)$$

$E(t)_1, E(t)_2$ = emission at T_1 resp. T_2 (mg/m²)

The emission as the result of diffusion at 10°C is approximately 70% of the emission at 20°C. This means that the correction factor for the temperature difference between the lab (20°C) and actual practice (10°C) is:

$$f_{tem} = 0.7$$

The factor y is based on one measurement of seven compounds; further research is necessary to specify the temperature effect for more construction materials and compounds.

8.2.9 Maximum allowable emissions for construction materials

In the following paragraphs the standards for construction materials as they are valid for most of the compounds are reproduced. If a compound has a low pD_e value, in certain cases a correction is allowed for exhaustion by filling in a smaller extrapolation factor. If the pD_e of a compound in a construction material and/or the application height[34] is unknown, then there can be no correction for (possible) exhaustion.

8.2.9.1 The maximum allowable emissions for category 1 construction materials in type A applications

In a type A application, the construction materials are almost continuously wet. The maximum allowable emissions for this type of application are calculated by filling in the Imax for table 7.4.1., $f_{ext.v}(h,x\%,D_e)$, and f_{tem} in equation 8.2.2. (table 8.2.5.).
The extrapolation factor ($f_{ext}.v(h,x\%,D_e)$) is 2.4. for chloride and sulphate and 15 for most of the other compounds (compounds with pD_e>11 and for compounds with pD_e=10 with h>30cm). With smaller pD_e values, correction is allowed for exhaustion by filling in the extrapolation factors from table 8.2.2. in equation 8.2.2.

Table 8.2.4. The extrapolation factor for category 1 construction materials in type A applications for pD_e>11.

	category 1 A	
	$f_{ext.v}$	f_{tem}
$pD_e \geq 11$	15	0.7
Cl, SO_4	2.4	0.7

34 The method by which the application height and the application thickness of a construction must be determined, as part of the ministerial ruling belonging to the Buildig Materials Decree .

Table 8.2.5. The maximum allowable emission for category 1 construction materials in type A applications for pD_e>11.

compound	category 1 A (mg/m^2)	compound	category 1 A (mg/m^2)
As	41	Sb	3.7
Ba	290*	Se	1.4
Cd	1.1	Sn	29
Co	29	V	97*
Cr	140	Zn	200
Cu	51	Br	29
Hg	0.4	Cl	18000
Mo	14	F	710*
Ni	50	SO_4	27000
Pb	120	CN-complex	7.1
		CN-free	1.4

* These leaching standards for construction materials exclude the adjustments of (chapter 8.3.).

8.2.9.2 The maximum allowable emissions for category 1 construction materials in type B applications

In a type B application, the category 1 construction materials are at most wet during a period equal to the period in which wetting as the result of atmospheric conditions takes place (chapter 8.2.4.). The maximum allowable emissions for construction materials in type B applications are calculated by the filling in of I_{max} from table 7.4.1. and the filling in of the factors below in equation 8.2.2. The maximum allowable emissions are reproduced in table

Table 8.2.6. The extrapolation factor for category 1 construction materials in type B applications for pD_e>10.

	category 1 B	
	$f_{ext,v}$	f_{tem}
$pD_e \geq 10$	5	0.7
Cl, SO_4	0.8	0.7

Table 8.2.7. The maximum allowable emissions for category 1 construction materials in type B applications for $pD_e \geq 10$

compound	category 1 B (mg/m^2)	compound	category 1 B (mg/m^2)
As	140	Sb	12
Ba	950*	Se	4.8
Cd	3.8	Sn	95
Co	95	V	320*
Cr	480	Zn	670
Cu	170	Br	95
Hg	1.4	Cl	54000
Mo	48	F	2400*
Ni	170	SO_4	80000
Pb	400	CN-complex	24
		CN-free	4.8

* These leaching standards for construction materials exclude the adjustments of (chapter 8.3.)

8.2.9.3 The maximum allowable emissions for category 2 construction materials in isolated applications

The maximum allowable emissions for category 2 construction materials in an isolated application are calculated with the same equation and extrapolation factor as the maximum allowable emissions for category 1 construction materials in a type B application.

The maximum allowable emissions for category 2 construction materials in an isolated application are therefore equal to the standards for category 1 construction materials in a B application (table 8.2.8. for compounds with $pD_e \geq 10$). For compounds with a $pD_e < 10$, a correction is allowed for (possible) exhaustion by filling in the extrapolation factor from table 8.2.3..

Table 8.2.8. The maximum allowable emissions for category 2 construction materials in isolated applications for $pD_e > 10$

compound	category 2 (mg/m^2)	compound	category 2 (mg/m^2)
As	140	Sb	12
Ba	950*	Se	4.8
Cd	3.8	Sn	95
Co	95	V	320*
Cr	480	Zn	670
Cu	170	Br	95
Hg	1.4	Cl	54000
Mo	48	F	2400*
Ni	170	SO_4	80000
Pb	400	CN-complex	24
		CN-free	4.8

* These leaching standards for construction materials exclude the adjustments of (chapter 8.3.).

8.2.10 Sensitivity analysis

With the calculation method presented, the relationship between the leaching behaviour in the lab and during actual practice situations must be verified more closely. For the correction factor for the temperature difference, it is possible to give some insight into the range. The correction factor for the temperature difference between the lab and the actual practice is based on an outside temperature of 10°C and a temperature of 20°C inside the lab. The outside temperature is 9.5° ± 0.5°C, and the temperature inside the lab is 20° ± 2°C. This leads to a band width of approx. 10% in the correction factor and also to a band width of approx. 10% in the standards for construction materials.

8.3 Adjustment of the standards by Directorate General for the Environment (DGM)

To make the re-use of the construction materials cement aggregate, phosphor slag and LD slag possible under category 1 or category 2 conditions, the standards for barium, fluor, and vanadium are adjusted by VROM/V&W.

At the same time, the U1 standards for chloride and sulphate from non prefabricated materials are not lowered by VROM/V&W to the values calculated by RIVM, but are

maintained at the level of the oBB. Recently the allowable immission value for SO_4 from granular construction materials is raised by VROM. In order to make this practical, the maximum allowable immissions for chloride and sulphate from category 1 applications of non-prefabricated construction materials are increased by a factor of 2.9 and 1.4 respectively. The composition standards for inorganic components are cancelled. For organic components, the difference between the S1 standards for prefabricated and granular construction materials in the oBB are cancelled. The composition standards for PAHs and mineral oil are raised by DGM, so that the use of recycling materials from the construction industry (demolition waste) as there are cement aggregate, masonry aggregate, mix aggregate of concrete and masonry aggregate and asphalt aggregate and asphalt cement, are not hindered. As a result also a large part of the sieve sand, (recycling) breaker sand, and "undefined construction waste and demolition waste" can be re-used. For the recycling materials from the construction industry, the standard for PAH-total with regards to the oBB is not raised to 75 mg/kg. For the individual PAHs, no standards are included in the Building Materials Decree for recycling materials from the construction industry.
Concerning the remaining construction materials, the standard for PAH-total is raised to 75 mg/kg; testing for the individual PAHs does then take place. In table 8.3.1. are included all the adjusted standards for construction materials.

Table 8.3.1. The standards for construction materials raised by VROM/DGM

COMPOSITION in mg/kg	non-prefabricated construction materials		prefabricated construction materials		
	oBB standards	adjusted standards	oBB standards	adjusted standards, excluding "construction recycling aggregates"	adjusted standards for "construction recycling aggregates"
compound	S1	**new standards**	S1	**new standards**	**new standards**
Naphthalene	0.5	5	1	5	
Phenanthrene	3	20	5	20	
Anthracene	3	10	5	10	
Fluoranthene	3	35	5	35	
Chrysene	0.5	10	1	10	
Benzo(a)anthracene	25	50	50	50	
Benzo(a)pyrene	3	10	5	10	
Benzo(k)fluoranthene	25	50	50	50	
Indeno(1,2,3cd)pyrene	25	50	50	50	
Benzo(ghi)perylene	25	50	50	50	
PAHs (total)	25	75	50	75	50
Mineral oil	250	500 *		500 *	

* Asphalt cement and asphalt aggregate do not have to be tested according to the standard for mineral oil.

LEACHING	IMMISSION (mg/m^2)			
	non-prefabricated construction materials		prefabricated construction materials	
compound	oBB standards	adjusted standards	oBB standards	adjusted standards
Ba	3000	6300	3000	6300
V	950	2400	950	2400
F	7000	14000	7000	14000
Cl *	30000	87000		
SO_4 *	45000	100000 #		

* Only for the category 1 application of non-prefabricated construction materials.
# Recently raised by VROM from 62000 to 100000 mg/m^2 for category 1 construction materials. Category 1 and category 2 applications of prefrabicated and non-prefabricated construction materials in direct contact with seawater and brackish water, this value is 180000 mg/m^2.

8.4 Survey of the standards

In the oBB, the emission standards were calculated for fixed application heights and/or thicknesses, diffusion coefficients, etc, and stated in mg/kg (granular construction materials) or mg/m^2 (prefabricated construction materials).

In the Building Materials Decree, the immission standards are stated in mg/m^2. Between the allowable immission and the measured emission, there is room for translation in which correction may be applied. To make a comparison with the oBB possible, the allowable emissions are measured with the leaching tests in a way comparable to the calculation in the oBB. In the table 8.4.1. and 8.4.2., a survey is given of both the emission standards, calculated according to the calculation method presented in chapter 8, and the standards in the oBB (Stc. 1991, 121 and 130) for non-prefabricated construction materials (h=0.7m) and prefabricated construction materials (h=0.3m and pD_e>10). From the tables it appears that the most new standards are higher in comparison with the oBB. The starting point here has always been to restrict the soil burdening to the "marginal soil burdening". The raising of the standards is the result of a greater taking into account of the characteristics of construction materials in the mathematical calculation, and the correction of the leaching behaviour in the lab for behaviour in actual practice. The strict application of the target values for soil quality [10] and the background values of metals in relatively unburdened Dutch soils in the calculations results in a decrease for barium (non-prefabricated and prefabricated construction materials) and selenium (prefabricated materials).

For bromium and cadmium, the category 2 standards for non-prefabricated materials are lower than in the oBB. This is the result of the strict application of the presented mathematical calculation for a maximum infiltration of 6 mm/year[35], as well as an improved extrapolation of 100 years to the equivalent for the column test at L/S=10.

In the tables 8.4.1., 8.4.2., and 8.4.3., the maximum allowable emission standards are reproduced. In those cases in which VROM/V&W has adjusted the standards, the values calculated are given between brackets.

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[35] On the basis of this maximum infiltration, the marginal values of chemical waste materials for IBC dump sites have also been calculated.

Table 8.4.1. Comparison of the oBB standards with the maximum allowable emissions for non-prefabricated construction materials for h=0.7 m in mg/kg.

LEACHING COLUMN TEST	oBB standards non-prefabricated construction materials in mg/kg			**new standards** maximum allowable emissions for non-prefabricated construction materials in mg/kg	
compound	U1	U2	S1	cat. 1	cat. 2
As	0.30	3.0	375	0.88	7.0
Ba	4.0	40	7500	(3.1) 5.5	(27) 58
Cd	0.010	0.10	10	0.032	0.066
Co	0.20	2.0	250	0.42	2.5
Cr	1.0	10	1250	1.3	12
Cu	0.35	4.0	375	0.72	3.5
Hg	0.005	0.050	5	0.018	0.076
Mo	0.050	0.50	125	0.28	0.91
Ni	0.35	4.0	250	1.1	3.7
Pb	0.80	8.0	1250	1.9	8.7
Sb	0.030	0.30	50	0.045	0.43
Se	0.020	0.20	50	0.044	0.10
Sn	0.20	2.0	250	0.27	2.4
V	0.70	7.0	1250	(0.9) 1.6	(14) 32
Zn	1.4	14	1250	3.8	15
Br	0.20	2.0	500	2.9	4.1
Cl	600	5000	5000	(240) 600	8800
CN-complex	0.050	0.50	125	0.067	0.38
CN-free	0.010	0.10	25	0.013	0.076
F	5.0	50	4500	(7.3) 13	(52) 100
SO_4	750	10000	25000	(576) 750	22000

() Values without adjustment by VROM/V&W.

Table 8.4.2. Comparison of the oBB standards with the maximum allowable emissions for prefabricated construction materials when h=0.3 m, $pD_e \geq 10$ in mg/m^2.

LEACHING DIFFUSION TEST	oBB standards prefabricated construction materials in mg/m^2			**new standards** maximum allowable emissions for prefabricated construction materials in mg/m^2	
compound	U1	U2	S1	cat. 1 A	cat. 2 & cat. 1 B
As	25	125	750	41	140
Ba	350	1750	15000	(290) 600	(950) 2000
Cd	0.70	3.5	20	1.1	3.8
Co	15	75	500	29	95
Cr	90	450	2500	140	480
Cu	30	150	750	51	170
Hg	0.30	1.5	10	0.4	1.4
Mo	4.0	20	250	14	48
Ni	30	150	500	50	170
Pb	75	375	2500	120	400
Sb	2.5	13	100	3.7	12
Se	1.8	9.0	100	1.4	4.8
Sn	20	100	500	29	95
V	60	300	2500	(97) 230	(320) 760
Zn	125	625	2500	200	670
Br	20	100	1000	29	95
Cl	2250	11250		18000	54000
CN-complex	4.5	23	250	7.1	24
CN-free	0.90	4.5	50	1.4	4.8
F	440	2200	9000	(710) 1300	(2400) 4400
SO_4	15000	45000	40000	27000	80000

A = A type application, B = B type application; see chapter 8.2.6.

Table 8.4.3. Composition standards for non-prefabricated and prefabricated construction materials in mg/kg.

ORGANIC COMPOSITION	non-prefabricated construction materials			prefabricated construction materials	
	oBB standards	adjusted standards excl. construction waste aggregates	adjusted standards construction waste aggregates	oBB standards	adjusted standards
compound	S1	**new standards**	**new standards**	S1	**new standards**
Benzene	1.25	1.25	1.25		1.25
Ethylbenzene	1.25	1.25	1.25		1.25
Toluene	1.25	1.25	1.25		1.25
Xylene	1.25	1.25	1.25		1.25
Phenols	1.25	1.25	1.25		1.25
Aromatics (total)	-	-	-		-
Naphthalene	0.5	5		1	5
Phenanthrene	3	20		5	20
Anthracene	3	10		5	10
Fluoranthene	3	35		5	35
Chrysene	0.5	10		1	10
Benzo(a)anthracene	25	50		50	50
Benzo(a)pyrene	3	10		5	10
Benzo(k)fluoranthene	25	50		50	50
Indeno(1,2,3cd)pyrene	25	50		50	50
Benzo(ghi)perylene	25	50		50	50
PAHs (total)	25	75**	50	50	75
PCBs (total)	0.5	0.5	0.5		0.5
EOCl (total)	3	3	3		3
Organochloride pesticide (total)	0.5	0.5	0.5		0.5
Chloride-free pesticide (total)	0.5	0.5	0.5		0.5
Mineral oil *	250	250	500		500

* Asphalt cement, asphalt aggregate and crushed asphalt cement with more than 80% asphalt aggregate does not have to be tested according to the standards for mineral oil.

** This value is 50 mg/kg for construction and demolition waste and the products made thereof. The testing for the individual PAHs is cancelled.

PART 1B

STANDARD SETTING FOR THE APPLICATION OF CONSTRUCTION MATERIALS IN THE WET WATERWAY CONSTRUCTION

9. FROM IMMISSION REQUIREMENTS TO EMISSION STANDARDS FOR CONSTRUCTION MATERIALS

The emission standards for the application of construction materials in the wet waterway construction have been formulated on the basis of the fixed maximum allowable immissions in the soil and the surface water (including the VROM/V&W decisions). An overview of these maximum allowable immissions is given in table 9.1.

Table 9.1. Maximum allowable immissions in the soil, the groundwater and the surface water from construction materials applied in waterway construction.

compound	soil	groundwater	surface water	
	max. allowable immission	max. allowable immission	max. allowable immission mg/m^2 per 4 days	
	mg/m^2 per 100 years	mg/m^2 per 1 year	with flow rate 5 m^3/s *	with flow rate 25 m^3/s *
As	435		346	1728
Ba	6300 **		5184	25920
Cd	12		7	35
Co	300		69	346
Cr	1500		691	3456
Cu	540		104	518
Hg	4.5		1.0	5.2
Mo	150		346	1728
Ni	525		346	1728
Pb	1275		864	4320
Sb	39		69	346
Se	15		17	86
Sn	300		9	43
V	2400 **		173	864
Zn	2100		691	3456
Br	300		276480	1382400
Cl		174000 # and 60000 ***	6912000	34560000
F	14000 **		51840	259200
SO_4		124000 # and 90000 ***	3456000	17280000
CN-tot	75		173	864
CN-free	15		-	-

* The maximum allowable immission for the surface water is dependent on the flow rate and the surface area of the construction in contact with the surface water. The emission values are given for a regular surface area of 5000m^2 and for the flow rates 5 and 25 m^3/s.

** These values are adjusted by VROM/V&W.

*** The first value mentioned for Cl and SO_4 concerns category 1 applications of non-prefabricated construction materials and is adapted. The second value concerns prefabricated construction materials.

For groundwater, an infiltration speed of 600 mm/yr is taken into account with applications in the wet waterway construction.

The standards are calculated in chapter 7.1. The parameters Ba, V, F, SO_4, and Cl for the maximum allowable immissions in the sediment bed of the surface water are adjusted by VROM/V&W, so that the re-use of several construction materials is made possible (see chapter 8.3.). The calculation of the allowable emission for the application of construction materials in the wet waterway construction with regards to the burdening of the sediment bed of the surface water is based on the calculation method which is also used for the standard setting for dry applications of construction materials (chapter 8). With the help of mathematical rules, the emission can be estimated in actual practice. For non-prefabricated construction materials and prefabricated construction materials, the emission in the column test and the diffusion test are extrapolated and interpolated to:

- an emission during a period of 100 years where the burdening of the sediment bed of the surface water is concerned, and
- an emission during a period of 4 days where the burdening of the surface water is concerned.

In this report, an attempt is made to correct for as many possible factors which are quantifiable which can affect the translation of the emission measured in the lab into the actual practice emission with applications in the wet waterway construction.

For prefabricated construction materials, concerning the burdening of the sediment bed of the surface water, a correction is made for the factors of temperature, exhaustion, and aging. For the burdening of the surface water, exhaustion and aging is neglected, because the 4-day period which is used for this, is too short. For non-prefabricated construction materials which are applied on the sediment bed of the surface water, a correction factor for the burdening of the sediment bed of the surface water is deduced from the difference between the leaching of soil in the lab and in actual practice. For applications in surface water, no correction is made for this, because it is not expected that within a period of 4 days, an environment situation will occur which will lead to a remarkably lower leaching than that measured in the lab. The emission to the surface water, therefore, is made equal to the emission in the lab test, calculated for a period of 4 days. Also, the highest emissions per unit of time in the direction of the surface water are expected to occur during the period of construction, and therefore in a situation in which the construction material is not (yet) in balance with its environment, so that there is a disturbed system with an increased leaching.

In the next paragraphs, a detailed study is given for the translation of the emission measured in the lab into the actual practice emission with applications in the wet waterway construction. At the same time it is determined which environmental routes give the lowest maximum allowable emissions for applications in the surface water, either the route to the sediment bed of the surface water or the route to the surface water. For this purpose, both of the routes are worked out. Also, for the route to the sediment bed of the surface water, the same maximum allowable immissions are adhered to as those for the dry soil. Then, a calculation is made for the route in the direction of the surface water as to which minimum flow rate is necessary to continue the application of at least the regular primary construction materials. Above this flow rate, it often appears that the route in the direction of the sediment bed of the surface water determines which leaching from a construction material may not exceed in order for it to be applicable. Only with a small range of low flow rates does the route to the surface water determine the allowable leaching of a construction material. The choice has been made to use only the route to the sediment bed of the surface water for the testing of construction materials. Although the route in the direction of the surface water usually does not appear to be necessary in the testing of the materials with regards to the Building Materials Decree, this is, however, worked out in this report, because:

- only after working out both routes is it possible to calculate which emissions are allowable for which routes, and is it possible to determine in which cases a certain route is decisive,
- the limit for the flow rate can only be decided using the route in the direction of the surface water which was worked out, whereby the route in the direction of the surface water, and not the route in the direction of the sediment bed of the surface water, is decisive for the allowable emission;
- only after determining this limit for the flow rate, is it possible to conclude that the application of secondary construction materials in almost each case takes place in surface waters with flow rates above this limit, and that the route in the direction of the sediment bed of the surface water will be decisive in almost each case.
- in situations with small surface waters and small flow rates, under this limit, using the calculation method given, it is possible to determine in which measure the testing according to the surface water quality would lead to a lowering of the allowable emission, and in how far it would be relevant to achieve a possible lower burdening by means other than the Building Materials Decree.

9.1 Non-prefabricated construction materials

9.1.1 The relationship between maximum allowable immissions in the soil and the surface water and emission measured in the column test

With applications in the surface water, there are two routes along which the environment is burdened, namely:

- in the direction of the surface water, and
- in the direction of the sediment bed of the surface water.

Construction materials must often be applied through (a column of) surface water; because of this, an emission to the surface water always takes place before the compounds not yet leached can give an emission to the surface water and the sediment bed of the surface water. For a quantification of the terms which possibly contribute to the emissions in the direction of the surface water and/or the sediment bed of the surface water, several things are put into a scheme in figure 9.1.

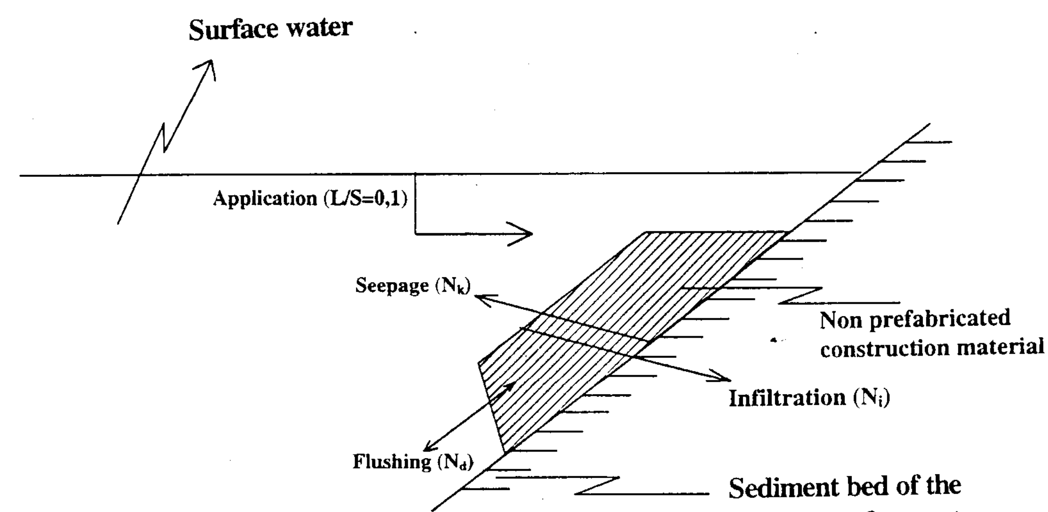

Figure 9.1. Schematic leaching terms.

For both routes, to the surface water as well as to the sediment bed of the surface water, the maximum allowable emissions from a construction material must be determined, whereby the lowest allowable emission will be decisive for the emission finally allowed from a construction material in its application. The maximum allowable immissions (table 9.1.) serve as starting point here. In the following paragraphs, a calculation method is worked out to translate the leaching behaviour measured in the lab to an emission in an actual practice.

a. the route in the direction of the sediment bed of the surface water

The relationship between emission from a non-prefabricated construction material and the immission in the sediment bed of the surface water is described by the following equation:

$$E_{max}(J\ yr) = \frac{I_{max}(J\ yr)}{d_c * h} \qquad \mathbf{(9.1.1a)}$$

$E_{max}(J\ yr)$ = maximum allowable emission in J years (mg/kg)
$I_{max}(J\ yr)$ = maximum allowable immission in J years (mg/m^2)
d_c = dry density of the construction material (kg/m^3)
h = total thickness of the construction layers which consists of roughly the same construction material (m)

b. the route in the direction of the surface water

The relationship between emission from a non-prefabricated construction material and the immission in the surface water is described by the following equation:

$$E_{max}(D\ days) = \frac{I_{max}(D\ days)}{d_c * h} \qquad \mathbf{(9.1.1b)}$$

$E_{max}(D\ days)$ = maximum allowable emission per D days (mg/kg)
$I_{max}(D\ days)$ = maximum allowable immission per D days (mg/m^2)
d_c = dry density of the construction material (kg/m^3)
h = total thickness of the construction layers which consists of roughly the same construction material (m)

In order to estimate the emission from non-prefabricated construction materials during a period of J years or D days, the column test according to NEN 7343 (appendix 3) is used. With this test, the leaching of a compound is determined as a liquid-solid ratio (L/S ratio) of 10, which usually does not correspond with the L/S ratio in actual practice during a period of J years or D days. The leaching with an L/S ratio of 10 must, therefore, be extrapolated and/or interpolated to an L/S ratio which corresponds to an L/S ratio belonging to J years or D days.

a. the route in the direction of the sediment bed of the surface water

$$E_{max}(J\ yr) = E_{max}(L/S{=}10) * f_{ext.n}(h,N_i,\kappa) \qquad \textbf{(9.1.2a)}$$

$f_{ext.n}(h,N_i,\kappa)$ = extrapolation respectively interpolation factor from L/S=10 to J years, in which the total thickness of the layer (h), infiltration (N_i) and constant κ have been quantified.

b. the route in the direction of the surface water

$$E_{max}(D\ days) = E_{max}(L/S{=}10) * f_{ext.n}(h,N_d,\kappa) \qquad \textbf{(9.1.2b)}$$

$f_{ext.n}(h,N_d,\kappa)$ = extrapolation respectively interpolation factor from L/S=10 to D days, in which the total thickness of the layer (h), percolation (N_d) and constant κ have been quantified.

From the equations 9.1.1.a., 9.1.1.b., and 9.1.2.b., follows:

a. the route in the direction of the sediment bed of the surface water

$$E_{max}(L/S{=}10) = \frac{I_{max}(J\ yr)}{d_c * h * f_{ext.n}(h,N_i,\kappa)} \qquad \textbf{(9.1.3a)}$$

b. the route in the direction of the surface water

$$E_{max}(L/S{=}10) = \frac{I_{max}(D\ days)}{d_c * h * f_{ext.n}(h,N_d,\kappa)} \qquad \textbf{(9.1.3b)}$$

The translation of the leaching during the column test to the leaching during actual practice situations seems to be a complex subject. An attempt has been made to correct for as many quantifiable factors as possible which can influence the translation of the emission measured in the lab to the actual practice emission.

Data concerning the quantitative influence of the factors are first of all present in limited amounts, and secondly, they are not unified. From research, it appears that in general, the leaching of compounds from natural soils to the groundwater under natural circumstances is minor (<10%) with respect to the leaching in the lab. A temporary choice has been made, therefore, to correct the maximum allowable emissions, which are related to the marginal soil burdening (the route in the direction of the sediment bed of the surface water), with the leaching values for natural soil in the lab. With the help of the equation below, the relationship between the maximum allowable immissions in the sediment bed of the surface water and the emission measured in the column test can be described.

a. the route in the direction of the sediment bed of the surface water

$$E_{max}(L/S=10) = E_{soil} + \frac{I_{max}(J\ yr)}{d_c * h * f_{ext.n}(h,N_i,\kappa)} \qquad \textbf{(9.1.4a)}$$

b. the route in the direction of the surface water

For this route, the period is too short to achieve a balanced situation with the environment, and thereby a lower leaching than measured in the column test. The column test, therefore, gives a realistic approach of the leaching which will also take place in actual practice for the period of 4 days which must be observed. For the route in the direction of the surface water, the equation remains unchanged (= is equal to 9.1.3.b.)

$$E_{max}(L/S=10) = \frac{I_{max}(D\ days)}{d_c * h * f_{ext.n}(h,N_d,\kappa)} \qquad \textbf{(9.1.4b)}$$

The equations are further explained in the following paragraphs. The equations above concern the leaching during the period that the surface water is in contact with the construction material. There is also transport of compounds determined by molecular diffusion from pore water to surface water and/or groundwater. The driving force for this diffusive transportation is the difference in concentration of the compound in the pore water and in the surface water or the groundwater. This transportation period is, however, not (well) quantifiable with the current knowledge. Molecular diffusion from pore water to surface water and/or groundwater is, however, of primary importance if it is comparable or becomes greater than the advective transport (transport by infiltration or seepage water).

From studies of the leaching and the transportation of compounds from dredging sludge depots, it appears that the diffusive transportation is of a size comparable to an advective transportation of several mm/year. The average advective transportation which is taken into account here is 600 mm/year. The transportation period determined by molecular diffusion will, therefore, not be included any further. It is not impossible, however, that based on closer research in the future, more accurate pronouncements can be made about the importance of this transport period and the quantification thereof.

9.1.2 Extrapolation and/or interpolation of E_{max}(L/S=10) to E_{max}(J year) and E_{max}(D-days)

To calculate the extrapolation/interpolation factor, the leaching curve is described with a leaching model by which the concentration decreases exponentially with an increasing L/S ratio, according to the equation below.

It has appeared that in experiments the leaching concentration usually decreases monotonous with the L/S ratio without any clear maxima or minima.

$$c = c(0) * e^{-\kappa * L/S} \qquad (9.1.5)$$

c(0) = initial concentration (mg/l)
κ = constant (measure of the rate of leaching)
L/S = Liquid-Solid-ratio (l/kg)

The constant κ is a measure for the speed of the leaching, and therefore determines the form of the leaching curve (see also chapter 9.1.3.). With this method, it is accepted that the form of the leaching curve is independent of factors such as percolation speed, temperature, redox, etc. In other words, only the size of the leaching emission changes, but not the form of the leaching curve, if leaching takes place with another value of the above mentioned factors. The influence of the changing of the factors during the leaching on the leaching curve is not considered here.

The cumulative emission is described by integrating the curve of the concentration.

$$E(L/S) = \int_{L/S=0}^{L/S} c(L/S)\, d\, L/S = \left(\frac{c(0)}{\kappa}\right) \{1 - e^{-\kappa * L/S}\} \qquad (9.1.6)$$

With the help of the equations 9.1.2a., 9.1.2b., and 9.1.6., the extrapolation and/or the interpolation factor can be described as follows:

a. the route in the direction of the sediment bed of the surface water

$$f_{ext.n}(h,N_i,\kappa) = \frac{E_{max}(J\ yr)}{E_{max}(L/S=10)} = \frac{\left(\frac{c(0)}{\kappa}\right)(1 - e^{-\kappa * L/S})}{\left(\frac{c(0)}{\kappa}\right)(1 - e^{-\kappa * 10})} = \frac{1 - e^{-\kappa * L/S}}{1 - e^{-\kappa * 10}} \qquad (9.1.7a)$$

b. the route in the direction of the surface water

$$f_{ext.n}(h,N_d,\kappa) = \frac{E_{max}(D\ days)}{E_{max}(L/S=10)} = \frac{(\frac{c(0)}{\kappa})(1 - e^{-\kappa * L/S})}{(\frac{c(0)}{\kappa})(1 - e^{-\kappa * 10})} = \frac{1 - e^{-\kappa * L/S}}{1 - e^{-\kappa * 10}} \qquad \textbf{(9.1.7b)}$$

In order to be able to calculate the extrapolation and/or the interpolation factor for the route in the direction of the sediment bed of the surface water and the route in the direction of the surface water, the L/S ratios must be determined for the respective routes.

- the mass S of the construction material is fixed to be the same with all the applications and routes, namely: $d_c * h * O$

d_c	=	dry density of the construction material (1550 kg/m^3)
h	=	total thickness of the construction layers consisting of roughly the same construction material (m)
O	=	Area (=1 m^2)

The volume of percolate L for the different routes is built up out of various periods, which must sometimes be seen in connection with eachother (see also paragraph 9.1.1., figure 9.1.).

The various periods are to be defined as follows:

- a period for the leaching in which surface water flows through a construction and ends up (again) in the surface water or in the sediment bed of the surface water. This period is to be described as: $N_d * t$

N_d	=	percolation (mm/yr or mm/day)
t	=	time (years or days)

Depending on the direction in which the leached compounds are transported, in this period the route to the surface water or the route to the sediment bed of the surface water must be kept in mind. Seeing the importance of the other periods, the N_d is assumed to be so small as to not contribute to the emissions, and can therefore be neglected. This is worked out more specifically in paragraph 9.1.4.1.

- A period for the leaching in the direction of the surface water as the result of seepage. This period is to be described as: $N_k * t$

N_k	=	seepage (mm/day)
t	=	time (days)

If seepage occurs, this is so small in The Netherlands (maximum approximately 50 mm/year) that it can be neglected with regards to other leaching periods. An elaboration of this is given in paragraph 9.1.4.2.

- A period for the leaching in the direction of the sediment bed of the surface water through infiltration. This is to be described as: $N_i * t$

N_i	=	infiltration (mm/yr)
t	=	time (yr)

For the infiltration, a fixed value of 600 mm/year has been chosen. A motivation for a fixed choice, and its size, is given in paragraph 9.1.4.3.

- A period for the leaching at the construction period by which the construction materials are brought through a water column on or in the sediment bed of the surface water. The length is set by using the leaching from the first fraction of the column test (L/S = 0.1).

A support of this approach is given in paragraph 9.1.4.5.

9.1.3 Quantification of the extrapolation and/or the interpolation factors

With the periods mentioned above, their numerical values and their interconnections, the extrapolation factors and/or the interpolation factors for the routes in the direction of the sediment bed of the surface water and the surface water can now be described. The emission to the surface water in the model takes place only during the period of construction of the construction/building. After the construction period of the construction/building, there is only emission of compounds to the sediment bed of the surface water. The contribution by way of streaming and seepage are neglected (see paragraph 9.1.2.). The leaching which is measured in the lab must therefore be divided into a emission to the surface water (L/S=0-0.1) and a emission to the sediment bed of the surface water (L/S=0.1-10). The L/S ratio which belongs with the allowable emission according to the definition of marginal soil burdening and/or surface water burdening seldom corresponds with L/S=10 measured according to the column test. In order to still be able to work with a standard column test in the lab, the allowable emissions are transformed into an allowable emission by L/S=10 via an extrapolation and/or interpolation factor. For both parts of the leaching curve, therefore, the extrapolations and/or the interpolations are carried out to L/S=10.

For the route in the direction of the sediment bed of the surface water, this is taken into account by subtracting the emission during the dumping of the construction material at the construction site from the total cumulative emission. The emission remaining is related to the allowable soil burdening. This is reproduced in figure 9.1.3.1.

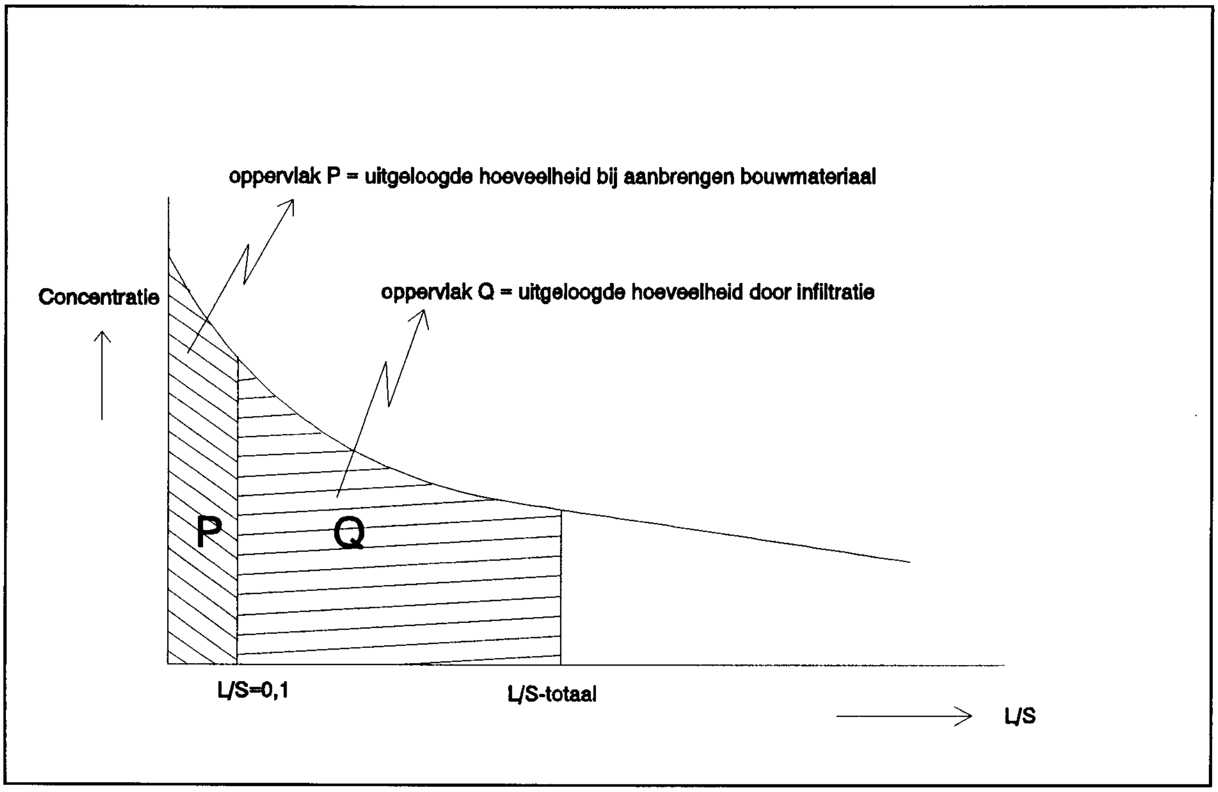

Figure 9.1.3.1. The emissions in total, and at application.

a. the route in the direction of the sediment bed of the surface water

$f_{ext.n}$ (const) which belongs to the surface P is equal to:

$$f_{ext.n}(const) = \frac{1 - e^{-\kappa * 0,1}}{1 - e^{-\kappa * 10}} \qquad \textbf{(9.1.10b)}$$

in which the L/S ratio is 0.1.

b. the route in the direction of the surface water

$f_{ext.n}$ (sediment bed) which belongs to surface Q is to be fixed with :

$$f_{ext.n}(sedimentbed) = f_{ext.n}(total) - f_{ext.n}(const) \qquad \textbf{(9.1.8)}$$

in which the L/S ratio is [0.1 + (N_i * t)/(d_c * h)] which belongs to $f_{ext.n}$(total).

From this follows from equation 9.1.7a:

$$f_{ext.n} = \frac{1 - e^{-\kappa * (0,1 + \frac{N_i * t}{d_c * h})}}{1 - e^{-\kappa * 10}} - \frac{1 - e^{-\kappa * 0,1}}{1 - e^{-\kappa * 10}} \qquad \textbf{(9.1.9)}$$

Further worked out, this becomes:

$$f_{ext.n} = \frac{e^{-\kappa * 0,1} - e^{-\kappa * (0,1 + \frac{600 * 100}{1550 * h})}}{1 - e^{-\kappa * 10}} = \frac{e^{-\kappa * 0,1} *(1 - e^{-\kappa * \frac{600 * 100}{1550 * h}})}{1 - e^{-\kappa * 10}} \qquad \textbf{(9.1.10a)}$$

From this appears that the extrapolation factor and/or the interpolation factor is only dependent on the constant κ and the L/S ratio. The extrapolation method used must be seen as a temporary solution. Based on the current modelling study of the leaching behaviour being carried out by RIVM and LUW, more specific conclusions can be made in the future (see chapter 10.6).

9.1.3.1 The constant κ

For the calculation of the constant κ, refer to paragraph 8.1.2. In table 9.1.3.1., per compound the average constant κ and the 95% confidence interval is given (the table is identical to table 8.1.1. in paragraph 8.1.2.).

In paragraph 9.1.8., the sensitivity of the standard setting for the uncertainty in the constant κ is examined.

Table 9.1.3.1. The average and the 95% confidence interval of the constant κ per compound.

compound	n	average	compound	n	average
As	44	0.03 ± 0.05	Se	10	0.38 ± 0.18
Ba	55	0.15 ± 0.04	Sn	5	0.19 ± 0.13
Cd	37	0.50 ± 0.10	V	40	0.05 ± 0.06
Co	10	0.20 ± 0.08	Zn	41	0.28 ± 0.05
Cr	82	0.18 ± 0.03	Br*	-	0.35
Cu	90	0.28 ± 0.03	Cl	45	0.57 ± 0.07
Hg	5	0.05 ± 0.03	F	6	0.22 ± 0.14
Mo	76	0.35 ± 0.04	SO_4	49	0.33 ± 0.05
Ni	37	0.29 ± 0.05	CN-complex*	-	0.35
Pb	52	0.27 ± 0.06	CN-free*	-	0.35
Sb	33	0.11 ± 0.07			

* The average κ of the anions.

9.1.4 Explanation of the various emission processes

An open application, freely accessible to surface water, is used as a model situation for the standard setting of category 1 construction materials for applications in surface water. In paragraph 9.1.1., and in figure 9.1., it is indicated that burdening of the surface water and/or the sediment bed of the surface water can occur by way of various emission processes, which can occur independently or in combination with eachother. The following processes can be taken into consideration:

- flushing (N_d):
  water which flows through a construction, over the area of the construction, without a noticeable replacing in a vertical sense;
- seepage (N_k):
  water which flows through a construction with a clear upward replacing in a vertical sense;
- infiltration (N_i):
  water which flows through a construction with a clear downward replacing in a vertical sense;
- leaching during the construction period with $f_{ext.n}$(const):
  the water don't flow along the construction material, but the construction material flows "along" the water.

9.1.4.1 Effective flowing (N_d)

a. the route in the direction of the sediment bed of the surface water

Surface water flowing through a construction can cause a leaching in a construction of non-prefabricated construction materials, whereby compounds leach out, and can be transported more or less horizontally over the area of the construction to end up in the surface water. For water flowing past, the flow rate to the banks decreases, and, if the water would penetrate into the construction, the rate would further reduce strongly in the construction itself.
As the result of wind influences, tides, and shipping, a certain forced flowing in the top layer of the construction can occur. The flowing through the construction will, however, averaged over the entire construction, never have a size which is of any importance in the L/S ratio for the route in the direction of the surface water. If, with a construction layer of h=1 m, the emission to the surface water in the first 4 days after the application of the construction must become of a size equal to the emission as the result of the application itself (L/S ratio = 0.1, see paragraph 9.1.4.5.), then the flow rate must average approximately 160 mm/4 days (approximately 15m/yr) throughout the entire construction. Such a large average effective flow through a construction is not to be expected with the application of non-prefabricated materials. The choice has been made to neglect the emission to the surface water as the result of flow through a construction.

Further research which makes it possible to (better) quantify this process, can later on possibly on lead to the adaptation of the equations if it should appear that this process, in contrast to what is to be expected, does appear to have some importance.

b. the route in the direction of the surface water

If the application lies in the groundwater, it is possible that compounds leach out and are transported to the surrounding sediment bed of the surface water or the groundwater due to the flow of groundwater through the construction. An important contribution to the immission of compounds from a construction material in the sediment bed of the surface water as the result of flow through a construction followed by the leaching of compounds to the sediment bed of the surface water is not expected, in comparison to the immission by infiltration (N_i, see paragraph 9.1.4.3.).

Aside from a more or less constant infiltration N_i, an N_d will barely be able to lead to an extra immission. For now, the choice has been to neglect this process also here. Further research, which makes it possible to (better) quantify this process, can later make it necessary to fill in this process.

In paragraph 9.1.8, the sensitivity of the standard setting to uncertainty in the effective flow with category 1 applications is further discussed.

9.1.4.2 Flowing as the result of seepage

Concerning a possible seepage situation, it can be said that when this occurs in general in surface water in The Netherlands, it is not greater than an average of 30-50 mm year.
A seepage situation simply means a burdening of the surface water and not of the sediment bed of the surface water. For a construction with a construction layer thickness (h) of 1 m and a seepage situation of 50 mm/yr, this corresponds to an L/S ratio of approx. 0.0004 (during a period of 4 days). The L/S ratio for the application of the construction material is 0.1 (see paragraph 9.1.4.5.).
The seepage is negligible for this period of 4 days for the route in the direction of the surface water, which must be observed for the calculation of the maximum allowable emission.

9.1.4.3 Effective infiltration (N_i)

When calculating the maximum allowable emission for the category 1 construction materials for the dry soil, the calculation is made with an effective infiltration and/or percolation of 300 mm per year when it concerns applications which are influenced by precipitation only.
The porosity of the sediment bed of the surface water is of importance for the measure of infiltration. This varies strongly, however, and is dependent on local situations, such as:

- nature of the soil (sand, clay, etc.) and the thickness of the layers (porosity)
- variation in, and change between the water level and the groundwater level of the surrounding areas (the difference in the levels is the driving force for the infiltration speed).

In table 9.1.4.1, the infiltration rates through the sediment bed of the surface water in several waters spread throughout The Netherlands are mentioned.

Table 9.1.4.1. The infiltration of surface water from Dutch rivers, canals, and lakes into the soil.

Water system	Infiltration in mm/year
Hollandsch Diep	100-200
Ketelmeer	tot 550
Noordzeekanaal	450-700
Amsterdam Rhine Canal	3600-7900 (max)
IJsselmeer	50-750
Rivers as Mose and Rhine	50-400
Nieuwe Merwede	200-800
Grevelingenmeer (oude geulen)	250-500

Data concerning the porosity are usually not known (exactly) for the specific place where a construction is applied. The porosity often varies during time and with changing circumstances (such as the water level or the groundwater level).
The highest infiltration rates are found along the banks, because that is where the difference in levels give the greatest gradients, and therefore the driving force for the infiltration is the greatest here. The infiltration, therefore, depends on the location. In table 9.1.4.1., these differences are reproduced as ranges. For the calculations, the upper limit values of the ranges are taken, because most of the construction is carried out along the banks.
Concerning polder outlet waters, the situation will not vary much with the values mentioned above in table 9.1.4.1. Most of the waters in table 9.1.4.1 border on (deep) polders. The remaining waters are generally smaller waters which often lie in polders. The polder ditches are usually dug out and lie below ground level. Water is able to flow down to the ditches (precipitation and seepage). In these ditches, there is barely any application of construction materials. Only when there is any type of filling, there can be larger amounts. With fillings, however, the construction is a part of the soil and this must be so for compounds which meet the target value for soil quality. Polder outlet waters always lie below the ground level, therefore there will always be infiltration.
Since the choice has been made for a standard setting which is independent of the variations in a compartment (chapter 5), with the calculation of the maximum allowable emission for the category 1 construction materials a fixed value of the effective infiltration is chosen (N_i). Otherwise, for each construction, before it can be carried out, a geohydrological test must be done, which can cause (relatively) high costs (especially with smaller constructions) and which also demand an amount of time. This value is fixed at 600 mm/yr, which is the rounded off average of the upper limit values from table 9.1.4.1.

The extreme situation in the Amsterdam Rhine Canal is not considered here. This extreme situation is caused by polders which lie very deep beside the canal, in combination with a high porosity of the canal bottom. Also, a certain spreading around the value of 600 mm/yr will not have a large influence on the maximum allowable emissions. This is because with variation in the L/S ratio belonging to this infiltration, the cumulative emissions in most cases barely change. This is reproduced in figure 9.1.4.1.

In paragraph 9.1.8, the sensitivity of the standard setting to the uncertainty in the effective infiltration with category 1 applications is further discussed.

9.1.4.4 Isolated applications of granular construction materials

If a construction material may only be applied isolated (a category 2 construction material), then with an construction/building in surface water the isolation layer must applied on each side around it, and the construction material may not be freely accessible to the surface water. This, however, is never completely feasible since during the construction, maintenance, or removal of the construction material, there are phases in which contact with the surface water is possible. At the same time, a certain infiltration of surface water through an isolation layer must be assumed, and the risk of leakage from an isolation layer must also be taken into account. For applications in surface water, it is not considered possible to describe the method of isolation in a simple and unified way in general enforced regulations which are applicable everywhere and at every time. For now it is still necessary to evaluate each case individually. An individual evaluation is necessary anyway in a permit-procedure because various items cannot be arranged now by way of general rules and regulations. This situation is not eligible for general regulation and cancellation of the permit necessity when it comes to the Building Materials Decree. In this report, there is no elaboration on an evaluation method, since general rules can not be given, and must be adapted to the specific situation occurring in a permit request.

9.1.4.5 Leaching during the application of the construction material

During the application of a construction material in surface water, the construction material comes into direct contact with a relatively large amount of surface water. Leaching will therefore take place. The magnitude of the leaching is dependent on a large number of factors, among others the amount of water with which the construction material can come into contact

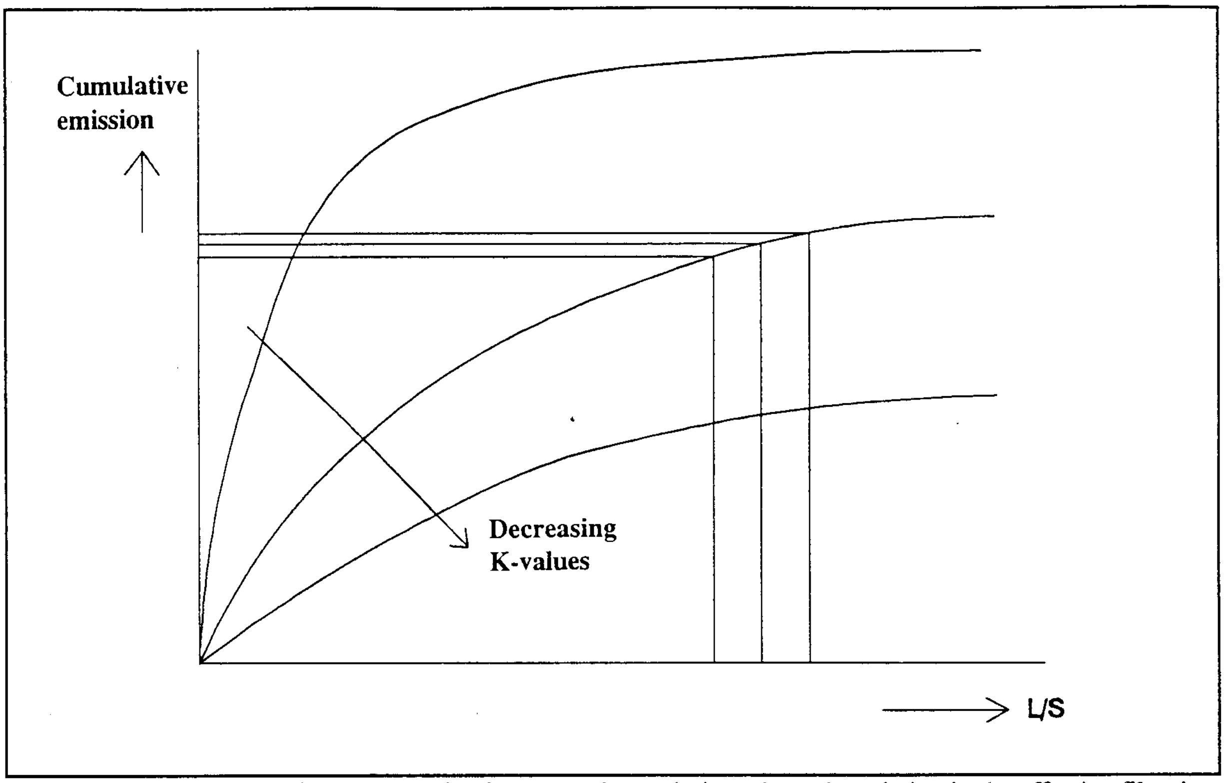

Figure 9.1.4.1. Example for the spreading in cumulative emissions through variation in the effective filtration.

during application, the leaching behaviour of compounds from construction materials, the time that the construction material passes the "water column", etc. For all these factors, it is not possible to singly determine the leaching in certain situations. It is certain, however, that leaching occurs. This first release is assumed to be equal to the leaching of the first fraction which is measured in the column test (L/S=0.1), as explained after this.
One of the most important questions is whether in the short time in which the construction material passes the water column, the exchange processes necessary for the leaching of compounds can take place in the right amounts. An examination is made, however, of what is known concerning the leaching behaviour of compounds from construction materials.

On the subject of the dumping of dredging sludge and its possible effects, the RIZA has carried out literature research on these processes [34]. Concerning the carrying out of the process, the dumping of dredging sludge can be compared to the application of a non-prefabricated construction material.
Also with the dumping of dredging sludge, hopper barges and such can be used, and the fall time is relatively short. Certainly concerning the soil-like materials, the similarities will be

great (dredging sludge itself is also seen as a soil-like or granular construction material). With the dumping of dredging sludge, among other things, an examination is made as to what can leach immediately from the dredging sludge at its first contact with water. The RIZA study mentioned showed that the leachable compounds can be divided into two parts:

- an unstable part: this is released almost immediately and is determined by the partition coefficient of a compound;
- a stable part: this is released less quickly and is dependent on many factors.

For organic compounds, there is a relationship between the rate of the leaching of the stable fraction, and the partition coefficient. The higher the partition coefficient (the stronger the binding of the compound to solid and/or organic material), the lower the leaching rate. When one then looks at the share in the total leaching at the dumping of the dredging sludge originating from the stable part, then this appears to be minute. For a very mobile compound such as y-hexacyclohexane (y-HCH, lindane), this is several tens of procents. For compounds having a lower mobility, this is, however, less than tens of procents. For less mobile compounds, the leaching from the stable part barely contributes to the total leaching, even when considered over longer time periods.

It is more difficult to determine a similar relationship for metals, because the amount of metals in a construction material is not built up of only a stably and an unstably bound part of absorption places, but possibly also out of a part which is taken up in the structure of the construction material. It can be assumed, however, that this last part is not or is barely available for leaching, and therefore will also not be measured in the column test. For the metals as a first indication, it can be assumed that the leaching which is measured in the column test is mainly made up of the unstably bound part, and is released immediately. Experimental field research as to the emissions of compounds during the application of construction materials, or during the dumping of dredging sludge is not available. The model approaches, therefore, are the only available indications as to the course of the desorption (and then still only for organic compounds). With the first part of the column test (L/S=0.1), at least a part, if not the total of this quickly released part is measured. Further research as to the quantification of initial emissions with the application of construction materials is recommended, in order to come to better estimates in the future.

9.1.5 The building tempo

For the calculation of the allowable emission of compounds from construction materials to the surface water, the relationship between the surface area of the construction/building in contact with the surface water (and thereby the amount of construction materials) and the flow rate are of importance (I_{max}). Since the period during which the maximum allowable emission is allowed to take place is 4 days (see the definition in chapter 6.3.), it is not realistic to allow the total emission which is released to take place during a period of 4 days for a large construction which cannot be constructed within 4 days. In the calculation of the allowable emission from the maximum allowable immission, therefore, the building tempo is taken into account.

In this calculation, it is assumed that the emission from construction materials to the surface water is mainly determined by the emission which is released through a water column during the building of the construction (see paragraphs 9.1.2 and 9.1.4.5), and that there is no significant contribution to the emission to the surface water from the amounts of construction materials already built (see paragraph 9.4.2.1 part a). In those cases it is therefore not necessary to consider the entire magnitude of the construction (and the surface area related to it), but only the amount which can be built in these 4 days[36].

The building tempo varies per construction. For the calculation of the leaching surface area O_w (see chapter 7.3.), a fixed building tempo is assumed (the average amount to be built during 4 days) in order to make the calculation method generally applicable.

DWW has researched as to which tempo is normal with the building of wet constructions in which granular construction materials are applied.

The information gathered gives the following insight concerning the use of these materials. Depending on the type of construction (new, large or small, or repair), under normal circumstances between 300 to 1000 tons of construction material is processed per day; between 100 and 700 kg/m^2 is applied. Using this data, the 4-day surface area is calculated for 3 categories of construction.

[36] It must be mentioned that when different constructions are built in the same surface water, this leads to a cumulation of emissions. It was not possible to keep this in consideration.

Table 9.1.3. Building tempo.

type of activity	amount of construction material (kg/m^2)	production in 4 days for 300 tons/day (m^2)	production in 4 days for 1000 tons/day (m^2)
repairs	100	12000	40000
normal dumping (by hoppers etc.)	500	2400	8000
heavy dumping (by hoppers etc.)	700	1714	5714

The building tempo for reparations of 1000 tons/day is probably too high, because it is not always possible to work continuously, since in between, time is necessary for the movement of people and engines. An average building tempo is estimated at approx. 5000 m^2/4 days. This is the average for both a normal tempo of dumping (2400 to 8000 m^2/4 days) as well as the average between the extremes of a normal dumping and a heavy dumping (1714 to 8000 m^2/4 days). In the calculation of the maximum allowable emission (E_{max}), in the following a fixed value of 5000 m^2 for O_w is assumed (exchange surface area in the equation for I_{max}, see chapter 7). It is possible that depending on the construction, the construction materials are brought into the construction, but are not processed. In this case there is mention of storage in a depot. This depot can be both wet as well as dry.

The construction material in a wet depot, then, lies in water during the storage phase, so that leaching can take place. In a dry depot, the construction material lies on land, but always close to a surface water. Mixed forms of half-wet, half-dry depots also occur. These depots can remain intact for a longer period of time, approx. half a year. If it is assumed that the greatest leaching takes place when the construction material first comes into contact with the water, then it does not matter if this happens when the material is brought into the depot, or into direct contact with the water.

If the tempo of bringing the construction material into the depot is made equal to the constructions building tempo, then the evaluation can take place at one time, whereby no distinction needs to be made between bringing into the depot on the one hand and the later definitive application and the direct application on the other hand. For the route in the direction of the sediment bed of the surface water, the building tempo is not of importance, because there the immission surface area is not related to the flow rate flowing past, but to a fixed volume of soil which is influenced.

9.1.6 Correction factor from lab into actual practice

In paragraph 8.1.4., the RIVM has suggested a correction factor which describes the relationship between leaching in the lab and the emission in actual practice. This correction is deduced from research done on natural soils. By removing a soil from its natural environment and conducting a column test on it, the system is disturbed in such a way as to cause a temporary change to the solubility (mostly an increase). Aside from this, the deviating circumstances (temperature, pH, etc.) in the lab compared to the circumstances in actual practice will be of such an influence as to increase the leaching.

It is accepted that these phenomena also occur with construction materials. There is no data known, however, as to the measure in which these phenomena take place with the various construction materials. It is suggested that in the calculation of the maximum allowable emission from construction materials to the sediment bed of the surface water, the same correction be used as with the dry soil.

For the emission from construction materials to the surface water, there is no correction made, because it is not expected that within a time period of 4 days, an environment situation will occur which will lead to a noticeable lower leaching than that which is measured in the lab. The emission to the surface water, therefore, is made equal to the emission calculated in the lab test during a 4-day period.

Also, the highest emissions per unit of time in the direction of the surface water are expected to occur with the application of the construction material, and therefore in the situation in which the construction material (still) is not in balance with its environment, and there is mention of a disturbed system with an increased leaching.

9.1.7 Leaching standards for category 1 construction materials

The standards for construction materials are worked out for various discrete layer thicknesses. If the calculations for the route to the sediment bed of the surface water would be followed into its extreme, then strongly leaching construction materials could be applicable in very thin layers and meet the allowed immission requirements. Keeping in mind the spreading of harmful compounds into the environment, one can ask whether very small layer thicknesses, chosen for the sake of their applicability, are acceptable or desired. It can be considered to determine a minimum layer thickness on the calculations of the acceptable leaching of the material. When determining these minimum layer thicknesses, it must be decided which layer thickness is still functional. In many cases, the non-prefabricated construction materials appear to be applied in a layer thickness of 20-50 cm, also in water engineering constructions in which these construction materials are applied in granular form.

For the route in the direction of the surface water counts that if the calculations would be followed into their extreme, (in comparison to the flow rate) strongly leaching construction materials would be applicable in very small constructions (concerning both the surface area as well as the layer thickness) without the maximum allowable immission being exceeded. Also in this case, one can ask whether this is desirable.

It must be decided as to which amount is still functional. It appears that in the waterway construction, very small amounts are applicable, especially with maintenance or supplements. By assuming an average building tempo of 5000 m^2/4 days for the calculations for the use of construction materials, it is implicitly prevented that construction materials with a relatively high leaching would be applicable.

For the density of a construction material, an average value of 1550 kg/m^2 is filled in. With the help of the equations 9.1.4a, 9.1.4b, and 9.1.10a, 9.1.10b, the relationship between the maximum allowable immission in the sediment bed of the surface water and the surface water, and emission with the column test, can be described.

a. the route in the direction of the sediment bed of the surface water

$$E_{max}(L/S=10) = E_{soil} + \frac{I_{max}(J\ yr) * (1 - e^{-\kappa * 10})}{1550 * h * (e^{-\kappa * 0,1} - e^{-\kappa * (0,1 + \frac{38,7}{h})})} \qquad (9.1.12a)$$

b. the route in the direction of the surface water

$$E_{max}(L/S=10) = \frac{I_{max}(D\ days) * (1 - e^{-\kappa * 10})}{1550 * h * (1 - e^{-\kappa * 0,1})} \qquad (9.1.12b)$$

In the tables 9.1.5a and 9.1.5b, the standards calculated for category 1 construction materials are reproduced for differing application heights for the route to the sediment bed of the surface water and the route to the surface water respectively (with different flow rates surface water).

For the route in the direction of the sediment bed of the surface water, the following is valid:
- infiltration rate (N_i): 600 mm/yr
- the first part of the leaching in the direction of the surface water during the construction period: L/S=0.1

For the route in the direction of the surface water, the following is valid:
- the size of the construction (O_w): 5000 m^2/4 days
- leaching during the construction period: L/S=0.1

In the tables 9.1.5a and 9.1.5b, the comparisons are made for application heights varying from 0.2 - 5 meters, and for flow rates of 5 - 50 m^3/s. When comparing both tables, it appears that the route in the direction of the sediment bed of the surface water makes greater demands on the construction materials than the route in the direction of the surface water. The route in the direction of the sediment bed of the surface water, therefore, determines the maximum allowable emission in the column test. Only with lower flow rates of much less than 1 m^3/s, can the route to the surface water be decisive. This is worked out in chapter 9.3.

Table 9.1.5a Maximum allowable emissions to the sediment bed of the surface water (mg/kg) for category 1 construction materials for various application heights (h),

compound	application height (h)						
	0.2 m	0.5 m	0.7 m	1 m	2 m	3 m	5 m
As	1.07	0.86	0.83	0.81	0.78	0.78	0.77
Ba	17.0	7.4	5.5	4.1	2.6	2.2	1.8
Cd	0.062	0.037	0.033	0.029	0.025	0.024	0.023
Co	1.0	0.52	0.43	0.35	0.27	0.24	0.22
Cr	4.2	1.7	1.3	0.92	0.52	0.40	0.31
Cu	1.9	0.93	0.73	0.59	0.42	0.37	0.33
Hg	0.022	0.018	0.018	0.017	0.017	0.017	0.017
Mo	0.64	0.35	0.29	0.25	0.20	0.18	0.17
Ni	2.3	1.3	1.1	0.96	0.80	0.74	0.70
Pb	4.8	2.4	1.9	1.6	1.2	1.1	0.98
Sb	0.11	0.054	0.045	0.037	0.030	0.028	0.026
Se	0.080	0.050	0.044	0.040	0.035	0.033	0.032
Sn	0.88	0.37	0.27	0.20	0.12	0.092	0.074
V	3.5	1.7	1.3	1.1	0.90	0.83	0.78
Zn	8.6	4.6	3.9	3.3	2.7	2.5	2.3
Br	3.6	3.0	2.9	2.8	2,7	2.7	2.6
Cl	944	720	682	654	621	612	607
F	42.9	18.0	13.3	9.8	5.7	4.4	3.5
SO_4	968	830	805	787	765	760	758
CN-tot	0.25	0.097	0.070	0.049	0.025	0.017	0.011
CN-free	0.049	0.019	0.014	0.009	0.005	0.003	0.002

Table 9.1.5b Maximum allowable emissions to the surface water (mg/kg) for category 1 construction materials for various application heights (h) and the flow rates in m^3/s.

compound	application height: h=0.2 m				application height: h=0.7 m				application height: h=2.0 m				application height: h=5.0 m			
	flow rate (Q_{surf})				flow rate (Q_{surf})				flow rate (Q_{surf})				flow rate (Q_{surf})			
	1 m^3/s	5 m^3/s	10 m^3/s	25 m^3/s	1 m^3/s	5 m^3/s	10 m^3/s	25 m^3/s	1 m^3/s	5 m^3/s	10 m^3/s	25 m^3/s	1 m^3/s	5 m^3/s	10 m^3/s	25 m^3/s
As	19.3	96.5	193	482	5.5	27.6	55.1	138	1.9	9.6	19.3	48.2	0.77	3.9	7.7	19.3
Ba	175	873	1745	4363	49.9	249	499	1247	17.5	87.3	175	436	7.0	34.9	69.8	175
Cd	0.09	0.45	0.91	2.3	0.03	0.13	0.26	0.65	0.009	0.045	0.091	0.23	0.004	0.018	0.036	0.091
Co	1.9	9.7	19.4	48.7	0.56	2.8	5.6	13.9	0.19	0.97	1.9	4.9	0.08	0.39	0.78	2.0
Cr	20.9	104	209	522	6.0	29.8	59.6	149	2.1	10.4	20.9	52.2	0.83	4.2	8.3	20.9
Cu	2.3	11.4	22.8	56.9	0.65	3.3	6.5	16.3	0.23	1.1	2.3	5.7	0.09	0.46	0.91	2.3
Hg	0.05	0.25	0.53	1.3	0.02	0.073	0.15	0.38	0.005	0.025	0.053	0.13	0.002	0.010	0.021	0.053
Mo	6.3	31.5	62.9	157	1.8	9.0	18.0	44.9	0.63	3.2	6.3	15.7	0.25	1.3	2.5	6.3
Ni	7.4	36.9	73.7	184	2.1	10.5	21.1	52.7	0.74	3.7	7.4	18.4	0.29	1.5	2.9	7.4
Pb	19.5	97.6	195	488	5.6	27.9	55.8	139	2.0	9.8	19.5	48.8	0.78	3.9	7.8	19.5
Sb	2.7	13.6	27.2	68.1	0.78	3.9	7.8	19.5	0.27	1.4	2.7	6.8	0.11	0.54	1.1	2.7
Se	0.29	1.5	2.9	7.3	0.08	0.42	0.84	2.1	0.03	0.15	0.29	0.73	0.01	0.060	0.12	0.29
Sn	0.25	1.3	2.5	6.3	0.07	0.36	0.72	1.8	0.03	0.13	0.25	0.63	0.01	0.050	0.10	0.25
V	8.8	44.0	88.1	219	2.5	12.6	25.2	62.8	0.88	4.4	8.8	22.0	0.35	1.8	3.5	8.8
Zn	15.2	75.8	152	379	4.3	21.7	43.3	108	1.5	7.6	15.2	37.9	0.61	3,0	6.1	15.2
Br	5030	25148	50295	125738	1437	7185	14370	35925	503	2515	5030	12574	201	1006	2012	5030
Cl	80216	401079	802159	2005396	22919	114594	229188	572970	8022	40108	80216	200540	3209	16043	32086	80216
F	1367	6834	13667	34168	391	1952	3905	9762	137	683	1367	3417	54.7	273	547	1367
SO_4	66154	330768	661536	1653839	18901	94505	189010	472525	6615	33077	66154	165384	2646	13231	26461	66154
CN-tot	3.1	15.7	31.4	78.6	0.9	4.5	9.0	22.5	0.31	1.6	3.1	7.9	0.13	0.63	1.3	3.1
CN-free																

9.1.8 Sensitivity analysis

To gain insight into the uncertainty of the calculated allowable emission, a sensitivity analysis is carried out for several parameters. The presented standard setting is based on:

- an effective infiltration and/or percolation of 600 mm/yr.
- an average density of 1550 kg/m^3;
- an average kappa (κ) per compound (see table 9.1.2a);
- a negligible effective stream through the construction (N_d);
- an average surface area of 5000 m^2 of the construction can be built during 4 days.

For the route in the direction of the sediment bed of the surface water and the direction of the surface water, the following values for the parameters are calculated in order to determine the sensitivity of the standard setting per parameter:

- effective infiltration (N_i) : 300 and 900 mm/yr;
- density (d_c) : 1250 and 1850 kg/m^3;
- kappa of the compound (κ) : upper and lower limit of the 95% confidence interval;
- effective stream-through (N_d).

In the tables 9.1.10a and 9.1.10b, the average influence (%) on the allowable emission from construction materials, as stated in the tables 9.1.9a and 9.1.9b, is reproduced per parameter for the various application heights (0.2 m, 0.7 m, and 5 m).

a. the route in the direction of the sediment bed of the surface water

Table 9.1.10a The average influence (%) on the allowable emission from construction materials reproduced per parameter.

	application height (h)		
	0.2 m	0.7 m	5 m
N_i = 300/900 mm/yr	5.3/-1.6	8.3/-2.5	20.2/-6.0
d_c = 1250/1850 kg/m^3	17.8/-13	13.9/-10.2	8.7/-6.4
κ = upper/lower limit	-11.8/6.4	-8.1/3.0	2.3/-1.0
L/S dumping = 0.05/0.15	-1.0/1.0	-0.8/0.8	-0.5/0.5

The magnitude of the emission is largely determined by the transportation of the leached compounds by water. The porosity of the construction material (and possibly the soil under the construction) determines the total amount of water which can pass through the construction material per unit of time. Both the effective infiltration (stream in a vertical direction) as well as the effective stream-through (stream in a horizontal direction) are a part of the total amount of water which passes through the material. The band width of the effective infiltration is in actual fact based on a spreading of the porosity. The effective stream-through is discounted in the effective infiltration and the band width of 300 to 900 mm/yr used there.

b. the route in the direction of the surface water

Table 9.1.10b The average influence (%) on the allowable emission from construction materials reproduced per parameter.

	Application height (h)		
	0.2 m	0.7 m	5 m
d_c = 1250/1850 kg/m³	23.1/-16.8	23.1/-16.8	23.1/-16.8
κ = upper/lower limit	25.5/-15.9	6.0/-1.7	6.1/-1.7
L/S dumping = 0.05/0.15	46.9/-46.9	49.1/-49.1	49.8/-49.8
O_w = 4000/6000 m²	25/-16.7	25/-16.7	25/-16.7

From the above tables it appears that the standards are sensitive. This is valid for the chosen fixed density, the κ, the chosen fixed building tempo, and for the route to the surface water, the size of the L/S ratio for the application of the construction material. For the density and the κ, the sensitivities are no different than in part 1A concerning the applications on the dry soil. The conclusion made there in the sensitivity analyses concerning these parameters are also used here. A fixed value is chosen for the building tempo.
For the size of the L/S ratio for the estimation of the initial leaching, further research is necessary in order to be able to better define this. The great sensitivity is not valid, however, for the route in the direction of the sediment bed of the surface water, which is in most cases decisive for the necessary quality of the construction materials.

9.2 Prefabricated materials

9.2.1 The relationship between maximum allowable immission and emission with the diffusion test

The relationship between the emission from a construction material and the immission in the sediment bed of the surface water of the surface water is reproduced with the following equations:

a. the route in the direction of the sediment bed of the surface water

$$E_{max}(J\ yr) = I_{max}(J\ yr) \qquad \textbf{(9.2.1a)}$$

$E_{max}(J\ yr)$ = maximum allowable emission of a compound per J years (mg/m^2);
$I_{max}(J\ yr)$ = maximum allowable immission into the soil per J years (mg/m^2).

b. the route in the direction of the surface water

$$E_{max}(D\ days) = I_{max}(D\ days) \qquad \textbf{(9.2.1b)}$$

$E_{max}(D\ days)$ = maximum allowable emission of a compound per D days (mg/m^2);
$I_{max}(D\ days)$ = maximum allowable immission into the surface water per D days (mg/m^2).

In the relationship between the emission and the immission, the following simplifications are used:

- the entire amount of the surface water flowing along the construction/building streams to the sediment bed of the surface water or the surface water;
- the emission per unit of the construction material surface area is equal to the immission per unit of soil surface area;
- the application of the construction material is completely under water, despite the sometimes changing water levels (no correction for a limited wetting period).

For the estimation of the emission from prefabricated construction materials during a period of J years (E_{max}(J yrs)) or D days (E_{max}(D days)), the diffusion test is used (appendix 3). In this way, the emission from the construction material during 64 days is determined. The emission during 64 days must then be extrapolated and/or interpolated to a period of 100 years or 4 days.

In this paragraph, a calculation method is worked out for the "translation" of:

- the maximum allowable burdening of the sediment bed of the burdening of the surface water (immission) during a period of 100 years and 1 year respectively, into an emission during 64 days which is determined in the lab;
- the maximum allowed surface water burdening (immission) during a period of 4 days into an emission during 64 days which is determined in the lab.

In this report, an attempt is made to correct for as many factors as possible which are quantifiable, and which can influence the translation of the emission measured in the lab into the actual practice emission. There is a correction for exhaustion, effective changing of the diffusion coefficient, the period of wetting and the temperature difference. The factors exhaustion, effective changing of the diffusion coefficient, and the period of wetting can be included in the diffusion comparison which is also used for the extrapolation and/or the interpolation of E(64d) to I(J yrs) or I(D days). These factors are then, also, quantified in the extrapolation factor and/or the interpolation factor. According to the equations below, the emission (during 64 days) is related to the maximum allowed immissions to the sediment bed of the surface water (during J yrs) and the surface water (during D days).

a. the route in the direction of the sediment bed of the surface water

$$E_{max}(64\ d) = \frac{I_{max}(J\ yr)}{f_{ext.v}(h,x\%,D_e) * f_{tem}} \tag{9.2.2a}$$

$E_{max}(64d)$ = maximum allowable emission in 64 days (mg/m^2);
$I_{max}(J\ yr)$ = maximum allowable immission per J years (mg/m^2);
$f_{ext.v}(h,x\%,D_e)$ = extrapolation factor for the extrapolation from 64 days to J years in which depletion (h), wetting period (x%) and D_e-change have been quantified;
f_{tem} = correction factor for the difference between the temperature in laboratorium and the temperature in practice;

b. the route in the direction of the surface water

$$E_{max}(64\ d) = \frac{I_{max}(D\ days)}{f_{ext.v}(h,x\%,D_e) * f_{tem} * f_{building}} \tag{9.2.2b}$$

$E_{max}(64d)$ = maximum allowable emission in 64 days (mg/m^2);
$I_{max}(J\ yr)$ = maximum allowable immission in J years (mg/m^2). The maximum allowable immission depends of the rate of volume of the surface water (see chapter 7.3);
$f_{ext.v}(h,x\%,D_e)$ = extrapolation factor for the extrapolation from 64 days to J years in which depletion (h), wetting period (x%) and D_e-change have been quantified;
f_{tem} = correction factor for the difference between the temperature in laboratorium and the temperature in practice;
$f_{building}$ = correction factor for the building tempo

The previous equations are further explained in the following paragraphs. For further information concerning the determining of the measured and the calculated emission with the diffusion test, refer to paragraph 8.2.1. For the route in the direction of the surface water, interpolation of the calculated emission leads to the underestimation of the emission during a shorter period, since the initial flushing is not included in the calculated emission. The measured emission is the sum of the calculated emission and the emission due to initial flushing. For the emission to the soil during 100 years, the initial flushing appeared negligible, but for the emission to the surface water, this does not have to be the case. It is suggested that further research be done as to the relative contributions of the emission by initial flushing and the calculated emission during 4 days.

9.2.2 The extrapolation of E_{max}(64 days) to E_{max}(J years) and E_{max}(D days)

In the diffusion test, the emission is determined for a 64-day period. A calculation method is worked out for the extrapolation and/or the interpolation of the emission during 64 days (E(64d)) to the emission during 100 years (E(100 years)) or during 4 days (E(4d)). The emission can be calculated with the following equation (deduced from the Law of Fick):

$$E(t) = E_{avail} * d_c * \sqrt{\frac{D_e}{\pi}} * \sqrt{t} \qquad (9.2.3)$$

E(t)	=	emission during t units of time (mg/m^2);
D_e	=	coefficient of effective diffusion (determined with the tank leaching test) (m^2/s);
t	=	time (s);
E_{avail}	=	the availability of compounds for leaching (determined with availability test of inorganic compounds for leaching (NEN 7340)) (mg/kg);
d_c	=	dry density of the construction material (kg/m^3).

The extrapolation factor is the quotient of the emission during 100 years or the emission during 4 days and the emission during 64 days:

a. the route in the direction of the sediment bed of the surface water

$$f_{exp.v} = \frac{E(100\ years)}{E(64\ days)} = \frac{E_{avail} * d_c * \sqrt{D_e/\pi} * \sqrt{100 * 365 * 24 * 3600}}{E_{avail} * d_c * \sqrt{D_e/\pi} * \sqrt{64 * 24 * 3600}} = 24 \qquad (9.2.4a)$$

b. the route in the direction of the surface water

$$f_{exp.v} = \frac{E(4\ days)}{E(64\ days)} = \frac{E_{avail} * d_c * \sqrt{D_e/\pi} * \sqrt{4 * 24 * 3600}}{E_{avail} * d_c * \sqrt{D_e/\pi} * \sqrt{64 * 24 * 3600}} = 0.25 \qquad (9.2.4b)$$

this model does not give a correct estimation of the emission if the concentration (available for leaching) of the construction material to be researched changes, or if the diffusion coefficient changes in the period during which the emission must be regarded (100 years). In paragraph 8.2.3. and paragraph 8.2.4., these two processes are quantified. In paragraph 9.2.3., a survey is given of the extrapolation factor and/or the interpolation factor in which both factors are included. This extrapolation factor and/or interpolation factor is valid for construction materials in applications which are (almost) continuously wet. This is the case for applications in surface water. This calculated emission provides the possibility for extrapolation to other periods. The initial emission as the result of flushing is not included here. For the emission to the surface water, further research is desired as to the contribution of this emission to the total emission to the surface water.

9.2.3 Exhaustion and changing of the diffusion coefficient

For the extrapolation factor, various aspects must be taken into account regarding the route in the direction of the sediment bed of the surface water or the route in the direction of the surface water, considering the difference in time periods over which the emissions must be determined for the evaluation of the application possibilities.

a. the route in the direction of the sediment bed of the surface water

With the extrapolation of the emission determined by the diffusion test to an emission during a period of 100 years, exhaustion and changing of the diffusion coefficient can be of influence (see also paragraph 8.2.3., 8.2.4., and 8.2.5.). In this paragraph, each compound is given one extrapolation factor. For compounds with a $pD_e > 11$, exhaustion does not occur with these application thickness. For these compounds, the extrapolation is carried out by multiplying by the extrapolation factor, in which only the changing of the diffusion coefficient is quantified. For the extrapolation of compounds with a $pD_e \leq 11$, both processes can play a role.

Regarding the emission, the processes work against eachother. It is suggested to take one process into account, and to use the lowest extrapolation factor. The extrapolation factors are reproduced in table 9.2.1. The table is equal to table 8.2.2.

Table 9.2.1. Extrapolation factor for the exhaustion and the changing of the diffusion coefficient.

pD_e	$f_{ext.v}$							
	thickness of the construction material (h)							
	0.1 m	0.2 m	0.3 m	0.5 m	0.7 m	1 m	2 m	10 m
5	1	1	1	1	1	1	1	2
6	1	1	1	1	1	1	1	5
7	1	1	1	1	1	2	3	15
8	1	1	2	2	3	5	10	15
9	2	3	5	8	11	15	15	15
10	5	10	15	15	15	15	15	15
11-19	15	15	15	15	15	15	15	15

* f = E(100 year)/E(64 days)
* pD_e = - log D_e
* pD_e=10 : pD_e-range 9.5 to 10.5
pD_e=9 : pD_e-range 8.5 to 9.5
etc.

For chloride and sulphate, the maximum allowable immission is defined during a period of 1 year (paragraph 7.2.) The extrapolation factor from 64 days to 1 year is: $f_{ext.v}$=2.4. The period of 1 year is considered to be too short to correct for exhaustion or changing of the diffusion coefficient.

b. the route in the direction of the surface water

The period of 4 days, during which the maximum allowed immission is defined, is considered to be too short to correct for exhaustion or changing of the diffusion coefficient. For chloride and sulphate, the same definition is valid for the maximum allowed immission as for the other compounds. The extrapolation factor of 64 days to 4 days is : $f_{ext.v}$=0.25 for all compounds (paragraph 9.2.2.).

9.2.4 Correction for wetting; type A and type B applications

For the use of materials on or in the dry soil, two types of applications are distinguished, namely: type A application in which the construction is virtually always wet, and type B application in which the construction material is only periodically wet due to atmospheric conditions (paragraph 8.2.6.). Applications in surface water, must be seen as a type A application. Even if these do not lie continuously under water, it must be assumed in the VWO-area (surface water including the areas beneath the highest water level; this also means extreme values) that these can be continuously wetted by groundwater and/or surface water, by capillary action or seepage.

9.2.5 Isolated applications of V construction materials

If a construction material may only be applied isolated (a category 2 construction material), then with an application in surface water, the isolation layer must be applied on every side all around the application, and the construction material may not be freely accessible to surface water. This is not totally feasible, however, since during construction, maintenance, or removal of the material, there are phases in which there can be contact with the surface water. Also, a certain infiltration of surface water through an isolation layer must be assumed, and the risk of leakage in an isolation layer must be taken into consideration. For applications in surface water, it is not considered possible to simply and uniformly describe the method of isolation by way of generally valid regulations which are applicable everywhere and always. For now, an evaluation per case is still necessary. Consequently, an individual evaluation is necessary in a permit procedure, and several items cannot be arranged in general rules and regulations at the moment. This situation, therefore, cannot be considered for general regulation and cancellation of the permit requirement regarding the Building Materials Decree.

In this report, an evaluation method is not worked out, as this is not generally applicable and must be adapted to the specific situation demanded by a permit request.

9.2.6 Correction factor for the temperature (f_{tem})

The surface water follows the temperature of the environment and therefore, the average temperature during a whole year will also be approximately 10°C in actual practice. Since insight into the temperature distribution of the surface water during the year is not available, an average, actual practice temperature of 10°C is maintained.
Research must be done as to the temperature distributions of surface water during one year.
For the calculation of the correction factor for the temperature, refer to paragraph 8.2.7.
The correction factor for the temperature is 0.7 (f_{tem}), and must be applied for both the route in the direction of the sediment bed of the surface water as well as the route in the direction of the surface water.

9.2.7 Correction factor for the building tempo

For the route in the direction of the surface water, the relationship between the surface area of the construction and the flow rate is of importance when determining the maximum allowable immission. The period during which the maximum allowable immission is determined is 4 days. For larger constructions, it is not realistic to assume that the entire construction is built at once. This could lead to a great overestimation of the emissions which would actually occur. It is more realistic to assume that the construction is built step by step, spread over a period of time, so that the leaching is also released, spread over a period of time.

In figure 9.2.7.1., this is reproduced by way of a model. In this model, it is assumed that a constant amount of construction material is applied immediately. The leaching is determined by diffusion, and it must be kept in mind that there are cumulations of emission from the compound which is applied during several days.

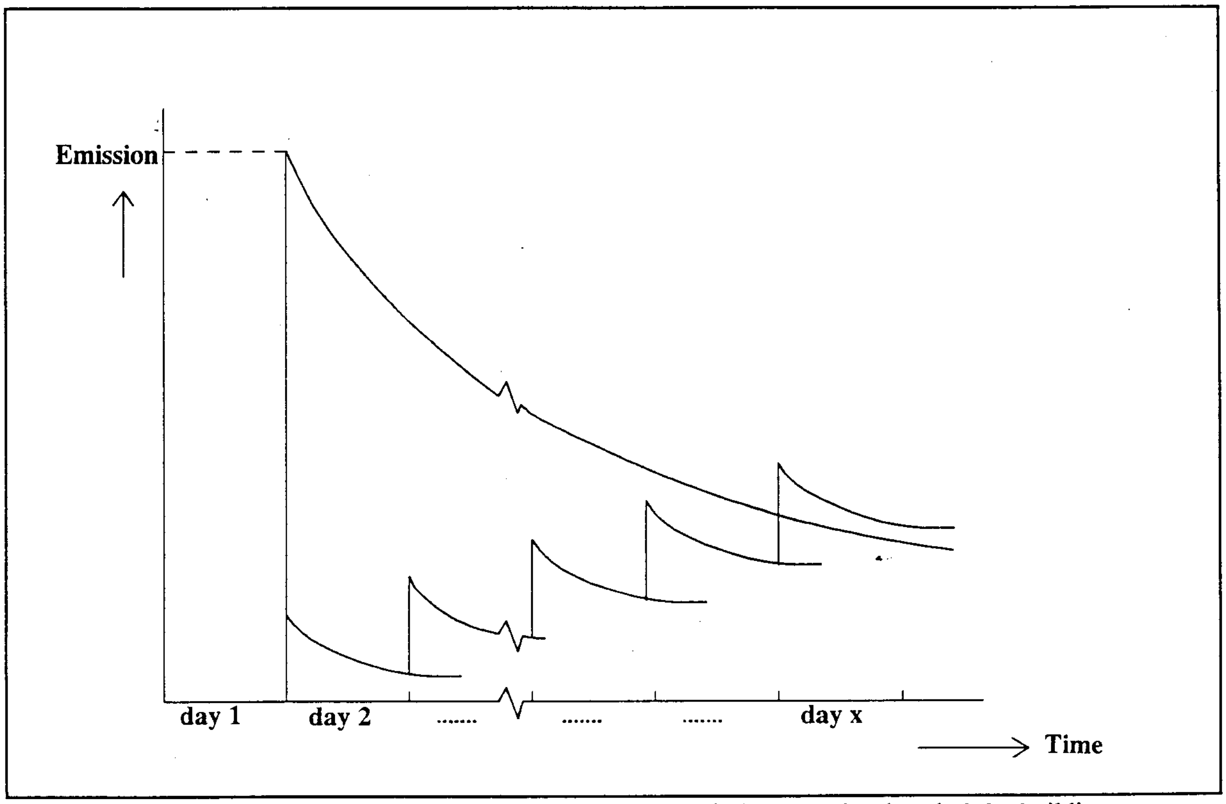

Figure 9.2.7.1. The course of the emissions as the result of diffusion, keeping in mind the building tempo, or application all at once.

In paragraph 9.1.5., the average building tempo is indicated as 5000 m^2/4 days for granular materials, and therefore also for the construction materials which are dumped loose and which meet the requirements for prefabricated materials (for example very coarse dump stone). This value is also used in the calculations for the maximum allowable emission for prefabricated construction materials. Besides the building tempo, the total size of the work also determines the contribution to the leaching and therefore also determines the correction factor.

DWW has researched as to what the average size of a construction is in the wet waterway construction (see paragraph 9.1.5.). This varies between 5000 and 10,000 tons with a maximum of 200,000 tons. Strictly, this refers to the amount of dumped construction materials, but in the calculations these amounts are also used for prefabricated construction works, such as dock walls, bridge constructions, etc. Keeping in mind an average building tempo of 5000 m^2/4 days and an average of 500 kg/m^2 of material, this means an average surface area of 10,000 to 20,000 m^2, and a building period of 8 to 16 days. For complex constructions, the building period will be longer.

The emission which is released per period ($E(t_1,t_2)$) and which is related to the size and the surface area of the construction which is being built (A) in that period between t_1 and t_2, is reproduced in equation 9.2.5. This equation is deduced from equation 9.2.3.

$$E(t_1,t_2) * A = C * A * (\sqrt{t_2} - \sqrt{t_1}) \qquad (9.2.5)$$

$E(t_1,t_2)$	= emission in the period between t_1 and t_2
A	= surface
C	= constant: $E_{avail}*d_c*\sqrt{D_e/\pi}$
t_1, t_2	= time t_1 respectively time t_2 in s.

With the method as described above, it is assumed that the construction is built immediately on the first day. The leaching during the first 4 days is then:

$$C * A * \sqrt{24*3600} * (\sqrt{4} - \sqrt{0}) = 2 * \sqrt{24*3600} * C * A \qquad (9.2.6)$$

If the construction is built during more than one day (n) (a building tempo, therefore, of A/n m^2/day), for each amount of construction material which is applied during each of the n days, it is possible to determine the contribution to the total emission of the total amount of construction material in the last 4 days of the building period. The maximum leaching during a period of 4 days takes place during the last 4 days of the building period, because that is when the maximum amount of construction material contributes to the leaching. The emission in this period is tested, for if the emission during the last 4 days meets the emission requirements, then the emission during the days prior to the last 4 will certainly meet the requirements.

- the amount of construction material of A/n m^2 which is applied on the first day, gives the following emission during the last 4 days of the building period of n days (t_1=(n-4) days and t_2=n days):

$$C * \frac{A}{n} * \sqrt{24*3600} * (\sqrt{n} - \sqrt{n-4}) \qquad \textbf{(9.2.7.a)}$$

- the amount of construction material of A/n m^2 which is applied on the second day, has leached one day less (t_1=5 days and t_2= n-1 days) and gives the following emissions during the last 4 days of the building period:

$$C * \frac{A}{n} * \sqrt{24*3600} * (\sqrt{n-1} - \sqrt{n-5}) \qquad \textbf{(9.2.7.b)}$$

- the previous is repeated to day n-3 (until 4 days before the end of the building period).
- the amounts of construction material of A/n m^2 per day which is applied during the last 4 days, contribute 4, 3, 2, and 1 respectively to the leaching.

The total emission from the total amount of construction material (n times an amount of A/n m^2) during the last 4 days of the building period is then the sum of the emissions mentioned above and is:

$$C * \frac{A}{n} * \sqrt{24*3600} * (\sqrt{n} + \sqrt{n-1} + \sqrt{n-2} + \sqrt{n-3}) \qquad \textbf{(9.2.8)}$$

From the equations 9.2.6. and 9.2.8., a correction factor can be deduced for the leaching occurring as the result of the application spread over time, over against the application of a construction at once:

$$f_{tempo} = \frac{\sqrt{n} + \sqrt{n-1} + \sqrt{n-2} + \sqrt{n-3}}{2 * n} \qquad \textbf{(9.2.9)}$$

f_{tempo} = correction factor for the speed of work.
n = number of days of 1250 m^2/day (O_w/1250), where $n \geq 4$.

In table 9.2.2. below, the correction factors for the building tempo concerning the diffusion is reproduced for various sizes of the construction (various values of n) as compared to the application of a construction at once.

Table 9.2.2 Correction factor for the building tempo: f_{tempo}.

amount of construction material in m^2 built in n days	correction factor for the building tempo: (f_{tempo})
5000 (n=4)	0.8
6250 (n=5)	0.7
7500 (n=6)	0.7
8750 (n=7)	0.7
10000 (n=8)	0.6
11250 (n=9)	0.6
12500 (n=10)	0.6
13750 (n=11)	0.6
15000 (n=12)	0.5
16250 (n=13)	0.5
17500 (n=14)	0.5
18750 (n=15)	0.5
20000 (n=16)	0.5

The average value can be determined on the basis of the average of the values in the table above[37] and is 0.6. In view of the minute spreading, the choice is made for a fixed correction factor of f_{tempo}=0.6 for the determining of the maximum allowable emission.
In the sensitivity analyses in paragraph 9.2.9. is indicated as to what the use of an average value with respect to the actual spreading means.

9.2.8 Leaching standards for category 1 construction materials

For the route in the direction of the surface water, if the calculations are followed into the extreme, strongly leaching construction materials (in comparison to the flow rate) in very small constructions would be allowed to be applied without exceeding the maximum

[37] With a size of 10,000-20,000 m^2 of a construction in the wet waterway construction, an average building tempo of 5000 m^2/4 days and therefore a building period of 8-16 days.

allowable immission. Also in this case (as with the non-prefabricated construction materials), one can ask whether this is desirable. It must be considered as to which amount is still functional. In the waterway construction, it appears that small amounts can be used, as maintenance or as supplements, for example.

To prevent the use of materials with a very high leaching, for the determining of the maximum allowable immission, the minimum size of the construction is calculated as 5000 m^2/4 days, and for the determining of the maximum allowable emission, the minimum layer thickness is calculated as 0,2 m.

In the tables 9.2.3a and 9.2.3b below, the calculated maximum allowable emissions for category 1 construction materials are showed for the route to the sediment bed of the surface water and for the route to the surface water (with various surface water flow rates).

Table 9.2.3a The maximum allowable emission to the sediment bed of the surface water for category 1 construction materials for $pD_e \geq 11$ in mg/m^2.

compound	category 1 (mg/m^2)	compound	category 1 (mg/m^2)
As	41	Se	1.4
Ba	290	Sn	29
Cd	1.1	V	97
Co	29	Zn	200
Cr	140	Br	29
Cu	51	Cl	36000
Hg	0.4	F	710
Mo	14	SO_4	54000
Ni	50	CN-tot	7.1
Pb	120	CN-free	1.4
Sb	3.7		

For the route in the direction of the sediment bed of the surface water, the following is valid:

- $pD_e \geq 11$

For the route in the direction of the surface water, the following is valid:

- O_w=10,000 m^2
- f_{tempo}= 0.6

Table 9.2.3b Maximum allowable emission to the surface water for category 1 construction materials for $pD_e \geq 11$ in mg/m^2.

	category 1 (mg/m^2)					category 1 (mg/m^2)			
	flow rate (Q_{surf})					flow rate (Q_{surf})			
compound	1 m^3/s	5 m^3/s	10 m^3/s	25 m^3/s	compound	1 m^3/s	5 m^3/s	10 m^3/s	25 m^3/s
As	329	1646	3291	8229	Se	16.5	81.9	165	411
Ba	4937	24686	49371	123429	Sn	8.2	41.0	81.9	206
Cd	6.6	33.3	65.7	165	V	165	823	1648	4114
Co	65.8	330	658	1648	Zn	658	3291	6583	16457
Cr	659	3291	6593	16457	Br	0.3.E6	1.3.E6	2.6.E6	6.6.E6
Cu	98.8	493	988	2469	Cl	6.6.E6	33.E6	66.E6	164.E6
Hg	0.95	4.8	9.5	24.8	F	0.05.E6	0.2.E6	0.5.E6	1.2.E6
Mo	330	1648	3295	8229	SO_4	3.3.E6	16.E6	33.E6	82.E6
Ni	329	1646	3291	8229	CN-tot	165	823	1648	4114
Pb	823	4114	8229	20571	CN-free				
Sb	330	1648	3295	8229					

From both tables it appears that the route in the direction of the sediment bed of the surface water, with the flow rate indicated (>5 m^3/s) and the size of the construction (5000 m^2/4 d), demands more rigid requirements than the route in the direction of the surface water. The route in the direction of the sediment bed of the surface water, therefore, determines the maximum allowable emission for prefabricated construction materials.

9.2.9 Sensitivity analysis

With the calculation method presented, the relationship between the leaching behaviour in the lab and in actual practice situations must be further verified. For the correction factor for the temperature difference (f_{tem}) and the building tempo (f_{tempo}), it is possible to give some insight into the band width. The correction factor for the temperature difference between the lab situation and the actual practice situation is based on an outside temperature of 10°C, and a temperature of 20°C in the lab. The outside temperature is 9.5° ± 0.5°C, and the temperature in the lab 20° ± 2°C. This leads to a range in the correction factor of 10% in the standards for construction materials.

The correction factor for the building tempo varies in the regular area of 0.5 to 0.7 In the correction factor, this is a range of approximately 15%, and in the standards for construction materials, also a range of approximately 15%.

9.3 Small surface waters

In the previous chapters, it has been concluded that in streaming waters, the route to the sediment bed of the surface water is decisive for constructions with a size of 5000 m^2 and a surface water flow rate of $\geq 5 m^3/s$. It is suggested to base the standard setting on the burdening of the sediment bed of the surface water.

With small flow rates, around or below 1-1.5 m^3/s, a turn-around point ("turn-around point D"), see figure 9.3.3.1. in paragraph 9.3.3.) is reached at a certain moment, whereby the release to the surface water becomes decisive. The flow rate whereby the turn-around point is reached is also dependent on the characteristics of the surface water (the size), the characteristics of the construction (size, thickness, nature of the construction material) and the type of compound which is evaluated for leaching.

With the (evaluation of the) burdening of the surface water, a distinction can be made between the admission of leached compounds in the flowing water (the flow rate of the surface water concerned), and/or in the water present (the volume of the water system concerned).

With higher flow rates whereby the water system is refreshed in less than 4 days (the period during which evaluation must take place), the flow rate often appears decisive (turn-around point D). Around the margin of refreshing in 4 days, a turn-around point occurs ("turn-around point V"), below which the flow rate (greatly) reduces in importance, and the volume has an increasing role in limiting the burdening of the surface water by compounds leached out the construction.

In this chapter, using several examples, a quantitative insight is given into the burdening of small waters by construction materials, and the consequences which this has for the evaluation of the application of construction materials.

9.3.1 The turn-around point at the decisive route from the sediment bed of the surface water to the water (turn-around point D)

The point where the burdening of the surface water becomes more decisive than the burdening of the sediment bed of the surface water is dependent on several characteristics of the surface water, and the application, as has been indicated before. Insight into the area in which a turn-around point ("turn-around point D") finds itself, can be obtained on the basis of several examples of applications in small surface waters. The characteristics of the surface waters and applications are described in table 9.3.1.1. In the calculations, it is assumed that on both banks, bank protection is applied or renewed along the entire bank below the water level.

Table 9.3.1.1. Characteristics of the surface water and the construction for several examples of constructions in small waters.

Characteristics surface water and application:		Example A	Example B	Example C	Example D
Length of the water system	[m]	1000	1000	1000	1000
Width of the water system	[m]	20	10	5	2.5
Depth of the water system	[m]	2.5	2.5	1.5	1
Volume of the water system	[m^3]	50.000	25.000	7.500	2.500
Flow rate	[m^3/s]	0.02	0.002	0.001	0.000005
Stay time	[days]	29	36	9	579
Turn-around V*	[m^3/s]	0.14	0.018	0.002	0.0007
Length of the construction	[m]	1000	250	100	100
Width of the construction	[m]	2.5	2.5	1.5	1
Thickness of the construction layer (h)	[m]	0.7	0.7	0.7	0.7
Surface area of the construction	[m^2]	5.000	1.250	300	200

* The turn-around point V is calculated as the flow rate whereby the volume of the water system is refreshed in 4 days (see also further on in this chapter).

Table 9.3.1.2. The most-used primary and secondary construction materials in the waterway construction which are used in the study

Primary Construction Materials		Secondary Construction Materials	
Non-prefabricated	Prefabricated	Non-prefabricated	Prefabricated
clay	cement concrete	mine stone (selected)	LD slag
loam	asphalt cement	masonry aggregate	phosphor slag
gravel	rough ceramic products	cement aggregate	
sand	calcium-silicate bricks		
de-silted sea sand	sand cement stabilisation		
lime stone			
basalt			

From the tables 9.3.1.5. and 9.3.1.6., it appears that the most used construction materials, both the primary as well as the secondary, have average leaching values which lie well below the standard for the route in the direction of the sediment bed of the surface water. From these tables can also be deduced that the construction materials currently most used in the waterway construction can still meet the leaching standards for the route in the direction of the surface water with a much lower flow rate than at the turn-around point D (see tables 9.3.1.3. and 9.3.1.4.).

In the tables 9.3.1.3. and 9.3.1.4., the turn-around points D (turn-around point = flow rate, whereby the allowable burdening for the route in the direction of the sediment bed of the surface water and in the direction of the surface water are equal to eachother) are reproduced for the model situations above. At the same time, the allowable emission of compounds from construction materials at this turn-around point is also indicated.

From these tables 9.3.1.3. and 9.3.1.4. it appears that, depending on the situation and the leaching compound, with a flow rate around 1 m^3/s or (much) lower, a turn-around of the evaluation according to the standard setting for the route to the sediment bed of the surface water takes place, to an evaluation according to the standard setting for the route to the surface water.

In the tables 9.3.1.5. and 9.3.1.6., a survey is then given of the emissions of the primary and secondary construction materials most used in the waterway construction (table 9.3.1.2.), and how these leaching values lie in comparison to the standard setting for the route in the direction of the sediment bed of the surface water.

Table 9.3.1.3. Turn-around point D, and the accompanying emission.

Element	Non-prefabricated Construction Materials				
	The flow rate, whereby the allowable emission to the surface water and the sediment bed of the surface water are equal to eachother (turn-around point D, whereby E-surface water = E-sediment bed) [m^3/s]				The accompanying allowable emission E [mg/kg]
	Example A	Example B	Example C	Example D	
As	0.15	0.04	0.01	0.01	0.83
Ba	0.11	0.03	0.01	0.00	5.5
Cd	1.27	0.32	0.08	0.05	0.033
Co	0.77	0.19	0.05	0.03	0.43
Cr	0.21	0.05	0.01	0.01	1.27
Cu	1.12	0.28	0.07	0.04	0.73
Hg	1.19	0.30	0.07	0.05	0.018
Mo	0.16	0.04	0.01	0.01	0.29
Ni	0.52	0.13	0.03	0.02	1.10
Pb	0.35	0.09	0.02	0.01	1.93
Sb	0.06	0.01	0.00	0.00	0.045
Se	0.53	0.13	0.03	0.02	0.044
V	0.53	0.13	0.03	0.02	1.34
Zn	0.90	0.22	0.05	0.04	3.9
Br	0.00	0.00	0.00	0.00	2.9
Cl	0.03	0.01	0.00	0.00	682
F	0.03	0.01	0.00	0.00	13.3
SO_4	0.04	0.01	0.00	0.00	805

Table 9.3.1.4. Turn-around point D and the accompanying emission

Element	Prefabricated Construction Materials				
	The flow rate, whereby the allowable emission to the surface water and the sediment bed of the surface water are equal to eachother (turn-around point D, whereby E-surface water = E-sediment bed) [m^3/s]				The accompanying allowable emission E [mg/m^2]
	Example A	Example B	Example C	Example D	
As	0.06	0.02	0.004	0.002	41
Ba	0.06	0.02	0.004	0.002	609
Cd	0.08	0.02	0.01	0.003	1.1
Co	0.22	0.06	0.01	0.01	29
Cr	0.11	0.03	0.01	0.004	140
Cu	0.26	0.07	0.02	0.01	51
Hg	0.20	0.05	0.01	0.01	0.4
Mo	0.02	0.01	0.001	0.001	14
Ni	0.08	0.02	0.01	0.003	50
Pb	0.07	0.02	0.004	0.003	120
Sb	0.03	0.01	0.002	0.001	3.7
Se	0.04	0.01	0.003	0.002	1.4
V	0.69	0.17	0.04	0.03	228
Zn	0.15	0.04	0.01	0.01	200
Br	0.00	0.00	0.00	0.00	29
Cl	0.003	0.001	0.00	0.00	36000
F	0.01	0.003	0.001	0.001	1325
SO_4	0.008	0.002	0.00	0.00	54000

Table 9.3.1.5. The leaching values of non-prefabricated primary and secondary construction materials in the waterway construction and the standard setting for the sediment bed of the surface water.

Element	Non-prefabricated Construction Materials		
	Allowable emission: E(L/S=10) sediment bed [mg/kg]	Emission primary construction materials* [mg/kg]	Emission secondary construction materials* [mg/kg]
As	0.83	0.19	0.12
Ba	5.5	0.50	1.6
Cd	0.033	0.002	0.001
Co	0.43	0.02	0.09
Cr	1.27	0.12	0.18
Cu	0.73	0.06	0.11
Hg	0.018	0.001	0.002
Mo	0.29	0.17	0.1
Ni	1.1	0.11	0.09
Pb	1.93	0.02	0.08
Sb	0.045	0.03	0.04
Se	0.044	0.02	0.008
V	1.34	0.3	0.22
Zn	3.9	0.2	0.19
Br	2.9	nb	nb
Cl	682	16	483
F	13.3	0.5	nb
SO_4	805	443	376

* = the highest value taken from a range of the average leaching values of the primary and secondary construction materials most used in the waterway construction, see also the survey of construction materials in Part 2.

nb = undetermined, because of the absence of data.

Table 9.3.1.6. The leaching values of prefabricated primary and secondary construction materials in the waterway construction and the standard setting for the sediment bed of the surface water.

Element	Prefabricated Construction Materials		
	Allowable emission E (64 days) sediment bed [mg/m^2]	Emission primary construction materials* [mg/m^2]	Emission secondary construction materials* [mg/m^2]
As	41	6.9	0.27
Ba	609	33	5.2
Cd	1.1	0.7	0.13
Co	29	nb	nb
Cr	140	3.2	4.9
Cu	51	2.1	1.5
Hg	0.4	nb	0.03
Mo	14	2.2	10.4
Ni	50	17.4	0.75
Pb	120	0.9	0.55
Sb	3.7	0.6	nb
Se	1.4	0.8	nb
V	228	40	101
Zn	200	9.1	4.0
Br	29	nb	nb
Cl	36000	10880	nb
F	1325	272	74
SO_4	27000	1659	213

* = the highest value taken from a range of the average leaching values of the primary and secondary construction materials most used in the waterway construction, see also the survey of construction materials in Part 2.

nb = undetermined, because of the absence of data.

9.3.2 Turn-around point of the decisive admission capacity of pollutions from flow rate, to water system volume (turn-around point V)

In the definition of the allowable immission in the surface water (chapter 6.3.), a temporary increase of 10% of the limit value is related to the period of 4 days, so that it was possible to relate the calculated increases to values for the acute toxicity. The measure of the allowed

increase with respect to the limit values is such that the levels at which acute toxic effects can occur, will not be exceeded. The standard setting, therefore, takes into account a refreshing of the burdened surface water once or more than once during 4 days. When the flow rate becomes very low and the burdened surface water is not refreshed once during 4 days, a turn-around point V is reached whereby the volume of the burdened surface water becomes the most important parameter. Since more factors play a role, an exact turn-around point is generally not to be indicated, for there is a gradual transition. It is not easy to indicate the burdening of the surface water in an equation, because both the method by which the emission is released in time and place as well as the manner of stream-through and mixing in the water system are of importance. It is possible, though, to indicate a theoretical turn-around point ("turn-around point V") around which the transition will take place. This point agrees with the flow rate, whereby the water system is refreshed in 4 days; mixing takes place immediately, and the emission characteristic occurs according to an e-power (see chapter 9.1 and 9.2.). In the overview containing the characteristics of the example situations (see table 9.1.3.2.), this turn-around point is indicated for each example.
The allowable burdening in relation to the volume of the water system is given in tables 9.3.2.1. and 9.3.2.2. for each of the 4 examples.
With flow rates lower than the those belonging to the turn around point V, the allowable burdening is constant and therefore independent of the flow rate. For some construction materials, the emission of compounds into the surface water according to the above-mentioned approach is such, that the emission to the sediment bed of the surface water is decisive with each flow rate. In the tables 9.3.2.1. and 9.3.2.2., the leaching values for the primary and secondary construction materials most used are given. From these, it appears that the leaching of the regular construction materials usually lies well below the standards. This means that the chance is small that the emission to the surface water becomes decisive in stagnant water or very slow streaming water. For application of the most regular construction materials, there is no reason to add to general regulations a complicating evaluation system to the testing system for the sediment bed of the surface water, seeing these indicative calculations.
With "completely still-standing" water or water which streams very slowly (refreshing time >>4 days), the emission can still contribute also after 4 days, which, however, is relatively limited compared to the first leaching. In this report, this is not further worked out.

Table 9.3.2.1. Allowable emissions for non-prefabricated construction materials in relation to the volume of the water system and the leaching values of the most regular primary and secondary construction materials.

Element	Non-prefabricated Construction Materials						
	Allowable emission, dependent on the water system volume (turn-around point V) [mg/kg]				Emission primary construction materials* [mg/kg]	Emission secondary construction materials* [mg/kg]	Allowable emission soil with E** [mg/kg]
	Example						
	A	B	C	D			
As	0.80	1.6	2.0	1.0	0.19	0.12	0.83
Ba	7.2	14.4	18.0	9.0	0.50	1.6	5.5
Cd	0.004	0.008	0.009	0.005	0.002	0.001	0.033
Co	0.08	0.16	0.20	0.10	0.02	0.09	0.43
Cr	0.86	1.7	2.2	1.1	0.12	0.18	1.27
Cu	0.09	0.19	0.24	0.12	0.06	0.11	0.73
Hg	0.002	0.004	0.005	0.003	0.001	0.002	0.018
Mo	0.26	0.52	0.65	0.32	0.17	0.10	0.29
Ni	0.30	0.61	0.76	0.38	0.11	0.09	1.1
Pb	0.81	1.6	2.0	1.0	0.02	0.08	1.93
Sb	0.11	0.22	0.28	0.14	0.03	0.04	0.045
Se	0.01	0.02	0.03	0.02	0.02	0.008	0.044
V	0.36	0.73	0.91	0.45	0.30	0.22	1.39
Zn	0.63	1.3	1.6	0.78	0.20	0.19	3.9
Br	208	415	520	260	nb	nb	2.9
Cl	3316	6631	8290	4145	16	483	682
F	56	113	141	71	0.5	nb	13.3
SO_4	2735	5469	6836	3418	443	376	805

* = the highest value from a range of average leaching values (at L/S=10) of the primary and secondary construction materials most used in the waterway construction, see also the survey of construction materials in Part 2.
** = according to table 9.3.1.3. when L/S=10
nb = undetermined because of the lack of data.

Explanation with the table:
If in the examples A, B, C, or D, there are values higher than the values in the last column, then for the example for the compound concerned, the allowable emission to the sediment bed of the surface water (the last column) remains decisive, since the construction materials must meet at least this standard.

Table 9.3.2.2. Acceptable emission prefabricated construction materials in relation to the volume of the water system and the leaching values of the regular primary and secondary construction materials.

Element	Prefabricated Construction Materials						
	Allowable emission, dependent on the water system volume (turn-around point V) [mg/m²]				Emission primary con-struction materials* [mg/m²]	Emission secondary con-struction materials* [mg/m²]	Allowable emission soil with E** [mg/m²]
	Example						
	A	B	C	D			
As	95	191	238	119	6.9	0.27	41
Ba	1429	2857	3571	1786	33	5.2	609
Cd	1.9	3.8	4.8	2.4	0.7	0.13	1.1
Co	19	38	48	24	nb	nb	29
Cr	191	381	476	238	3.2	4.9	140
Cu	29	57	71	36	2.1	1.5	51
Hg	0.3	0.6	0.7	0.4	nb	0.03	0.4
Mo	95	191	238	119	2.2	10.4	14
Ni	95	191	238	119	17	0.75	50
Pb	238	476	595	298	0.9	0.55	120
Sb	19	38	48	24	0.6	nb	3.7
Se	4.8	9.5	12	6.0	0.8	nb	1.4
V	48	95	119	60	40	101	228
Zn	191	381	476	238	9.1	4.0	200
Br	76191	152381	190476	95238	nb	nb	29
Cl	1904762	3809523	4761904	2380952	10880	nb	36000
F	14286	28571	35714	17857	272	74	1325
SO_4	952381	1904761	2380952	1190476	1659	213	54000

* = the highest value from a range of average leaching values (during 64 days) of the primary and secondary construction materials most used in the waterway construction, see also the survey of construction materials in Part 2.
** = according to table 9.3.1.4. during 64 days
nb = undetermined because of the lack of data.

Explanation with the table:
If in the examples A, B, C, or D, there are values higher than the values in the last column, then for the example for the compound concerned, the allowable emission to the sediment bed of the surface water (the last column) remains decisive, since the construction materials must meet at least this standard.

9.3.3 Standard setting in relation to the turn-around points D and V

The data from the previous tables can be joined in one diagram per example-situation, per compound, and for non-prefabricated and prefabricated construction materials. Below, a diagram is given (figure 9.3.3.1.) for the burdening of a water system with a compound. In this diagram, the vertical axis shows the emissions, and the horizontal the flow rates.

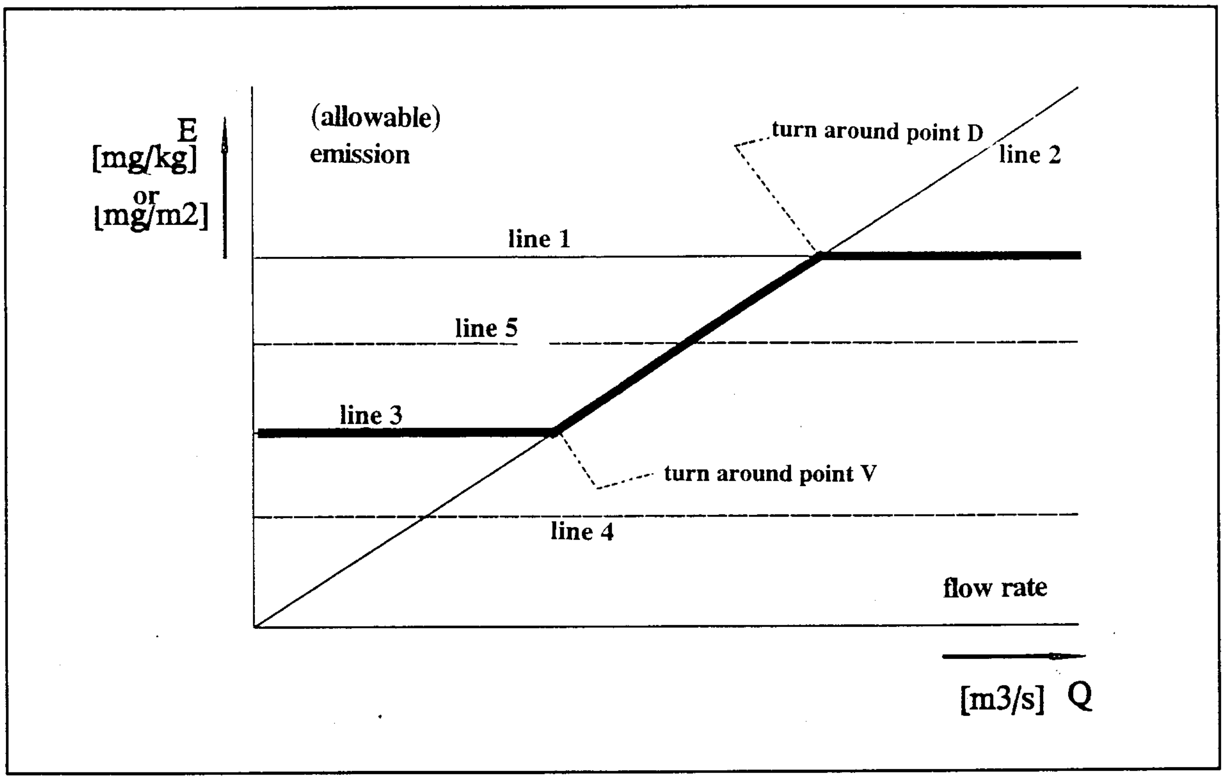

Figure 9.3.3.1

Legend for figure 9.3.3.1.:

Line 1:	the extended horizontal line 1 indicates the allowable burdening for the route in the direction of the sediment bed of the surface water (E_{max} sediment bed) with various flow rates.
Line 2:	the diagonal line 2 through the source indicates the allowable burdening for the route in the direction of the surface water (E_{max} surface water) with various flow rates, without taking into account the volume of the water system.
Turn-around point D:	the meeting point of these lines is the turn-around point D.
Line 3:	With the horizontal line 3, then, the allowable emission in the direction of the surface water is reproduced, based on the volume of the water system (E_{max} volume) with flow rates smaller than the turn-around point V.
Turn-around point V:	the meeting point of line 3 and line 2 is the turn-around point V.
Line 4/5:	in this figure, in the horizontal lines 4 and 5, the highest and average values for regular primary (E_{max} primary) and secondary construction materials (E_{max} secondary) respectively are given. From the examples in the tables 9.3.2.1. and 9.3.2.2. it appears that there are situations for which the route to the sediment bed of the surface water is decisive for each flow rate. In that case, the lines 4 and 5 always lie below line 1 and 3.
Thick line:	the composed line which determines the standard setting is reproduced as a thick line, so that now for each flow rate, the allowable emission can be seen.

9.3.4 The results of the calculations and reproduced data

From the calculations which were carried out and the reproduced data, the following can be said and concluded:

- As the stream-through decreases in small waters, a turn-around point can be reached under which the allowable burdening becomes lower than the allowed burdening for the route in the direction of the sediment bed of the surface water.
- The most regular primary and secondary construction materials in the waterway construction in general meet the lower burdening requirement of surface waters allowable for small waters.
- For those cases in which the presented standard is met for the route in the direction of the surface water based on the volume (and flow rates below the turn-around point V), a remark must be made concerning the time span of the burdening. For, with a minute through-streaming, the duration of an exposure around the 10% level of increase will last much longer than with an evaluation based on only the flow rate. With very small flow rates (Example D), the increase can last for perhaps even many months. In other cases, it is a question of days or weeks. This means that for surface waters with a very minute streaming, such as closed off ditches, fens, ponds, etc., larger constructions or constructions following eachother relatively quickly must be considered with reservation. This reservation can also lead to a preference for the lesser leaching construction materials if there are various alternatives for the construction materials. The care will be dependent on the ecological or other specific importance of the waters, and on the water quality.
- Primary and secondary construction materials which, concerning leaching, just meet the evaluation method recommended for the Building Materials Decree according to the route to the sediment bed of the surface water, can, in many cases, lead to an increase of more than 10% of the limit values, and therefore can lead to undesired influencing of the surface water.
- The actually occurring increase of the contents of compounds in the surface water is strongly dependent on a number of factors/characteristics, as the previous has shown. This would probably be workable with the use of a complicated equation. It also appears, however, that the primary and secondary construction materials most used, mostly meet the desired requirements.

  For simplicity's sake, it is suggested, however, not to introduce separate evaluation methods for smaller flow rates and to use the evaluation suggested for the route in the direction of the sediment bed of the surface water.

- For waters with a very minute streaming and/or a great (ecological) sensitivity or having a specific function, the provinces have the possibility to formulate specific demands in a regulation based on the Environmental Protection Law, whereby these waters can be sufficiently protected in case certain construction materials or large constructions are being contemplated.
- For the remaining waters, it is assumed that the number of cases in which the desired limits would be exceeded unacceptably will be very limited, partly due to the reservation with which the carrying out of large constructions will be approached, and/or the choice of the construction materials to be used. A separate standard setting (other equations than those for the route in the direction of the sediment bed of the surface water) is not necessary.

Further specific remarks:

- In the standard setting for the various flow rates, it appears that it is of little importance to use an equation around the turn-around point V in which an allowable burdening according to streaming based on the flow rate and according to the volume present (based on the water system volume) is combined. Depending on the specific hydrological characteristics of the surface water concerned, only a part of the "volume room" could be added up with the "flow rate room", or vice versa. The combination is only of importance with a short flow rate under and above the turn-around point V. The developing and application of a combination equation demands a disproportionate effort.
- For several compounds, it appears that the standard setting on the basis of the volume of the water system, leads to a higher allowable burdening than the allowable burdening based on the route in the direction of the sediment bed of the surface water. This occurs with Ba, Sb, Cl, F, and SO_4. For such compounds, no restrictions would have to be valid for these example cases concerning their application in small waters, except that the increasing of the concentrations due to burdening can last relatively long depending on the streaming still present, and therefore, in some cases can lead to problems. Such construction materials, must, of course, meet the maximum allowable emission requirements based on the route in the direction of the sediment bed of the surface water.
- Aside from the possibilities which the province has for formulating more specific demands,

developing such possibilities in the area of general rules based on the WVO is also being considered at the moment. At a later point in time (for example with a possible adjusting of the Building Materials Decree), for applications in surface waters, these possibilities can be included in the Building Materials Decree.

9.4 Results and conclusions

In contrast to applications on the dry soil, various routes of influencing by the environment can take place with applications in surface water. There is distinction between the route in the direction of the sediment bed of the surface water and a route in the direction of the surface water.
Both routes are worked out in calculation rules for an approach of the emissions occurring in actual practice. Furthermore, in previous chapters, maximum allowable emissions are given. For the route in the direction of the surface water, the allowable immission is dependent on the flow rate: with a decreasing flow rate, the allowable emission decreases. The route in the direction of the sediment bed of the surface water appears, up to low flow rates, to be decisive for the quality standards which the construction materials must meet.
With decreasing flow rate, the allowable emission decreases proportionally. Below a certain flow rate, it would not even be possible to still be able to apply primary construction materials with a low leaching, if only the flow rate is taken into account. Besides the flow rate, the water present (volume water system) can also take up leached compounds. Keeping this in mind, the most regular primary and secondary construction materials in the wet waterway construction can be used without hardly any problems at all. In the Netherlands, there is no mention of completely still-standing water. There is always a certain amount of refreshing as the result of rainwater and groundwater streaming. Often there is a connection and/or exchange with surface waters. As a result, there is always a combination of the "flow rate factor" and the "volume factor" with small surface waters.The limit for the flow rate below which the route to the surface water is decisive lies around 1.0 m^3/s. This would mean that for a small range of surface water flow rates, it is necessary to calculate also the route to the surface water aside from the route to the sediment bed of the surface water to determine the maximum allowable emission. Within this range it is also necessary with lower flow rates to look more closely at the route for the surface water in relation to the volume of the water system. This makes the evaluation in this range of flow rates complex. Since the

most regular construction materials in the wet waterway construction can also be applied in smaller surface waters without too many problems, the choice is made to leave the evaluation according to the route in the direction of the surface water, also in the range of flow rates below 1 m^3/s.

The advantages of this are:

- a great simplification in the evaluation of construction materials.
- no list of surface waters and flow rates is necessary.
- no below margin flow rate or allowable emission and/or indication of construction materials which can always be applied in surface water;
- missing limit values surface water quality do not create a problem in the evaluation.

The equations for the route in the direction of the sediment bed of the surface water en therefore for the evaluation of construction materials which are used in the waterway construction are as follows:

non-prefabricated construction materials:

$$E_{max}(L/S=10) = E_{soil} + \frac{I_{max}(J\ yr)}{d_c * h * f_{ext.n}(h,N_i,\kappa)} \tag{9.4.1}$$

In which:

$$f_{ext.n} = \frac{e^{-\kappa * 0,1} * (1 - e^{-\kappa * \frac{N_i * t}{d_c * h}})}{1 - e^{-\kappa * 10}} \tag{9.4.2}$$

The difference with the equations for the dry soil is that here, a first leaching, which always goes to the surface water is kept in mind, and that the effective infiltration is 600 mm/yr instead of 300 mm/yr.

prefabricated construction materials:

$$E_{max}(64\ days) = \frac{I_{max}(J\ yr)}{f_{ext.v}(x\%,D_e) * f_{tem}} \tag{9.4.3}$$

This equation is exactly the same as that for the dry soil, for the evaluation of prefabricated construction materials there are, therefore, no differences.

10. EVALUATION STANDARDS

In this chapter, four points are discussed, namely: a) the emission from construction materials which still takes place after the period which is mentioned in the definition of marginal burdening, b) an evaluation of the allowable emissions to the groundwater, c) the relationship between the ability to take back and the composition of the construction material, and d) summary of the research to the leaching in the practice in comparison with the leaching in the lab.

10.1 Emission after 100 years

10.1.1 Non-prefabricated construction materials

In this paragraph is researched as to which rest-emissions are still to be expected according to the leaching model used, after the period which is mentioned in the definition of marginal burdening. The leaching percentages P(t) are calculated for each period of 25 years with the equation below.

$$P(t) = 100 * (1 - e^{-\kappa * \frac{t * N_i}{d_c * h}}) \qquad (10.1.1)$$

t = time (yr)
d_c = dry density of the construction material (1550 kg/m^3)
h = total thickness of the construction layers consisting of roughly the same construction material (m)
N_i = infiltration (mm/yr)
κ = constant (measure of the rate of leaching)

In figure 10.1., the leaching percentages for an open application of non-prefabricated construction materials in connection with the total leached load per 25 years are given for four compounds.

To get an impression of the metals not mentioned in figure 10.1., the method is as follows. In table 8.1.1., find the κ, and in figure 10.1., find the compound with the κ which lies the closest to this. For the filling in of the various values in the equation, refer to chapter 8.

In conformity with the equation, the emission of the metals reduces, and takes place for the most part during the first 100 years. Compounds with a kappa greater than 0.1. barely leach anymore after 100 years. Arsenic leaches the longest.

The conclusion that marginal burdening of the soil is restricted to the first 100 years for the most compounds is justified.

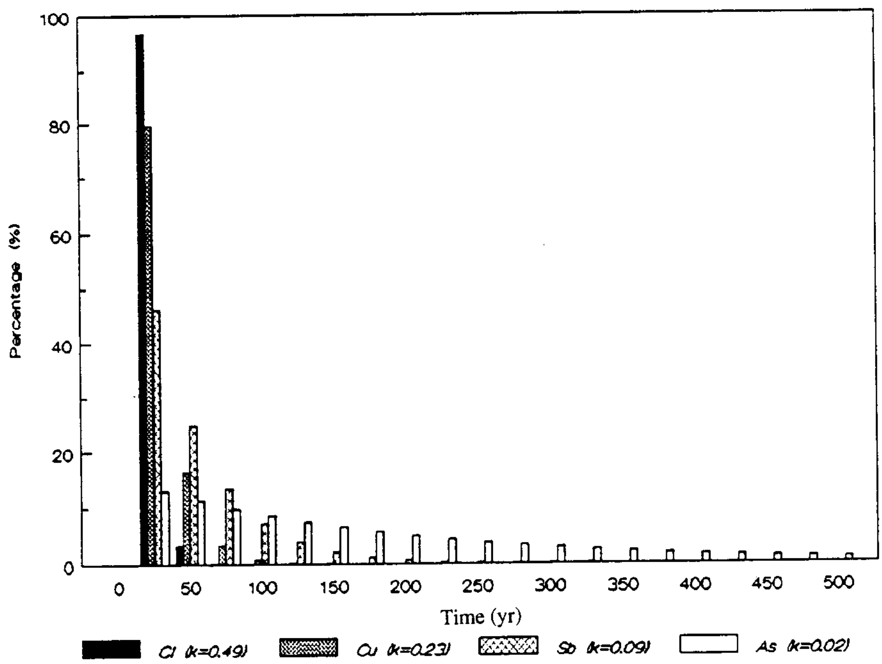

Figure 10.1. Leaching (%) of Cl, Cu, Sb, and As per 25 years.

10.1.2 Prefabricated construction materials

The leaching emission as the result of diffusion from prefabricated construction materials reduces during time. The leaching emissions after the period of 100 years, on which the definition of marginal soil burdening is based, is calculated with the same equation as in 8.2.2.:

$$E(t) = E_{avail} * d_c * (D_e / \pi) * \sqrt{t} \qquad \textbf{(10.1.2.1)}$$

The emission during several years is the sum of the emissions per year, whereby the pD_e is raised each year with a 1/100 unit. With this equation is calculated that the largest part of the emission takes place in the first 100 years. The emission during a following period of 100 years is only 5% of the emission during the first 100 years.

10.2 Emission to the groundwater

In order to be able to quantify the exact immission to the groundwater, the behaviour of the compounds in the soil must be kept in mind. The horizontal and vertical transportation, as well as the dilution of the percolate with the groundwater, is dependent on the chemical, physical, and geohydrological characteristics of the soil (such as absorption, dispersion, diffusion, concentration of the compounds in the groundwater, and the flow rate). The measure in which the absorption of metals takes place, is also determined by other compounds which leach from the construction materials. Especially macro elements such as calcium and magnesium can increase the mobility of the micro elements in the soil. The behaviour of compounds from construction materials in the soil is momentarily being studied by RIVM. the results of this study will be available in 1994 (see chapter 10.6).

Studies at dump sites have shown that for chloride and sulphate, the emission especially takes place to the groundwater. A standard setting based on the groundwater is more logical than a standard setting based on the soil, such as is applied for metals. In the standard setting in the Building Materials Decree, only chloride and sulphate are based on the target value groundwater quality. In table 10.3., both the immissions based on marginal soil burdening, as well as immissions based on marginal groundwater burdening, are showed. The calculations are carried out according to the equation in chapter 7.

Table 10.3 Comparison of allowable emissions of metals to the soil with the "allowable emissions of metals" to the groundwater in case this is calculated in the same way as for Cl and SO_4.

metal	soil			groundwater		
	Immission maximum (mg/m^2) per 100 years	non-prefabricated category 1 E-max (L/S=10) mg/kg	prefabricated category 1-A E-max mg/m^2	maximum immission (mg/m^2) per 1 year	non-prefabricated category 1 E-max (L/S=10) mg/kg	prefabricated category 1-A E-max mg/m^2
As	435	0.88	41	3	0.79	1.8
Ba	3000	3.1	290	15	1.16	8.9
Cd	11.8	0.032	1.1	0.12	0.02	0.07
Co	300	0.42	29	6	0.27	3.6
Cr	1500	1.3	140	0.3	0.09	0.2
Cu	540	0.72	51	4.5	0.30	2.7
Hg	4.5	0.018	0.4	0.015	0.02	0.009
Mo	150	0.28	14	1.5	0.16	0.9
Ni	525	1.1	50	4.5	0.68	2.7
Pb	1275	1.9	120	4.5	0.85	2.7
Sb	39	0.045	3.7			
Se	15	0.044	1.4			
Sn	300	0.27	29	3	0.08	1.8
V	1020	0.9	97			
Zn	2100	3.8	200	19.5	2.23	12
Br	300	2.9	29	90	3.47	54
Cl	3000	54	286	30000	240	17857
F	7500	7.3	710	150	3.58	89
SO_4	2250	120	214	45000	576	26786
CN-tot	75	0.067	7.1	3	0.03	1.8
CN-free	15	0.013	1.4	1.5	0.01	0.9

From the table it appears that the "allowable emission" for chloride and sulphate, calculated on the basis of marginal soil burdening, is very low (column 3 and 4). These compounds are low in the soil because they flush out immediately to the groundwater.

The "allowable emissions" for the remaining compounds, calculated on the basis of marginal groundwater burdening, lie on an equal or slightly lower level than those calculated on the basis of marginal soil burdening. In fact, it appears that the groundwater for metals on the basis of marginal soil burdening is protected in an acceptable way, since a levelling takes place there by way of absorption and dispersion.

10.3 Barium, fluoride and vanadium

The critical compounds fluoride and vanadium are typical when it comes to phosphor slag and LD slag respectively. Noticeable is the exceeding of barium with respect to the allowable exceeding of barium for construction materials for cement aggregate without addition. The raw materials cement, water, sand and gravel, which are used for the making of cement aggregate, do not show an exceeding of barium. The same phenomenon occurs with cement aggregate with E fly ash. The E fly ash with a high content of barium does not show an exceeding while cement aggregate with E fly ash does exceed the standard for construction materials. The measure of exceeding for cement aggregate with E fly ash is a little higher than for cement aggregate without addition, but lower than would be expected on the basis of the composition. Apparently barium in cement aggregate is more mobile than in the individual raw materials, and for barium there is no direct relationship between the composition and the leaching. To continue the re-use of the construction materials phosphor slag, LD slag and cement aggregate without addition as category 1 or as a category 1 construction material, the maximum allowable immissions for barium, fluor, and vanadium have been adjusted by VROM.

10.4 Evaluation of the allowed immission to the surface water

Two situations can be distinguished, namely:

a. The construction material is leached by percolating and along streaming surface water with concentrations below or on the limit values for surface water quality. In the first 4 days, the concentrations are increased to a maximum of 110% of the limit values. Thereafter, the concentrations reduce quickly. Seeing the temporary character of the increase and the measure of the increase, there are no objections to this. The time period is comparable with that at which acute toxicity will reveal itself, while the absolute occurring concentrations remain well below the acute toxicity values.

b. The construction material is leached by percolating and along streaming surface water with concentrations above the limit values. The concentrations already too high are increased even more. No insuperable extra effects of the limited, temporary increase of the concentrations are to be expected. With the policy of achieving a further improvement of the surface water quality, this situation will occur increasingly less, and over time will not occur at all anymore.

10.5 The relationship between the ability to take back and the composition

The oBB prescribes that the construction materials to be applied, distinguished between prefabricated construction materials and granular construction materials, must be evaluated on the leaching behaviour of compounds and the composition. The two criteria mentioned are parameters which can contribute to the exceeding of the marginal soil burdening. In this paragraph the relationship between the "maximum allowable mixing" of the construction materials not taken back with the underlying soil and the composition of the construction materials is explained. Decisive for the relationship is the marginal soil burdening in conformity with the Building Materials Decree. The calculations concern the inorganic combinations of both prefabricated as well as granular construction materials. It must be emphasized that in the mathematical reproduction, the contribution to the marginal soil burdening as the result of leaching is not taken into account. The maximum allowable immission of compounds can be translated into the maximum allowable mixing of construction materials with the underlying soil according to the equation below:

$$Wi_{max} = \frac{I_{max}}{S} = \frac{0.01 * d_s * T_s * 1000}{s} \qquad \textbf{(10.5.1)}$$

Wi_{max}	= maximum allowable mixing of the construction material with the soil. (g/m^2.J years)
I_{max}(J yr)	= maximum allowable immission into the soil of compound M in J years (mg/m^2.J years).
T_s	= target value for the soil quality of compound M (mg/kg, table 4.1).
d_s	= 1400 kg/m^3; average dry-density of the soil.
S	= Composition limit of compound M according to oBB.

This equation reproduces the mathematical relationship between 1) the "maximum allowable mixing" in the soil of weight amounts (mg) of construction materials not taken back per surface area unit (m^2) in the top meter layer during a period of 100 years - fully in conformity with the criterium of the marginal soil burdening from the Building Materials Decree - and 2) the composition of a construction material to be applied (mg/kg) according to oBB.

The results of the calculations are mentioned in table 10.7. If the leaching of compounds from construction materials is not kept in mind, then it is permitted, on the basis of the critical compound barium, that a maximum of 373 grams of the non-prefabricated construction materials with a composition which is equal to the composition margins in the Building Materials Decree, is not taken back during 100 years per square meter in the top meter layer of the soil. For prefabricated construction materials, this is 187 grams.

Table 10.7. "Maximum allowable mixing" of construction materials (kg construction material/m^2) with the soil.

compound	non-prefabricated construction material	prefabricated construction material
As	1.083	0.541
Ba	0.373	0.187
Cd	1.099	0.550
Co	1.120	0.560
Cr	1.120	0.560
Cu	1.344	0.672
Hg	0.846	0.423
Mo	1.120	0.560
Ni	1.960	0.980
Pb	0.952	0.476
Sb	0.728	0.364
Se	0.560	0.280
Sn	1.120	0.560
V	0.762	0.381
Zn	1.568	0.784
Br	0.560	0.280
Cl	0.560	-
CN-tot	0.560	0.280
CN-free	0.560	0.280
F	1.556	0.778
SO_4	0.280	0.175

During the demolition of a construction, it is profitable for the demolition company to leave as much material behind as possible (extra dumping costs). It is necessary, therefore, to set requirements for the dumping, so that it is prevented as much as possible that construction materials which must be applied as being able to be taken back, becomes soil.

Note: the marginal burdening as the result of construction materials left behind is added to the burdening caused by leaching. For a road base with a thickness of 50 cm, the weight of the road base is approximately 1000 kg per m^2. Per kg road base, 0.04 (m/m%) and 0.02 (m/m%) respectively may be left behind. According to RWS-DWW, these values lie between 0.01 - 2 (m/m%) in actual practice. If a construction material is not taken back carefully enough, then the marginal burdening is mainly "used up" by mixing of the construction material left behind (with composition S1) and the underlying soil. More careful removal will result in construction waste which is mixed relatively much with clean soil. It is suggested to indicate by way of a regulation how carefully the taking back of a construction must take place after the finishing of its application.

10.6 Summary of the results of the research to the relation between leaching in the lab and leaching in practice

Research founded by CROW (reported in INTRON report no. 95146)

For the environmentally acceptable application of primary and secondary construction raw materials regulations are in preparation in the framework of the Soil Protection Act (WBB) and the Act Contamination Protection of Surface waters (WVO): the Building Materials Decree. A theoretical relation has been made between the desired protection level of soil and surface water on the basis of leaching tests in the laboratory and a translation of laboratory conditions to field conditions. Since a direct translation of laboratory data to field conditions is not possible, correction factors to compensate for the differences have been derived by RIVM. This relates in particular to the difference in temperature between the laboratory and the field situation. Another factor relates to the degree of contact with water in practical applications, where the construction material is not continuously exposed to water contact as in the laboratory test. To verify the agreement between predictions based on laboratory test data and data obtained from field observations in road base applications, a study has been carried out on characteristic road base applications, where coal fly ash and municipal solid waste incinerator waste materials have been applied as stabilization layer. This study is the first extensive field verification of impact from the application of secondary materials coal fly ash and MSWI bottom ash - in construction applications. The study was carried out by RIVM, ECN, and Intron.

Aim

The aim of the study is to verify the leaching behaviour in field applications of secondary materials in road base applications with that of laboratory leaching data on the same construction material.

This implies the following activities:

- measuring the release under field conditions
- establishing the main transport mechanisms
- calculation of release (immission) according to the Building Materials Decree
- comparison of calculated and measured release in the field

Description of the study

For the verification study of leaching under field conditions two locations have been selected where leaching has taken place under relatively undisturbed conditions for a long period (more than 10 years). The selected sites consist of a topcover (asphalt cement, sand or concrete paving blocks), a stabilization layer consisting of a secondary construction material (coal fly ash cement, stabilised MSWI bottom ash or MSWI bottom ash) and an underlying sand layer. The coal fly ash stabilization has been applied in the Coloradoweg (Maasvlakte) under both an asphalt cover and a sand cover layer. The MSWI bottom ash stabilization (FENIKS and regular MSWI bottom ash) have been applied in the Vondelingenweg (Rotterdam) under a pavement of concrete blocks. For the comparison of the measured release under field conditions with predictions, it is important to determine the release mechanism before assessing release in mg/m^2. A statistical evaluation of the field data is needed to be able to draw conclusions. This implies that for each location to be assessed 10 cores have been taken through the topcover, the stabilization layer well into the underlying soil.

Each core consisting of the stabilization layer and the sandy subsoil has been sampled in the laboratory by slicing it in thin segments. These have been analyzed to obtain a vertical concentration profile in the construction material and in the underlying soil. This allows a calculation of release when the density of the soil and the background concentration in the soil is known. In addition to the concentration measurements, leaching experiments (column and availability test) have been carried out on the field exposed material.

Three approaches have been followed to assess the release from the secondary construction material:

A. Release calculated from a decrease in concentration of the secondary construction material.
B. Release calculated from an increase in the soil concentration or groundwater composition relative to the local background.
C. A comparison of leaching from fresh and field-exposed secondary construction material

From the measurements of leachate collected over the first 2 years after placement a release of mobile compounds and a field L/S ratio can be calculated. Based on a few assumptions this can be extrapolated to an estimated release after 11 years exposure.

Besides the actual release, the mechanism of release - diffusion or percolation ~ is very important for the comparison of predicted release with measured field data, as the prediction model requires a choice for one mode of transport of contaminants. The leaching mechanism can be predicted on the basis of the water transport at the location under study and can be verified with the geochemical transport model ECOSAT. The study of the water transport will provide an estimate of the field L/S ratio and possible interferences such as fluctuations in the groundwater level reaching the interface of soil and construction material.

According to the methods specified above the release under field conditions is compared with calculations of release following the calculation rules specified in the Building Materials Decree (according to this report) for respectively a percolation dominated regime and a diffusion dominated regime. For all means of determining a release either by modelling or by measurement uncertainties need to be established. As starting point for the predictions leaching data of the fresh secondary construction material, the time of application and the height of the application are used. For all calculations standard values have been applied, which implies that all calculations are in accordance with the Building Materials Decree and the formulas developed by RIVM/RIZA.

At the locations where the secondary materials have been applied extensive sampling has resulted in a large number of concentration profiles for a wide range of elements. Relative to the background values for these elements in reference cores taken beside the road or based on reference values established in the unaffected section at the bottom of the cores, significant increases in soil concentration have been established for several elements. Both in the release determined from measurements as well as in estimates of release based on modelling large variations occur (50 - 100%). In spite of the large variations in measured and calculated emission values for several elements, a reasonable to good comparison is obtained between release in practice and predictions based on laboratory data.

The following conclusions can be drawn from the first large scale verification of the application of secondary materials in construction:

- After 10 years of exposure leaching of contaminants from secondary construction materials can be measured in practice.

- A clear distinction proved possible between diffusion controlled and percolation dominated sections of an application.
- Modelling of transport in the construction material and in the underlying soil using the geochemical transport model ECOSAT has revealed that the release of contaminants from a road section under an asphalt cover by diffusion is lower in practice due to an additional diffusion resistance caused by the unsaturated soil layer under the stabilization layer.
- For lot of elements the agreement between the emission based on the formulas of the RIVM/RIZA report and the measured emission in practice is reasonable to good.
- The methods applied for determining release (method A, B and C) are not equally reliable. The method B, in which the concentration increase in the soil is assessed, is generally the most reliable method. For mobile elements, which are readily transported to the groundwater, the method C provides better estimates of release. Release calculations based on a concentration decrease in the secondary construction material are generally least accurate.
- The difference between predicted and measured release of B, Cd, Co, Pb and Zn is often more than a factor of 5, which is at present not well explained and requires further work. The emissions calculated by RIVM/RIZA appear to be less than the emissions measured in the field.
- In case of a percolating system mobile compounds, such as Mo and sulphate, are not retained in the soil. The measured soil composition leads to an underestimation of actual release. In this case, release based on leachate collection can give a good estimate, but the difference between fresh and exposed construction material is probably the best predictor.
- In case of a diffusion controlled system, method B leads to the best field verification for all materials.

11. THE METHOD OF COMPARING MEASURED EMISSIONS WITH MAXIMUM ALLOWABLE IMMISSIONS

From the Building Materials Decree follows that the construction materials on or in the soil may be applied as long as:

- none of the composition values for organic compounds, as indicated in the Building Materials Decree is exceeded, and
- construction materials are used in such a way that, also if no isolating measures are taken (category 1 construction materials) and if exclusively isolating measures are taken (category 2 construction materials), none of the immission values for inorganic compounds, as indicated in the Building Materials Decree is exceeded.

This means that calculated immissions (I_c) must be determined from the emissions (leaching) measured in the lab (E_{meas}). These must be placed beside the maximum allowable immission (I_{max}). For non prefabricated and prefabricated construction materials, separate, leaching-test-focused equations have been developed, which indicate the difference between the leaching behaviour in actual practice and in the lab (see chapter 8). In the following paragraphs, the equations for the calculated maximum allowable emissions for construction materials, as described in chapter 8, are converted to calculated immissions (I_c). At the same time, the correction factors used for the difference between the leaching in the lab and in actual practice are once again reproduced.

11.1 Calculated immission for non-prefabricated construction materials

The calculated immission is calculated as follows:

$$I_c = d_c * (E_{meas(L/S=10)} - a) * h * f_{ext-N}(h,\kappa,N_i) < I_{max} \qquad (11.1.1)$$

I_{max}	=	maximum allowable immission (mg/m^2).
I_c	=	calculated immission to the soil or the sediment bed of the surface water as the result of the use of a construction material (mg/m^2).
d_c	=	1550 kg/m^3; density of construction material (kg/m^3).
E_{meas}(l/S=10)	=	leaching of a construction material measured in the lab (mg/kg).
$a=E_{soil}$	=	correction factor (see table 11.1.) for the leaching from a construction material in actual practice (mg/kg). For applications in the surface water, this factor is 0.
h	=	the greatest height in which a construction material is applied in a construction (m), with a minimum of 0.2m If the same construction material is applied in several layers, then h is the sum of these layers.
$f_{ext-N}(h,\kappa,N_i)$	=	factor for the extrapolation of the measured emission with L/S=10 with the column test to the emission during 100 years and for Cl and SO_4 during 1 year.

For application on or in the soil is.

$$f_{ext\text{-}N} = \frac{1 - e^{-\kappa * \frac{t * Ni}{1550 * h}}}{1 - e^{-\kappa * 10}} \qquad (11.1.2)$$

For application in the surface water, the route in the direction of the sediment bed of the surface water is decisive, and is:

$$f_{ext.n} = \frac{e^{-\kappa * 0,1} * (1 - e^{-\kappa * \frac{t * N_i}{1550 * h}})}{1 - e^{-\kappa * 10}} \qquad (11.1.3)$$

κ = constant, measure for the rate of leaching (see table 1.2.1.).

N_i = effective infiltration (mm/yr); 300 mm/yr for category 1 construction materials and 6 mm/yr for category 2 construction materials. With the application of category 1 construction materials in surface water, a first leaching, which always goes to the surface water, is taken into account. The effective infiltration is 600 mm/yr instead of 300 mm/yr. Category 2 construction materials remain under a permit regulation for application in surface water.

t = time (year); 1 year for chloride and sulphate, 100 years for the remaining materials.

Table 11.1 Correction factors non prefabricated construction materials for the difference between leaching in the lab and in actual practice.

compound	$a=E_{soil}$	κ	compound	$a=E_{soil}$	κ
As	0.7	0.03	Se	0.03	0.38
Ba	0.9	0.15	Sn	0.03	0.19
Cd	0.021	0.50	V	0.4	0.05
Co	0.18	0.20	Zn	2	0.28
Cr	0.09	0.18	Br	2.6	0.35
Cu	0.25	0.28	Cl	51	0.57
Hg	0.016	0.05	F	1.5	0.22
Mo	0.15	0.35	SO_4	118	0.33
Ni	0.63	0.29	CN-complex	0	0.35
Pb	0.8	0.27	CN-free	0	0.35
Sb	0.02	0.11			

11.2 Calculated immission for prefabricated construction materials

The calculated immission for type A applications, for type B applications and isolated applications are calculated with the following equation:

$$I_c = E_{meas(64d)} * f_{ext\text{-}V}(h,x\%,D_e) * f_{tem} < I_{max} \quad (11.2.1)$$

I_{max} = maximum allowable immission (mg/m²)
I_c = calculated immission in the soil as the result of the use of a construction material (mg/m²)
$E_{meas(64d)}$ = leaching from a construction material measured in the lab (mg/m²)
$f_{ext.V}(h,x\%,D_e)$ = factor for the extrapolation of the leaching measured with the diffusion test to the leaching during 100 years (see table 11.2.).
h = thickness of the prefabricated construction material with a minimum of h=0.1m.
f_{tem} = factor for the difference in temperature with the determining of the leaching of a construction material in the lab and with the use of that construction material (see table 11.2.).

Table 11.2. Correction factors $f_{ext\text{-}V}(h,x\%,D_e)$ and f_{tem} for prefabricated construction materials for the difference between leaching in the lab and in actual practice.

pD_e (rounded off)	category 1 type A (x%=100%)								category 1 type B (x%=10%) and category 2 (x%=10%)								f_{tem}
	$f_{ext.V}$								$f_{ext.V}$								
	Thickness of the construction material (h)								Thickness of the construction material (h)								
	0.1 m	0.2 m	0.3 m	0.5 m	0.7 m	1 m	2 m	10 m	0.1 m	0.2 m	0.3 m	0.5 m	0.7 m	1 m	2 m	10 m	
5	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	2	0.7
6	1	1	1	1	1	1	1	5	1	1	1	1	1	1	1	5	0.7
7	1	1	1	1	1	2	3	15	1	1	1	1	1	2	3	5	0.7
8	1	1	2	2	3	5	10	15	1	1	2	2	3	5	5	5	0.7
9	2	3	5	8	11	15	15	15	2	3	5	5	5	5	5	5	0.7
10	5	10	15	15	15	15	15	15	5	5	5	5	5	5	5	5	0.7
$pD_e \geq 11$	15	15	15	15	15	15	15	15	5	5	5	5	5	5	5	5	0.7
Cl, SO_4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7

Category 1 construction materials are distinguished according to the type of application, namely A and B applications (see chapter 8).

A construction material in a type A application is virtually always wet. Examples of this type of application are an embankment/bank/quay, a road base, a street or a (part of a) wall which can be wetted by surface water or groundwater (also with capillary action of the soil).

A construction material in a type B application is only periodically wet, depending on the atmospheric conditions. Examples of this type of application are: a roof, a closed road surface, a street or (the top part of) a wall, if the applications cannot be wetted by (the capillary action of) the groundwater or the surface water. This type of application is constructed in such a way that the construction materials are wetted, during a period in which wetting takes place independent of the atmospheric conditions.

Explanation

The leaching emission is measured with the diffusion test (conform NEN 7345). The evaluation of whether the emission is determined by diffusion, takes place on the basis of the direction coefficient from the double logarithmic graph of the time and the emission;

Direction coefficient>0.6:	The emission is not determined by diffusion. The emission must be determined according to NEN 7343 (column test). The calculated immission according to 11.1. is compared with the maximum allowable immission.
0.35<Direction coefficient<0.6:	the emission is determined by diffusion (depending on the pD_e, a correction can take place). The calculated immission according to 11.2. is compared with the maximum allowable immission (for details see NEN 7345).
Direction coefficient<0.35:	with the emission not determined by diffusion (E(64d)) and the factors for compounds with $pD_e \geq 11$, the calculated immission must be calculated according to 11.2 ("worst case"). This calculated immission is compared with the maximum allowable immission. A column test may also be applied (see procedure above for a direction coefficient of >0.6), if no exhaustion of the available amount has occurred during the diffusion test. In that case, the diffusion test must be repeated with a larger volume of prefabricated construction material (see NEN 3745).

In NEN 7345 a decission procedure is described which lead to the qualification of the emission of a construction material is determined by diffusion. The decision is based on the leaching behaviour of the individual compounds by means of the evaluation of the direction of the coefficient.

11.3 Examination protocol for construction materials

Summary of RIVM report no 771402010

11.3.0 Introduction

In the Ministerial Regulation (MR) of the Building Materials Decree Soil and Surface Waters Protection (oBB), is described how construction materials must be tested, the so-called examination protocol. This examination protocol describes the manner in which a sample must be taken from a batch of construction material, how this sample must be prepared for analysis, which tests must be carried out, and how the analysis of the percolates, extracts and destruates must take place. Then, the measurement result must be translated per compound into a calculated immission value with the use of conversion equations and keeping in mind one or more correction factors. These are then the immission values which must be compared to the immission standards of the Building Materials Decree (see this report Part 1, 1A and 1B). It is known that in each step of coming to a measurement result, accidental and systematic errors are made.
A minor transgression of the testing/standard value (T) therefore, does not mean for the applier, the user or the enforcer that transgression can be made proved with a certain probability.

11.3.1 Rejection value

The ministries of VROM and V&W want a unified, statistically argumented rejection value for which it is valid that above this rejection value (AW), it is determined with a certain confidence that the sample to be evaluated exceeds the testing/standard value (T). If during an enforcement check, a measurement value is found to be above this rejection value, the sample is rejected and may not be applied. The term rejection value plays an important role.

The rejection value (AW_i) for parameter i is equal to the average measurement result ($\bar{x}$)

of parameter i which just escapes rejection with a certain probability. The quotient of rejection value and testing/standard value is the rejection factor (AF). The rejection factor is a multiplication factor for the testing/standard value. During an enforcement check, the following comparison must therefore be made for compound i:

$$\bar{x}_i \leq AW_i = T_i * AF \qquad (1)$$

The RIVM report 771402010 describes:

1. The mathematical, statistical argumentation of the examination of batches for the enforcement check,
2. an estimation of the total variance of the batch as a result of the specific variance of the batch (heterogeneousness) and the measurement error,
3. Calculation of the rejection value,
4. The effect of the choices on the acceptance chance and on the height of the rejection value,
5. The effect of the examination method on:
   - the protection of the soil
   - the re-usability of construction materials
   - the costs of the examination
6. Proposal for a examination procedure.

11.3.2 Starting points

Average value: the choice is made for a testing of the average value against a testing/standard value of a characteristic (leaching behaviour, for example) of a batch to be researched. Procedurally, this means that one or more samples, composed of one or more increments, is measured. The measurement results of the various samples is averaged. The mathematical average (indicated by $\bar{x}$) is regarded as an estimation of the "actual" value of the batch (indicated by µ). The "actual" value must be below the testing/standard value and $\bar{x}$ must below the rejection value (AW). If $\bar{x}$ is above the rejection value, it is indicated with a certain confidence (90%, for example) that the samples originate from a batch which has an "actual" value higher than the testing/standard value.

From this follows that this rejection value (AW) is above the actual testing/standard value (T).

Above this rejection value, the batch is rejected at the enforcement for the application in a certain category. The height of the rejection value is determined among other things by the material specific characteristics of the batch (VC_{part}) and the measurement error (VC_{meas}). At the moment, both of these have been limitedly characterized.

The examination protocol of the MR will therefore have to take into account the fact that as both are better characterized (and reduced), the rejection value is adapted by changing the MR into the direction of the testing/standard value.

Log normal distribution: In the statistical argumentation for the examination of construction materials against the testing/standard value, a log normal distribution will be accepted for the distribution of the characteristic in the batch, and a normal distribution for the measurement error.

VC_{part} and VC_{meas}: Since it is not realistic from a cost point of view to determine for each batch by way of measurements the measurement error and the dispersion in the batch, a testing strategy has been developed which assumes known values for VC_{meas} and VC_{part}. In this report, both values are estimated, and then assumed as being known. The choice has been made, therefore, to give knowledge beforehand. This results in a examination protocol with less increments and samples in order to achieve the same result.

At the moment, there is still limited insight into the measurement error (VC_{meas}) and the own dispersion of a batch of construction material (VC_{part}). The first step is the estimation of the "sum" of VC_{meas} and VC_{part}. In equation 2, a relationship is made between VC_{part} and VC_{meas} with VC_{tot}.

$$VC_{tot} = \sqrt{VC_{part}^2 + VC_{meas}^2} \tag{2}$$

In the meeting between VROM/V&W and the construction industry, it is agreed that, as long as more detailed knowledge is lacking, the "sum" of VC_{meas} and VC_{part} are determined per examination method with the help of leaching and composition data in the RIVM data base BASIS. The total dispersion concluded from this is called VC_{rivm}. For the leaching of non-prefabricated construction materials and the composition (organic compounds), VC_{rivm} = 0.65, and for the leaching of prefabricated materials, $VC_{rivm} = 0.45$.

From an indicative research by TNO, it can be concluded that, besides the data in the RIVM data base, there is still little known about this matter[38]. The data which is available are, however, not in disagreement with the values mentioned.

A measurement error of $VC_{meas} = 0.25$ also seems reasonable. Over time, as more data becomes available from the monitoring research and the certification of construction materials, both of these values can be determined per compound and per product, and for example be included in construction material specific CUR and CROW documents.

In the future, it would then be possible to calculate with these values. For now, however, in this examination protocol $VC_{tot} = VC_{rivm}$.

Producer risk 10%: In the meeting between VROM/V&W and the construction industry, it is agreed that the examination protocol will be developed on the basis of a 10% producer's risk.

11.3.3 Calculation of the rejection value

The rejection factor (AF) and with this the rejection value (AW) are calculated with equation 3.

$$AW = AF * T = T * e^{1.282 * VC_{part} * \sqrt{\frac{1}{n} + \frac{1}{c} * \frac{VC^2_{meas}}{VC^2_{part}}}} \quad (3)$$

In which T is the testing/standard value from the Building Materials Decree. Because of the choices made, the rejection factor is no longer dependent on the compound, but it is dependent on the testing method (column test, diffusion test, or composition), the total number of increments (n) and the number of samples measured (c).

[38] In RIVM report 771402010, no research is done as to a VC_{part} inorganic composition. This is not relevant for construction materials, except for clean soil. The testing of clean soil is not a part of this report. VC_{part} is also not developed for the leaching of organic compounds. The development of a leaching test for organic compounds is still in progress.

11.3.4 Costs, soil protection and re-use

Costs: In view of the parameters: the number of increments (n) and the number of samples (c), choices must be made. Taking more than 3 samples existing of more than 4 increments per sample, is less effective in view of the costs. It is suggested to prescribe the minimum of 3 samples of 4 increments in the enforcement protocol. Taking more samples and/or more increments is allowed, the rejection factor is then lower. For the last-mentioned situation, an equation is included in the examination protocol (equation 3).
The measurement costs for the examination protocol developed are approximately f4000,- per 2000 tons of construction material.

Burdening of the soil: In order to restrict the effect of unjust acceptance of construction materials on the burdening of the soil, the rejection factor must be as small as possible.
A lowering is made possible by prescribing more samples and/or increments in the examination protocol. In this way, the chance of unjust acceptance is also limited to a maximum.
A batch with an "actual" value at the level of the testing/standard value has an acceptance chance of 90%. At the level of twice the testing/standard value, the chance of unjust acceptance is zero within the proposed examination protocol.

Re-usability: Finally, with the data available in the RIVM data base BASIS, the influence of the examination protocol on the re-usability of construction materials was researched.
These calculations are carried out for the so-called "Van Ruiten/Branch document" set, among others (see Part 3).
This set of construction materials is also used in the RIVM/RIZA report in which the standard setting of the Building Materials Decree is described (see table 11.3).

Table 11.3. Expected use in Kton of construction materials in 1990 assuming the "Van Ruiten/Branch Document" set and the calculated use according to the examination protocol and standard setting of the Building Materials Decree for VC_{meas} = 25%.

Division according to Van Ruiten	Division according to classes							
1990 expected use in Kton Construction material type	total evaluated amount	cat.1.	uncertain cat. 1. or cat. 2.	uncertain cat. 1. or dumping	cat.2.	uncertain cat.1. or cat. 2. or dumping	No dumping: "special category" or applicable in other ways	dumping
N1/V1: expected	7246	6482			764	0	0	0
95% confidence	7246	3406	1709	856	20	1255	0	0
calculated in this study	7246	6401			836		0	8
N2/V2 expected	4083	3020			351	0	582	131
95% confidence	4083	1208	1448	249	0	632	470	77
calculated in this study	4083	2788			575		367	353
remaining expected	100	61			39	0	0	0
95% confidence	100	47	27	0	20	6	0	0
calculated in this study	100	100			0		0	0
Total expected	11429	9563			1154	0	582	131
95% confidence	11429	4661	3184	1105	40	1892	470	77
calculated in this study	11429	9289			1412		367	361

The re-use agrees well with the expected re-use in this report (see Part 3). The re-use will probably be higher for many construction materials because of the "worst case" approach.

11.3.5 Examination procedure

A first initiative for a examination procedure is as follows:

- delimit a batch of 2000 tons of construction material or the entire batch if this is smaller than 2000 tons.
- take at least 12 a-select increments from this batch according to NEN 7300.
- join these increments a-select to at least c=3 mix samples of at least m=4 increments each (each sample the same number of increments).
- measure the sample characteristics to be tested per compound according to the NEN 73xx series.

- calculate per compound (i) the average ($\bar{x}_i$) of the measurement results of the three or more mix samples.
- reject the sample if $\bar{x}_i$ > rejection factor * testing/standard value for compound i (T_i).

Read off the rejection factor in table 11.4 and the testing/standard value in appendix 1 of the Building Materials Decree in case of 3 or 4 mix samples of 4-20 increments each. Note: for other values of c and m, the rejection value can be calculated with equation 4:

$$\bar{x}_i \leq AW_i = T_i * AF = T_i * e^{1.282 * VC_{part} * \sqrt{\frac{1}{n} + \frac{1}{c} * \frac{VC^2_{meas}}{VC^2_{part}}}} \qquad (4)$$

in which n=c*m.

Table 11.4. Rejection factors (AF) for various c and n for VC_{meas}=0.25.

				number of takings per sample				
category	VC_{rivm}	VC_{part}	VC_{meas}	4	8	12	16	20
				3 samples				
non-prefabricated: leaching and composition (organic)	0.65	0.60	0.25	1.34	1.27	1.25	1.24	1.23
prefabricated: leaching	0.45	0.38	0.25	1.26	1.23	1.22	1.22	1.22
				4 samples				
non-prefabricated: leaching and composition (organic)	0.65	0.60	0.25	1.28	1.23	1.22	1.21	1.20
prefabricated: leaching	0.45	0.38	0.25	1.22	1.20	1.19	1.19	1.18

11.3.6 Conclusion

In order to enforce law, reliable regulations are necessary. These regulations must contain information about the repeatability and reproducibility of the method described (validation). The chance that the soil is burdened more than marginally by construction materials is not completely excluded, but can also not be proven. It is desirable, therefore, to continue the process of validation and the research of the lowering of the error sources. It is possible, that over time it can be determined that certain construction materials systematically exceed the testing/standard value. This would impede the application of these construction materials. Change in the re-usability of these construction materials, if technical adaptations in the production process are not possible, demands a policy choice in which re-use and soil protection must be compared with each other, resulting in a possible adaptation of the testing/standard value in the Administrative Order (or MR). It is, however, not possible to remove hindrances through adaptation of the examination procedure.

PART 2

THE QUALITY OF CONSTRUCTION MATERIALS

12. COMPARISON OF CONSTRUCTION MATERIALS WITH THE STANDARDS

12.1 Data acquisition

Composition and leaching data was gathered to compare construction materials with the standards for construction materials. This data describes the environmental quality of construction materials.

Data was gathered through requests for reports or other information about lab tests from RIVM, DGM, various research institutes, consultancy agencies, and the industries. All those concerned have given their cooperation in this gathering of data. The collection of information took place from January to April, 1992, and January to June, 1993.

The construction materials for which data was gathered are those construction materials mentioned in appendix 1 of the oBB, in addition to various other construction materials which are mentioned in the CROW/CUR/NNI report 92002 [5](see table 12.1.1. and appendix 11).

The gathered composition data and leaching data involve composition measurements by way of total destruction and aqua regina destruction, leaching of granular construction materials with the column test and the cascade test, and leaching of prefabricated products with the diffusion test.

The available data had to be useful for a comparison of the standards for construction materials. If data did not meet this requirement, it was examined whether this could be solved by giving additional information in the report concerned. In several cases, this did not appear possible. No inquiries have been made of the researchers or the publishers of the data because of the limited amount of time available. Approximately 30% of the reports collected contained imformation which was not directly useful.

The useful data was entered into a data base. In this data base is found, when available, the name and the origin of the construction material (with the possible additions of waste materials), the measurement results per compound, and the detection limits used. With the help of the data in the data base, calculations have been carried out for each individual construction material. These are calculations of the number of measurements per parameter (N), the mean, the standard deviation, the minimal, and the maximum value, and the categorization of the number of measurements into the various categories of construction materials in the oBB and in categories according to the new standards as calculated by the RIVM/RIZA (see this report). Some standards for construction materials are raised by DGM so that the re-use of certain construction materials is not impeded. Refer to [2] for the argumentation for this rise. These adjustments are included in the evaluation. The entire method of collecting, evaluating, and processing of the data is described in appendix 5 "Data Acquisition and Processing". The sources of the lab tests which were used are given in a seperate literature list [35].

Table 12.1.1. Researched construction materials.

construction material	raw material added	cat. oBB	identification-number
Clay		N	0
Silt		N	1
Gravel		N	2
Natural sand		N	3
De-silted sea sand		N	4
Lime stone		VN	5
Quartsite		VN	6
Sand stone		VN	7
Basalt		VN	8
Granite		VN	9
Porphyry		VN	10
Flug sand		N	11
Lava stone		N	12
Cement concrete		V	13
Cement concrete	**with addition** Cleaned soil Lavalith Certified cement aggregate Certified mix aggregate Certified masonry aggregate Breaker sand Blast furnace slag LD slag Phosphor slag Jarosite end slag Copper slag MSWI bottom ash Arteficial aggregate from E fly ash E fly ash E fly ash (in portland cement) E bottom ash	V	14

construction material	raw material added	cat. oBB	identification-number
Asphalt cement		V	15
Asphalt cement	**with addition** Asphalt aggragate (non tar-holding) Breaker sand LD slag Phosphor slag Jarosite end slag MSWI fly ash MSWI bottom ash Artificial aggregates from E fly ash E bottom ash E fly ash	V	16
Mortar		VN	17
Mortar	**with addition** E fly ash Breaker sand	VN	18
Rough ceramic products		V	19
Rough ceramic products (bricks)	**with addition** E fly ash	V	20
Prefabricated concrete components		V	21
Prefabricated concrete components	**with addition** E fly ash MSWI fly ash MSWI bottom ash	V	22
Calcium-silicate bricks and blocks		V	23
Calcium-silicate bricks and blocks	**with addition** E fly ash E fluid bed ash Ash lime	V	24
Aerated concrete units		V	25
Aerated concrete units	**with addition** E fly ash	V	26
Sand bentonite		VN	27
Sand bentonite	**with addition** Sieve sand	VN	28
Sand cement stabilization		VN	29
Sand cement stabilization	**with addition** Sieve sand Cleaned soil E fly ash E fly ash (in portland cement)	VN	30
Crushed asphalt cement		VN	31
Asphalt aggregate		VN	32
Asphalt aggregate	**with addition** Asphalt aggregate (tar-holding) breaker sand	VN	33
Blast furnace slag mix		VN	34
Hydraulic mix aggregate		VN	35
Lightly stabilised phosphor slags		VN	36
Lightly stabilised steel slags		VN	37
Stabilised MSWI bottom ash		VN	38

construction material	raw material added	cat. oBB	identification-number
Stabilised MSWI bottom ash	**with addition** RO gypsum E fly ash E fly ash (in portland cement) E fluid bed ash Breaker sand	VN	39
Lightly stabilised E fly ash		VN	40
Lightly stabilised E fly ash	**with addition** Breaker sand	VN	41
Cement aggregate		N	42
Masonry aggregate		N	43
Mix aggregate of concrete and masonry aggregate		N	44
Sieve sand		N	45
Recycling breaker sand		N	46
Undefined demolition waste		N	47
Smoke gas desulphurization gypsum (RO gypsum)		N	48
Phosphor acid gypsum		N	49
Mine stone (red)		N	50
Mine stone (black)		N	51
E fly ash		N	52
E bottom ash		N	53
E fluid bed fly ash		N	54
E fluid bed bottom ash		N	55
Gassing E-bottom ash		N	56
Gassing E-slag		N	57
Gassing E-fly ash		N	58
MSWI bottom ash		N	59
MSWI fly ash		N	60
Blast furnace slag		VN	61
Blast furnace foam slag		N	62
Granulated blast furnace slag		N	63
Blast furnace slag sand		N	64
Jarosite end slag		N	65
LD slag		N	66
Phosphor slag		VN	67
ELO slag		N	68
Copper slag		VN	69
Chrome slag		N	70

12.2 Data transformation

In the oBB, construction materials are classified on the basis of leaching and composition. Leaching is measured by way of the column test and the diffusion test; for metals the composition is measured after destruction of the sample with aqua regina, and for organic compounds after extraction with a suitable solvent. The (literature) sources are screened for these test methods. In this screening it became apparent that data meeting the requirements of these analysis methods as prescribed in the oBB and Building Materials Decree was, for several construction materials, either not available or barely available.

In order to increase the amount of data, information concerning the cascade test and total destruction is also included. The cascade test describes the leaching behaviour after L/S=20 to L/S=100. By way of a manual extrapolation, an estimation of the leaching at L/S=10 is achieved. The leaching at L/S=10 is then an estimation for the emission of the column test at L/S=10, such as is required by the oBB and Building Materials Decree. The metal contents of the construction materials can also be measured after total-destruction of the sample. As a rule, these contents are equal to or higher than those achieved after total-destruction with aqua regina. The RIVM has measured the composition of several construction materials after destruction with aqua regina, and compared this with the composition achieved after total-destruction of the same construction materials. From this comparison, a transformation factor is deduced.

In the presentation of both the composition results as well as the leaching results, it is indicated whether the result concerns a transformed or an untransformed value.

12.2.1 The transformation factor for composition

The transformation factor is determined by comparing the contents in several construction materials (primary and secondary) after aqua regina destruction with those contents achieved after total-destruction (appendix 6). The construction materials are divided into six groups (see table 12.2.1.).

For each group, the mean transformation factor and the standard deviation is calculated from aqua regina destruction in comparison to total-destruction. At the same time, the mean of the standard deviation of the six groups together is calculated.

If in a literature source the composition of a construction material was achieved after total-destruction, then the construction material was first placed into a certain group (appendix 7). After that, the content of all the metals was corrected for the recovery of the aqua regina destruction (table 12.2.1.) which belonged to the group concerned. The result was regarded as an estimation for the composition as if the construction material was destroyed by way of aqua regina.

Table 12.2.1. Recoveries (%) of the aqua regina destruction.

category	construction material	aqua regina/total*100%
1	slags and bottom-ashes	75 ± 16
2	fly-ashes	67 ± 15
3	construction(recycling)materials	61 ± 20
4	sand	68 ± 28
5	natural raw materials	53 ± 26
6	silt	82 ± 15
Mean		67 ± 9

As a control, the mean composition of construction materials after destruction with aqua regina is compared with the mean composition of construction materials after total-destruction and transformation to an equivalent for aqua regina destruction. This comparison took place per compound with the help of the student-t test at 95% confidence.
Only those construction materials of which the composition was measured according to both methods at least ten times, are involved in the comparison. The research concerned only those construction materials of which the composition was determined either after aqua regina destruction or after total-destruction. The results of this comparison are showed in table 12.2.2.

Table 12.2.2. Comparison of aqua regina with transformed total-destruction.

	Percentage
aqua regina < transformed after total-destruction	19%
aqua regina = transformed after total-destruction	64%
aqua regina > transformed after total-destruction	17%

12.2.2 Leaching transformation factor

The concentration curve of the cascade test, of which the measurement points lie between L/S=20 and L/S=100, are graphically extrapolated to L/S=10. The compound concentrations are measured with the cascade test, set against the cumulative L/S ratio of the fractions. The concentration line is manually extrapolated to "cumulative L/S=10" where the accompanying concentration is read. In the case of a horizontal line or a line moving upwards from the left to the right and a concentration below the detection limit at a cumulative L/S=20, the concentration at a cumulative L/S=10 was read as being lower than the detection limit.

The transformations are only carried out if the emission at a cumulative L/S=20 was given, and more than two measurement points were available. Only for MSWI bottom ash was sufficient data available from column tests as well as cascade tests to determine the direction coefficient (rc)[39]. The correlation between the cumulative emission at L/S=10, determined by the column test, and the value for the L/S=10, generated by the cascade test, is determined with a linear regression analysis for each compound. This correlation can be expressed as follows:

$$\textit{Emission (column test)} = a * \textit{Emission (cascade test)} \qquad \textbf{(10.2.2.1)}$$

a = the direction coefficient (rc)

Values below the detection limit are calculated as being the detection limit. The direction coefficient is calculated by means of a regression line through the source (coordinate = 0.0).

Then, it is determined whether the rc significant (α=0.05) differs from 1. The following situations can be distinguished:

rc = 1.	rc < 1.	rc > 1.
$\alpha = 0.05$	$\alpha = 0.025$	$\alpha = 0.025$

In table 12.2.2.1., the rc, the confidence interval of the rc, the probability of rc being equal to 1, and the conclusion are given.

The correlations for the compounds Sn, F, and Hg were not significant ($p<0.05$). For this reason, no conclusion can be made with regards to the rc. This may be the result of a large spreading and/or a lack of measurement points. An rc<1 means that the compound does leach, based on the cascade test after extrapolation to L/S=10, but less than the emission at L/S=10 measured with the column test.

For the compounds Cd, Cu, Pb, Cr, As, Ba, and Sb, this leads to an overestimation. The rc of the compounds Zn, V, and Se do not differ greatly from 1, which means that the extrapolation of the cumulative emission to L/S=10 from the cascade test gives the same

[39] This method is recently evaluated and improved by dr. H.A. van der Sloot by means of a more extended research [ ].

value as the column test.

For the compounds Ni, Mo, Cl, and SO_4, the rc is significantly greater than >1. This means that for these compounds, the extrapolation of the cumulative emission to L/S=10 from the cascade test gives an underestimation of what the column test would indicate at L/S=10. The results are valid for MSWI bottom ash.

Table 12.2.2.1. Per component: the number of measurements, the direction coefficient with the standard fault, the 95% confidence interval of the direction coefficient, the chance of the direction coefficient being equal to 0 ("P(rc=0)") and/or the chance that the 95% confidence interval is greater than 1 (rc>1), smaller than 1 (rc<1), or contains 1 (rc=1) measured for MSWI bottom ash.

component	number	direction coefficient ± standard error	95 % confidence interval	size of rc	
				P(rc=0)	concl.
Cd	14	0.2 ± 0.1	0.0 to 0.3	0.05	rc < 1
Cu	14	0.8 ± 0.1	0.7 to 0.9	0.00	rc < 1
Pb	14	0.5 ± 0.1	0.4 to 0.6	0.00	rc < 1
Cr	14	0.4 ± 0.1	0.1 to 0.7	0.02	rc < 1
Ni	14	1.7 ± 0.3	1.1 to 2.3	0.00	rc > 1
Zn	14	1.1 ± 0.2	0.6 to 1.6	0.001	rc = 1
As	14	0.2 ± 0.1	0.1 to 0.4	0.01	rc < 1
Mo	14	2.8 ± 0.2	2.3 to 3.2	0.00	rc > 1
Cl	8	1.2 ± 0.1	1.0 to 1.4	0.00	rc > 1
SO_4	8	1.3 ± 0.1	1.2 to 1.4	0.00	rc > 1
Ba	8	0.5 ± 0.1	0.4 to 0.7	0.00	rc < 1
Sn	8	1.8 ± 0.9	-0.4 to 3.9	0.09	-
Sb	6	0.3 ± 0.1	0.2 to 0.4	0.001	rc < 1
V	6	1.0 ± 0.2	0.4 to 1.6	0.01	rc = 1
Se	6	1.2 ± 0.2	0.7 to 1.6	0.001	rc = 1
F	2	1.6 ± 0.1	-0.2 to 3.5	0.06	-
Hg	2	1.2 ± 0.2	-1.4 to 3.8	0.11	-

- rc does not differ from zero with 95% confidence.

> rc is with 95% confidence, greater than 1.

< rc is with 95% confidence, smaller than 1.

= the confidence interval of the rc contained with 95% confidence 1.

12.3 Evaluation strategy and statistics

To draw a conclusion from a comparison between the construction materials listed in appendix 1 of the oBB, and the categorization which would be achieved after testing according to the oBB appendix 2 standards for construction materials, it is of great importance that the data is described accurately. In this research, the amount of data per construction material varies greatly between just one data to several data up to more than 100. The abscence of data, however, does not immediately mean that these construction materials are suspect, and that no (indicative) evaluation can be given for the construction material concerned. In view of cost savings, for example, only the critical compounds can be examined, or, as another example, the examination may concern a non-suspect primary raw material which has never been researched.

Whether a compound in a construction material is critical or not, may have been deduced at an earlier stage in time from the Mammoth research [8]. For example, from knowledge about the production process, or from the appearance of the compounds in the raw materials, or from knowledge and insight into the physical/chemical characteristics of the construction material in comparison to comparable construction materials. In a comparison, a small number of observations does not necessarily have to impede testing; only, the uncertainty of the evaluation increases as the number of data N becomes smaller.

In appendix A, B, and C[40], all the construction materials researched are described by way of the number (N), the mean, the standard deviation (sd(n-1)), the number of excessions of a standard value (n>U1, n>U2, n>S1), and in case more than 10 observations appear in the data base, the mean and the standard deviation after logarithmic transformation is also calculated. Research has also been done as to the form of the distribution (kurtosis and skewness, appendix 8).

From the research as to the form of the distribution, it appeared mostly impossible to make normality or log normality acceptable in a statistical sense. A possible reason may be the small number of observations. With a constant production process, however, and a constant raw material quality, the expectation that the composition and the leaching will vary around a certain value is justified. MSWI bottom ash and MSWI fly ash, for example, produced from very non-homogeneous household waste and for which enough

[40] Appendix B and C in English, but only available in the Dutch version of this report.

data is available, appear to indicate a significant normal distribution. Based on these considerations, the acceptance of a normal distribution would be justified, and outliers could be removed (beforehand) (for details, appendix 8).

In appendix A, the mean and the standard deviation is corrected for outliers, when accepting a normal distribution. In appendix B and C, the tail probability is calculated when accepting a normal and a binomial distribution respectively. Tail-probabilities (P-value) calculated on the basis of a binomial distribution include the outliers mentioned. For, if the sample follows the binomial distribution, then the form of the distribution is not assumed to be known, and the outliers cannot be removed. In appendix 8, the pros and cons of a comparison based on the normal and binomial distribution are indicated.

12.4 Comparison of oBB appendix 1 with oBB appendix 2

In the discussion around the comparison of the leaching and the composition of construction materials with the standards for construction materials, the following strategy has been chosen. Its basis is formed by the data obtained by way of the column test or the diffusion test, and the composition after aqua regina destruction for inorganic compounds, and the composition for organic compounds. For both the column test as well as the diffusion test, the detection limit[41] is used as a value in the calculations, if the detection limit has been measured. The resulting cumulative emissions are, therefore, upper limit (worst case).

Since in only a few cases, a positive indication of the distribution of the population is obtained, the binomial distribution serves as the starting point for the statistic comparison (appendix 8). In appendix C, the tail-probabilities (P-values) and the accompanying 95% confidence intervals, assuming the binomial distribution, is reproduced. The most critical compound is selected first. This is the compound with the greatest tail-probabitity (P-value), which is what determines in which category a construction material is placed in. Concerning MSWI bottom ash (see appendix C, see table 12.4.2), this is, for the leaching

[41] In the calculation of the emission, the detection limit used is the one given in the literature source consulted. This does not necessarily have to be the lowest quantitative measurable detection limit, such as the one given in the RIVM check list. A less sensitive analysis technique may also be used. At the same time, there can also be differences in the definition of the detection limit; both qualitatively or quantitatively determined analysis limits.

of molybdenum with p(U2)=0.625 (62%). Also the less critical compounds can be deduced from appendix C. For MSWI bottom ash, these are copper and antimony.
For MSWI bottom ash, a seperate investigation has been made as to whether the critical compounds are correlated amongst eachother. If they are not correlated, then there is a greater chance that at a batch evaluation, a sample is rejected above the presented rejection level of the most critical compound. There are then two or more critical compounds for which the overall tail-probability (P-value) for the construction material concerned is greater than the individual chances of the critical compounds. The number of observations is increased with data from the cascade tests which are extrapolated to L/S=10, and total destructions which are transformed to aqua regina destructions. For the details of the transformations, refer to appendix 6. It has been investigated whether the conclusions could be expanded and/or improved with this information. If this is the case, then this will be indicated in the discussion of the results.
In table 12.4.1. and 12.4.2., an example is given of the tables for MSWI bottom ash which are also reproduced in appendix A and C respectively.
From table 12.4.1., it appears that for the compounds arsenic, cadmium, chrome, copper, molybdenum, nickel, lead, antimony, selenium, tin and zinc, assuming a normal distribution, outliers have been indicated for the leaching. (indicated with an *)[42]. A correction is made for this. Usually, this concerns an upper outlier. How high or low the outlier is, is reproduced with the highest and the lowest observed observation (the maximum and the minimum are not corrected for outliers). The mean of the compounds arsenic, mercury, nickel, tin and selenium lies around the mean detection limit (table 12.4.4.). The mean, highest, and lowest reported detection limits are shown in table 12.4.3.

[42] An outlier is a value which on the basis of a statistical calculation significantly differs from the other data. The calculation method is reproduced in appendix 8.

Table 12.4.1. MSWI bottom ash, example appendix A.

RIVM
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man and environment

BASIS
database

Building material: **AVI-slak**

identification number: NV8059.wk1

17-Dec-93

adjusted values granular materials				leaching characteristics					L/S=10 columntest in mg/kg						composition				aqua regia in mg/kg					
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	71	0.014	0.017	0.005	0.235			-2.022	0.382	•	D	169	5.982	6.762	0.500	65.560	0.605	0.386		•	D
Ba	5.50	58.00	7500.00	16	0.913	0.581	0.270	2.047			-0.135	0.309			115	919.257	434.314	340.000	3792.050	2.934	0.177		•	
Cd	0.03	0.07	10.00	71	0.004	0.006	0.001	0.040	2		-2.649	0.431	•	D	169	4.821	4.559	0.100	52.150	0.539	0.390	17	•	
Co	0.42	2.50	250.00	3	0.022	0.007	0.015	0.029							105	11.198	6.409	4.000	68.242	1.016	0.192		•	
Cr	1.30	12.00	1250.00	69	0.090	0.083	0.008	0.680			-1.206	0.433	•		169	187.604	88.985	53.000	2741.600	2.237	0.216	1	•	
Cu	0.72	3.50	375.00	73	4.153	2.825	0.191	14.031	66	41	0.498	0.386	•		172	1591.018	968.391	12.000	7748.000	3.129	0.294	170	•	
Hg	0.02	0.08	5.00	6	0.001	0.000	0.001	0.001						D	20	0.252	0.294	0.022	3.978	-0.738	0.510		•	
Mo	0.28	0.91	125.00	71	1.856	1.677	0.070	9.722	69	45	0.109	0.425	•		160	35.412	21.381	1.490	476.055	1.411	0.431	1	•	
Ni	1.10	3.70	250.00	70	0.114	0.082	0.013	0.477			-1.050	0.355	•	D	164	123.256	94.413	22.000	1010.000	2.020	0.259	9	•	
Pb	1.90	8.70	1250.00	73	0.619	1.186	0.010	9.200	7	1	-0.740	0.743	•		164	1232.050	633.967	35.000	5500.000	3.034	0.267	63	•	
Sb	0.05	0.43	50.00	49	0.110	0.090	0.006	0.900	42	2	-1.063	0.388	•		154	25.594	87.507	1.000	1100.000	0.826	0.699	9	•	
Se	0.04	0.10	50.00	7	0.006	0.002	0.005	0.028					•	D	108	0.982	1.401	0.100	15.198	-0.157	0.328		•	D
Sn	0.27	2.40	250.00	10	0.081	0.035	0.042	2.559	1	1	-0.992	0.504	•	D	101	161.668	61.915	8.000	380.000	2.163	0.262	9	•	
V	1.60	32.00	1250.00	12	0.218	0.146	0.048	0.530			-0.765	0.332			112	59.622	25.000	0.100	130.000	1.720	0.316			
Zn	3.80	15.00	1250.00	71	0.408	0.555	0.060	4.653	1		-0.616	0.457	•		172	1992.513	833.992	550.000	7673.500	3.268	0.180	145	•	
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	9	17.923	21.661	2.436	426.140	1.128	0.738		•	D
Cl	600.00	8800.00	5000.00	8	1740	578	845	2412	8						109	1549	921	360	18104	3.130	0.272	2	•	
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	3	1.000		1.000	1.000					
F-tot	13.00	100.00	4500.00	2	1.900	0.566	1.500	2.300							11	372.328	318.963	50.000	987.000	2.425	0.394			
SO4	750.00	22000.00	25000.00	11	5695	2734	2011	10805	11		3.703	0.235			12	3402	2982	826	9418	3.375	0.386			
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

Table 12.4.2. MSWI bottom ash, example appendix C.

Building material: **AVI-slak**

identification number: NV8059.wk1

BINOMINAL DISTRIBUTION

	confidence intervals of P									leaching %			composition %		leaching %					composition %		
										U1	U2		S		in detail					in detail		
element	P(U1,l)	P(U1)	P(U1,r)	P(U2,l)	P(U2)	P(U2,r)	P(S,l)	P(S)	P(S,r)	build.mat <U1	build.mat >U1&<U2	landfilling >U2	build.mat <S1	landfilling >S1	U1 accepted	U1 unkown	U2 accepted	U2 unknown	landfilling	S1 accepted	S1 unkown	landfilling
As			0.051						0.022	100			100		95	5				98	2	
Ba			0.231						0.032	100			100		77	23				97	3	
Cd	0.003	0.028	0.100			0.051	0.059	0.100	0.155	97	3		90	10	90	7		3		84	10	6
Co			0.708						0.035	100			100		29	71				97	3	
Cr			0.053				0.000	0.006	0.033	100			99	1	95	5				97	3	0
Cu	0.798	0.892	0.952	0.434	0.554	0.670	0.949	0.983	0.996	11	34	55	2	98	5	15	13	24	43	0	5	95
Hg			0.459						0.176	100			100		54	46				82	18	
Mo	0.878	0.958	0.991	0.503	0.625	0.737	0.000	0.006	0.034	4	33	63	99	1	1	11	14	23	50	97	3	0
Ni			0.052				0.025	0.055	0.104	100			95	5	95	5				90	8	2
Pb	0.038	0.095	0.195	0.000	0.014	0.075	0.307	0.382	0.461	91	8	1	62	38	81	13		6	0	54	15	31
Sb	0.709	0.840	0.929	0.005	0.040	0.144	0.027	0.058	0.110	18	80	4	94	6	7	22	57	14	0	89	8	3
Se			0.369						0.034	100			100		63	37				97	3	
Sn	0.002	0.091	0.505	0.002	0.091	0.505	0.040	0.088	0.168	91		9	91	9	50	25		25	0	83	13	4
V			0.308						0.033	100			100		69	31				97	3	
Zn	0.000	0.014	0.077			0.051	0.775	0.838	0.890	99	1		16	84	92	5		3		11	12	77
*Br	NA	NA	NA	NA	NA	NA			0.309	NA	NA	NA	100		NA	NA	NA	NA	NA	69	31	
*Cl	0.631	1.000	1.000			0.369	0.002	0.018	0.065		100		98	2		37	26	37		93	6	0
*CN-complex	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
*CN-free	NA	NA	NA	NA	NA	NA			0.708	NA	NA	NA	100		NA	NA	NA	NA	NA	29	71	
*F-total			0.842						0.335	100			100		16	84				68	34	
*SO4	0.665	1.000	1.000			0.335			0.308		100		100			34	33	34		69	31	
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w

NA: No information available. ERR: zero-division.

Table 12.4.3. Detection limits for inorganic compounds for the column test at L/S=10, the diffusion test during 64 days, and the composition, taken from the literature in the data base.

compound	column test mg/kg					diffusion test mg/m²					composition aqua regina mg/kg				
	N	mean	sd(n-1)	min	max	N	mean	sd(n-1)	max	min	N	mean	sd(n-1)	min	max
As	53	0.026	0.003	0.002	0.067	22	0.260	0.135	0.223	8.889	40	7.043	8.367	0.1	50
Ba	9	0.251	0.024	0.025	1.000	15	0.921	0.000	1.117	17.778	1	0.100		0.1	0.1
Cd	59	0.004	0,002	0.001	0.025	48	0.071	0.028	0.056	2.667	168	0.826	0.365	0.01	2
Co	10	0.014	0.001	0.010	0.028	5	0.000	0.000	0.000	0.000	4	3.250	4.500	1	10
Cr	38	0.073	0.004	0.010	0.217	44	2.861	2.210	0.559	88.889	9	7.667	4.301	1	12
Cu	35	0.088	0.005	0.007	0.205	33	1.572	0.582	0.559	35.556	14	5.071	3.832	1	10
Hg	24	0.001	0.000	0.000	0.001	13	0.046	0.000	0.056	0.889	100	0.153	0.091	0.02	0.3
Mo	28	0.068	0.003	0.013	0.105	23	1.687	0.389	0.971	35.556	197	37.929	20.238	0.5	50
Ni	55	0.141	0.021	0.010	1.000	56	12.221	11.949	1.117	444.444	15	5.133	6.704	0.5	20
Pb	42	0.088	0.013	0.010	0.505	34	0.541	0.466	0.056	22.222	67	12.806	9.257	0.5	50
Sb	23	0.006	0.000	0.002	0.020	15	0.207	0.082	0.209	8.222	68	1.476	6.020	0.2	50
Se	24	0.013	0.002	0.005	0.103	28	0.546	0.474	0.056	17.778	98	2.029	10.195	0.4	100
Sn	23	0.124	0.008	0.043	0.500	30	46.029	0.000	55.866	888.889	97	99.765	68.760	0.2	150
V	29	0.051	0.003	0.021	0.106	18	2.331	0.887	2.235	71.111	35	46.200	12.630	1	50
Zn	54	0.165	0.012	0.016	0.511	31	4.324	2.448	0.223	120.000	5	19.000	0.000	19	19
Br											3	25.000	0.000	25	25
Cl	11	4.905	0.144	0.530	10.000		1993.083	2433.105			5	500.000	0.000	500	500
CN-free	0	0.000	0.000	0.000	0.000		0.000	0.000			0				
CN-total	0	0.000	0.000	0.000	0.000		0.000	0.000			3	1.000	0.000	1	1
F	11	0.995	0.096	0.25	6.913		12.581	4.666			2	37.500	17.678	25	50
SO_4	10	1346	56	26	8409		3452	0			16	471	119	25	510

Table 12.4.4. Detection limits of organic compounds for the composition from the literature in the data base.

compound	composition organic compounds mg/kg					compound	composition organic compounds mg/kg				
	N	mean	sd(n-1)	min	max		N	mean	sd(n-1)	min	max
Benzene	12	0.035	0.041	0.005	0.100	PCB-28	67	0.025	0.085	0.002	0.500
Ethylbenzene	5	0.080	0.027	0.050	0.100	PCB-52	74	0.024	0.081	0.002	0.500
Toluene	8	0.061	0.036	0.005	0.100	PCB-101	70	0.025	0.083	0.002	0.500
Xylene	3	0.083	0.029	0.050	0.100	PCB-118	52	0.029	0.096	0.002	0.500
Phenols	5	0.340	0.219	0.100	0.500	PCB-138	70	0.025	0.083	0.002	0.500
Cl-phenols	9	1.070	0.867	0.010	2.000	PCB-153	69	0.025	0.083	0.002	0.500
Arom.(tot)	2	0.100	0.000	0.100	0.100	PCB-180	75	0.023	0.080	0.002	0.500
Naph	311	0.519	5.685	0.001	100.000	PCB(tot)	68	0.177	0.223		
Ph	109	0.124	0.473	0.002	5.000	EOCl(tot)	18	0.428	0.339	0.100	1.300
An	213	0.089	0.341	0.002	5.000	OCl-pesticides	84	2.962	4.373	0.140	10.000
Fla	98	0.124	0.499	0.001	5.000	Cl-free pesticides	3	1.700	0.000	1.700	1.700
Chr	122	0.133	0.482	0.005	5.000	Min.oil	37	81.216	101.224	10.000	400.000
BaA	138	0.653	2.215	0.005	10.000						
BaP	141	0.119	0.448	0.001	5.000						
BkF	161	0.112	0.405	0.001	5.000						
IP	187	1.378	7.823	0.001	100.000						
BPe	191	1.365	7.742	0.001	100.000						
PAH10(tot)	167	4.616	12.631								

It is not so that the seperate measurements do lie below the mean detection limit, but that they may lie below this. For mercury concerning MSWI bottom ash, this is indeed the case. For the other compounds, one or more measurements lie beneath the mean detection limit. In the evaluation it is determined whether measurements were taken on the detection limit level, and where necessary, this is indicated in the discussion of the comparison.
Although statistically not entirely correct, it is possible to calculate the below-margin chances if the tail-probability (P-value) is known. In this way it can be made clear which part of the construction material lies below the U1 standard for construction materials, which part lies between U1 and U2, and which part exceeds the U2 standard for construction materials. The tail-probability (P-value) is the fraction of the distribution which lies above the standard for construction materials, and is indicated by $P(U_x)$. For the part smaller than the U1 standard the following is valid:

$$100\% - P(U_x) * 100\% \qquad (12.4.1)$$

This is the below P-value probability as a percentage, a chance which is at the most equal to the confidence coefficient of 1-0.5α. For the part greater than the U2 standard, the following is valid:

$$P(U2) * 100\% \qquad (12.4.2)$$

The remaining part, therefore, lies between U1 and U2 with a probability of 95%:

$$100\% - 100\% + P(U1) * 100\% - P(U2) * 100\% = P(U1) * 100\% - P(U2) * 100 \qquad (12.4.3)$$

For the composition, the same can be done. These values are reproduced in table 12.4.2. (middle) and appendix C. The evaluation of the quality of construction materials took place for the most critical compound, this is the compound with the greatest tail probability.

12.5 Confidence intervals around the excession changes

In chapter 9.4., an indication is given of what is done with the tail-probabilities (P-values). The calculated tail-probability (P-value) is statistically the best estimator. For the tail-probability, a range can be calculated in which the tail-probability has, for example, a probability of 95%; the 95% confidence interval of the calculated tail-probability. This confidence interval is limited by a lower (p_l) and a upper (p_r) limit value. The tail-probability (P-value) for leaching standard U1 and U2 and the accompanying confidence intervals are described by way of the following codes in appendix 8:

U1: $p(U1)_l$ ------ $P(U1)$ ------ $p(U1)_r$ and

U2: $p(U2)_l$ ------ $P(U2)$ ------ $p(U2)_r$

The limit values $p(U1)_l$, $p(U1)_r$, $p(U2)_l$, and $p(U2)_r$ can be calculated using the calculation rules in appendix 8.

For the binomial distribution, it is accepted that if the expected excession of the U1 standard for construction materials is zero ($P(U1)=0$)[43], then an excession of the U2 standard for construction materials certainly does not occur. In that case, $p(U2)_l=p(U2)_r=0$ is fixed. The available construction material mass (Ktonne) can be divided into five classes, based on the construction materials leaching standards. These are: certainly U1, U1 or U2; certainly U2; U2 or dumping; and certainly dumping. This can be suggested as follows:

certainly U1 -/- U1 or U2 -/- certainly U2 -/- U2 or dumping -/- certainly dumping

And, although statistically not entirely correct because excession is not complimentary to below-margin, the courses can be described as:

U1-accept	=	$(1 - p(U1)_r)$	* 100%
U1-unkown	=	$(p(U1)_r - p(U1)_l)$	* 100%
U2-accept	=	$(p(U1)_l - p(U2)_r)$	* 100%
U2-unkown	=	$(p(U2)_r - p(U2)_l)$	* 100%
landfill	=	$p(U2)_l$	* 100%
TOTAL		1	100%

A problem develops if there is an overlapping of U1-unknown and U2-unknown, so that U2-accept becomes negative. In this special case, U2-accept is fixed at zero, but then the

[43] The expected tail probability of the U2 standard for construction materials is then also zero!

total sum will become greater than 100%. To prevent this, the ranges U1-unknown and U2-unknown are equivocally reduced with the sizes of the ranges U1-unknown and U2-unknown to the size of the negative part of the U2-accept.

For the composition, a divison can be made in the same way:

S1-accept	=	$(1 - p(S1)_r)$	* 100%
S1-unkown	=	$(p(S1)_r - p(S1)_l)$	* 100%
landfill	=	$p(S1)_l$	* 100%
TOTAL			100%

The results of these calculations are reproduced in appendix A, B, and C[44].

12.6 Summary of the evaluation procedure

Together with the industries (see appendix 13), principial agreements have been made regarding the evaluation of data, especially if there is little data available. For an evaluation, at least two measurement values are necessary. Besides this, the RIVM will give an expert opinion where possible. Further, the confidence of the tail-probabilities (P-values) are given. The available data is evaluated according to the following scheme:

1. determine whether the U2-standard[45] is exceded, and for which compounds. Yes: proceed to 10; No: proceed to 2.
2. determine whether the U1-standard is exceded, and for which compounds. Yes: proceed to 10; No: proceed to 3.
3. is N equal to 1 or 0 for all compounds, go to 4; is N greater than 1 for one or more compounds, go to 7.

[44] Appendix B and C are not available in this report, only available in the Dutch version of this report.

[45] In the Administrative Order for Construction Materials, there are no fixed U1 and U2 standards, only the allowed immission is fixed. In part 2, the allowable emissions are calculated for fixed values for the application height, etc. In the Administrative Order for Construction Materials, these values are dependent on the application. By making these "fixed choices", two fixed values are achieved for the allowable emission. In this way, the method of category-division in the Administrative Order for Construction Materials Act becomes comparable to that of the oBB, with the exception of the value of the limits of the U1 and U2 standards.

4. write in conclusion:
   - if N=1, no excession of the standard [0/1] (N is the total number of measurements excluding outliers).
   - if N=1 or 0, insufficient information for the classification of the construction material (one measurement is no measurement).
   - in the overview, no (most) critical compounds.
   - possibly give an RIVM expert judgment concerning the class, based on the comparison with equivalent construction materials and/or composition. Make a note concerning the lacking critical compounds which are not measured.
5. go to the next construction material.
7. select the compound with the greatest ratio mean/standard (as close as possible to 1) and N>1.
8. write in conclusion:
   - no excession of the standard COMPOUND NAME with the greatest ratio [0/N] (N is the total number of measurements excluding outliers).
   - 0% (95% confidence interval).
   - this construction material is classified as a category 1 construction material.
   - in the survey, no (most) critical compounds.
   - possibly give an RIVM expert judgment concerning the class distribution, based on the comparison with equivalent construction materials and/or composition. Make a note concerning the lacking critical compounds.
9. go to the next construction material.
10. determine the most critical compound(s) (this is/these are the compound(s) with the highest tail-probability (P-value). If N=1, the tail-probability (P-value) is 100%!).
11. are there more most critical compounds with the same chance of excession; select the compound with the greatest ratio mean/standard.
12. if N=1: go to 19; if N>1: go to 13.
13. is there a detection limit above the standard and/or the outlier? yes: go to 14; no: go to 17.
14. correct for detection limits of measurements which are greater than the standard (these are considered to be below the standard) and mention this in the conclusion.
15. correct for outliers (these are considered to not have been measured) and mention this in the conclusion.
16. again calculate the tail-probability (P-value) of the compound. Go to 1.

17. write in conclusion:
    - based on compound..[n>Ux/N], ..% falls (95% confidence interval) into category 1/2/X (and the rest into category 2/X).
    - this construction material is classified as a category 1/2/X construction material.
    - in the survey, include the (most) critical compounds.
    - possibly give an RIVM expert judgement concerning the class divison, based on the comparison with equivalent construction materials and/or composition. Make a note concerning the lacking critical compounds.
18. go to the next construction material.
19. write the compound into a survey with the most critical compounds. Exclude this compound from any further evaluation (one measurement is no measurement). Go to 1.

Composition organic and inorganic: For S, start with step 2, read for U=S, category 2 is cancelled, read for category 1 = applicable and read for category X = not applicable.

12.7 Non-prefabricated construction materials

Since it was known in advance that DGM was planning to cancel the composition requirement for inorganic compounds, only the leaching and the composition requirements for organic compounds are considered in the categorization on the basis of the new adjusted standard setting. The composition requirement for inorganic compounds, however, is included in the calculations for the re-usability under the oBB standards (the old standard).

Periodical reports of the comparisons with the standards for construction materials have been given to DGM several times during the composition of this report. On the basis of these periodical reports, the standards for construction materials have been adjusted to ensure the re-use of certain construction materials. Refer to chapter 9.

In chapter 12.7.3., the quality and the possibilities are described if construction materials are applied on or in the soil. In chapter 12.7.4., a number of construction materials which are applied in waterway construction are discussed.

12.7.1 Leaching emissions of inorganic compounds

The evaluation of non-prefabricated construction materials over against the leaching standards in appendix 2 of the oBB is summarized in table 12.7.a. (the old leaching standards) and 12.7.1b. (the new leaching standards). Per construction material shall be indicated how many observations which have passed the RIVM control are included in the data base, and which percentage of the construction material is placed into a certain category on the basis of the samples performed. The sample embraces several measurements per compound. The number of measurements is smaller or equal to the number of observations in the data base. The categories are: N1; N2 and not applicable under the oBB standards for construction materials and the category 1 construction materials; category 2 construction materials, and non-applicable construction materials under the new standards according to the Building Materials Decree. Only the highest category is mentioned; the rest of the construction material ends up in a lower category. For details concerning these categories, refer to appendix C. As mentioned earlier, the presented tail probabilities, based on the samples carried out, is the best estimator for the behaviour of the construction material in actual practice. The confidence limits of the distribution into a category is also mentioned between brackets.

Many evaluations and conclusions must be based on just a few measurements. The judgments, distributions and evaluations made by the RIVM must be seen in this light. Aside from this, there is also the knowledge about equivalent construction materials from which an estimation of the behaviour can be made. Concerning the construction materials which are allowed to become soil, there was no information available about leaching for loam, lime stone, quartzite, sand stone, granite, porphyry, smoke gas desulphurizing gypsum, red mine stone, and chrome slag (appendix 2 oBB).

Polluted and cleaned soil will also fall under the Building Materials Decree. Although RIVM has knowledge of the leaching behaviour of these materials, it is not possible to give a general evaluation of this. The diversity in the concentration and type of pollution, as well as the changing in the emission behaviour as the result of cleansing, do not allow this. Furthermore, soil is a construction material which is evaluated and judged per batch. The cleaning is adjusted to the quality demands.

Finally, transformed data is also included in the discussion (appendix 8); it is sometimes possible to make a judgment. The measure in which use is made of transformed data is mentioned in the text. The judgments concern the compounds measured. Which compounds these are, is mentioned in appendix A, B, and C. Sometimes, important critical compounds are not measured in the construction material; this is also mentioned in the text.

12.7.2 Composition of (in)organic compounds

RIVM has not made any suggestions to change the S1 standards for inorganic compounds for construction materials. The evaluation, therefore, takes place on the basis of the S1 standards for construction materials such as these are mentioned in appendix 2 of the oBB. For the leaching emissions, the most important aspects of the evaluation of the sample in view of the leaching standards for construction materials are reproduced in table 12.7.1a. (old leaching standards for construction materials according to the oBB) and 12.7.1b. (new standards for construction materials according to the Building Materials Decree). In table 12.7.2., the most important aspects of the evaluation with regards to the composition criteria is reproduced.

Table 12.7.1.a Comparison (binomial) of the research construction materials with the standard values for leaching in the oBB

16-Jul-96

construction material	n	iden-tifi-cati-on nr	Bijl.1 cat. oBB	category construction material N1 <U1	N2 >U1& <U2	not applic. >U2	most critical	others critical	others not critical
clay	1	0	G	(100)			Mo, Sb	-	As, Ba, Cd, Cr, Cu, Hg, Ni, Pb, V, Zn, Cl, SO4.
gravel	1-2	2	G	50	50		Mo	-	As, Ba, Cd, Co(1), Cr, Cu, Hg(1), Ni, Pb, Sb, Se(1), V, Zn, Cl(1), SO4(1).
natural sand	1-6	3	G	80	20		Cd(6), Mo(5)	-	As, Ba(4), Co(3), Cr(4), Cu, Hg(1), Ni(4), Pb, Sb(5) Se(4), V(5), Zn, Cl(1), F(1), SO4(3).
natural sand	1	4	G	(100)			-	-	As, Ba, Cd, Co, Cr, Cu, Mo, Ni, Pb, Sb, Se, V, Zn.
flug sand	1	11	N1	(100)			-	-	As, Cd, Co, Cr, Cu, Mo, Ni, Pb, Sb, Se, Sn, V, Zn, SO4.
lava stone	1-4	12	N1	67	33		Mo, Cd	As	Ba(2), Co(3), Cr, Cu, Hg(2), Ni, Pb, Sb(2), Se(1), V, Zn, Cl(2), F(1), SO4(3).
asphalt aggregate	1-2	32	N2	33	67		Mo	-	As, Ba, Cd, Co, Cr, Cu, Hg(1), Mo, Ni, Pb, Sb, Se, V, Zn.
asphalt cement:	1-4	15		33	67		Mo	-	As, Ba, Cd, Co(3), Cr, Cu, Hg, Ni, Pb, Sb, Se(3), Sn(3), V, Zn, Cl(1), SO4(1).
with MSWI fly ash	1-3				100		Mo(2), Sb(1), Cl(1)	-	As, Ba(1), Cd, Cr, Cu, Hg(1), Ni, Pb, V(1), Zn, SO4(1).
with E fly ash	1-3				100		Mo(2)	-	As, Ba(1), Cd, Cr, Cu, Hg(1), Ni, Pb, Sb(1), V(1), Zn, Cl(1), SO4(1).
with E + MSWI fly ash	1				100		Mo, Sb	-	As, Ba, Cd, Cr, Cu, Ni, Pb, Se, V, Zn.
cement aggregate	4-9	42	N1	8	92		Mo(9)	Ba(8), Cu	As, Cd, Co(7), Cr, Cu, Hg(6), Ni, Pb, Sb(7), Se(7), Sn(8), V(7), Zn, Cl(4), SO4(4).
cement concrete	1-3	13			100		Mo(3)	Ba(2)	As, Cd, Co(1), Cr, Cu, Hg, Ni, Pb, Sb(2), Se(1), Sn(1), V, Zn, Cl(2), SO4.
with E fly ash	1-2				50	50	Mo	Ba(1)	As, Cd, Cr, Cu, Hg, Ni, Pb, Sb(1), V, Zn, Cl, SO4(1).
with hydr. fly ash aggregate	3				33	67	Mo	-	As, Ba, Cd, Co, Cr, Cu, Hg, Ni, Pb, Sb, Se, Sn, V, Zn, SO4.
with MSWI bottom ash	1				(100)		Ba, Mo	-	As, Cd, Cr, Cu, Hg, Ni, Pb, Sb, V, Zn, Cl, SO4.
masonry aggregate	1-4	43	N1/2		100		Mo	SO4(3)	As, Ba, Cd, Co(2), Cr, Cu, Hg(1), Ni, Pb, Sb(2), Se(2), Sn(3), V(2), Zn, Cl(3).
rough ceramic products	1-39	19			35	65	As(39), Mo(31)	V(32)	Cd(31), Cr(1).
with E fly ash	15-20	20			85	15	As(39), Mo(16)	V(16)	Cd(15).
Ca-silicate bricks and blocks	1-2	23		100			-	-	As, Cd(1), Cr, Cu(1), Hg(1), Mo(1), Ni(1), Pb(1), Sb(1), V, Zn, Cl(1), SO4(1).
with E fly ash	1-2				100		Mo, Sb(1), V	As, Ni	Ba(1), Cd, Cr, Cu, Hg, Pb, Zn, Cl, SO4.
aerated concrete	1	25				100	SO4	Mo	As, Ba, Cd, Cr, Cu, Hg, Ni, Pb, Sb, V, Zn, Cl.
with E fly ash	2	26			50	50	Mo	Cr, V, SO4	As, Ba, Cd, Cu, Hg, Ni, Pb, Sb, Zn, Cl.
porous masonry bricks	2					100	Mo	As, Ni, V, SO$	Cd, Cr, Cu, Hg, Pb, Zn, Cl.
mixed aggregate certified	3-15	44	N1/2	71	29		SO4(15)	-	Ba, Cd(3), Cr, Cu, Ni, Pb, Sb, V, Zn, SO4.
mixed aggregate non cert.	1-11			20	80		Mo(9)	Ba	As(9), Cd(10), Co(2), Cr, Cu, Hg(1), Ni, Pb, Sb(4), Se(2), Sn(1), V(7), Zn, SO4(8).
sieve sand	3-19	45	N2	63	37		Cu	Sb(9), Se(9), V(9), SO4(3)	As(12), Ba(9), Cd(9), Co(9), Cr, Hg(18), Mo(9), Ni(9), Pb(9), Sn(8), Zn(9), Cl(3).
recycling breaker sand	1-18	46	N	50	50		Mo(2)	Cu(18), V(17), SO4(18)	As(1), Ba(17), Cd(11), Cr, Hg(3), Ni, Pb, Sb(17), Zn, Cl(1).
constr. and demolition waste	5-16	47	N	40	20	40	Mo(5)	Cd(6), SO4(5)	As(6), Cr(15), Cu, Hg(15), Ni(5), Pb(6), Zn(6), Cl(5).
sand cement stabilisation	1	29			(100)		Ba, Mo, Cl	-	As, Cd, Cr, Cu, Hg, Ni, Pb, Sb, V, Zn, SO4.
with E fly ash	1	30				(100)	Mo	Cr, Sb, V	As, Cd, Cu, Hg, Ni, Pb, Zn, Cl, SO4.
blast furnace slag mix	1-8	34		38	63		Ba(8)	SO4(6), Mo(1), Se(1)	As, Cd, Co(1), Cr, Cu, Ni(7), Pb, Sb(1), V, Zn.
hydraulic mix aggregate	2	35			50	50	Mo	Ba	As, Cd, Cr, Cu, Hg, Ni, Pb, Zn.
lightly stabilised steel slag	1	37		(100)			-	-	As, Ba, Cd, Cr, Cu, Mo, Ni, Pb, V, Zn.
lightly stabilised E fly ash	1	40		(100)			-	-	As, Cd, Cr, Se, V, Cl, F, SO4.
phosphor acid gypsum	2	49	N			100	Cd, F, SO4	Mo, Se, As, Cu, Zn	Pb, Sb, V.
mine stone(NL)	2	51	N		100		Cd, Mo, SO4	-	As, Ba, Cr, Cu, Ni, Pb, Sn, Zn, Cl.
sorted	4-8			100			-	As(6), SO4(10), Zn	Ba, Cd, Cr, Cu, Ni, Pb(6), Cl(4).
mine stone(Ger)			N	100				As(18), Zn(21)	[Ba(18)], [Hg(3)].
E fly ash	1-17	52	N2	17		83	Se(6)	Mo(16), Sb(5), V(10)	As(12), Ba(5), Cd, Co(2), Cr, Cu(7), Hg(1), Ni(11), Pb(9), Zn(6), Cl(4), F(4), SO4(6).
E bottom ash certified	1-13	53	N1	33	67		Se(12)	Ba(9), Mo(13), V(13), Zn	As, Cd, Co(12), Cr, Cu, Hg(9), Ni, Pb, Sb(8), Sn(10), Cl(1), F(1), SO4(12).
E bottom ash non cert.	3-49			28	72		Mo(43)	As, Ba(46), Cd, Co(46), Cu, Ni, Sb(39), Se(46), V(46), Zn(48), SO4(45)	Cr, Hg(45), Pb, Sn(43), Cl(3), CN-comp(3), CN-free(3), F(3).
fluid bed fly ash	1-2	54	N	17		83	Mo(1)	see E fly ash	As(1), Ba(1), Cr, Cu(1), Pb(1), Sb(1), Zn(1).
coal gassing bottom ash	2-4	56	N	28	72		-	F, Se, see E bottom ash	As, Ba, Cd, Cu, Mo, Pb, V, Cl(2), SO4.
coal gassing fly ash	1	58	N		(100)		Mo, Se	-	As, Ba, Cd, Cu, Pb, V, Cl, F, SO4.
MSWI bottom ash	2-74	59	N2		4	96	Mo(72)	Cu, Pb, Sb(50), Cl(8), SO4(11)	As(72), Ba(16), Cd(72), Co(3), Cr(70), Hg(6), Ni(71), Se(8), V(12), Zn(72), F(2).
MSWI fly ash	1-17	60	N			100	Mo	Cd, Pb(16), Se(7), Zn, Cl(14), SO4(14)	As(15), Ba(7), Co(1), Cr(16), Cu(16), Hg(3), Ni(16), Sb(7), Sn(6), V(7).
blast furnace slag	1-8	61	N	67	33		SO4(6)	Ba(2), Mo(7), V96), Se(2), Cl(5)	As, Cd, Co(2), Cr, Cu, Hg(3), Ni, Pb, Sb(2), Zn, F(1).
blast furnace foam slag	1-4	62	N1	50	50		V(2)	-	As, Ba(2), Cd, Co(1), Cr, Cu, Mo(2), Ni, Pb, Sb(1), Se(1), Zn, SO4(1).
granulated blast furnace slag	1	63	N1	(100)			-	-	As, Ba, Cd, Co, Cr, Cu, Mo, Ni, Pb, Sb, Se, V, Zn.
blast furnace slag sand	1-2	64	N	100			-	-	As, Ba(1), Cd, Cr, Cu, Mo, Ni, Pb, V, Zn, Cl(1), SO4.
jarosite end slag	1	65	N			100	Ba, Mo, Sb	Cd, Hg	As, Co, Cr, Cu, Ni, Pb, Se, V, Zn.
LD slag	1-14	66	N	14		86	Br(7)	Mo(9), F(12), Cl(12)	As(8), Ba(13), Cd(9), Co(6), Cr, Cu(10), Hg(1), Ni(9), Pb(10), Sb(5), Se(2), Sn(5), V, Zn(12), SO4(11).
phosphor slag	1-7	67	N		100		F(1)	Mo, SO4(3)	As, Ba(2), Cd(4), Co(2), Cr(4), Cu(4), Ni(4), Pb(4), Sb(2), Se(2), V(5), Zn, Cl(1).
ELO slag	1-4	68	N		25	75	Mo	Ba(3), Cr	As, Cd, Co(1), Cu, Hg(2), Ni, Pb, Sb(1), Se(1), V(2), Zn, Cl(1).
E fly ash aggregate	2-5	71			60	40	As, Mo, Se	V, Sb	Cd(2), Cr(2), Ni(2), Pb(2), Zn.

Note: The evaluation of the products could only be done with a small number of measurements. The accompanying confidence intervals are mostly large because of this.
The values between brackets are based on only 1 measurement. The divisions presented in this table are the best estimators based on the sample check.

Table 12.7.1.b — Comparison (binomial) of the researched construcion materials with the new adjusted standard values of the Adminstrative Order for Construction Materials for leaching (for the height of 70cm)

16-Jul-96

construction material	n	iden-tifi-cati-on nr	Bijl.1 cat. oBB	N	category construc material N1 <U1	N2 >U1& <U2	not applic. >U2	most critical	others critical	others not critical
clay	1	0	G	1	(100)			-	-	As, Ba, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Sb, V, Zn, Cl, SO4.
gravel	1-2	2	G	1-2	100			-	-	As, Ba, Cd, Co(1), Cr, Cu, Hg(1), Mo, Ni, Pb, Sb, Se(1), V, Zn, Cl(1), SO4(1).
natural sand	1-6	3	G	1-6 [1	100			-	-	As, Ba(4), Cd, Co(3), Cr(4), Cu, Hg(1), Mo, Ni(4), Pb, Sb(5), Se(4), V(5), Zn, Cl(1), F(1), SO4(3).
natural sand	1	4	G	1	(100)			-	-	As, Ba, Cd, Co, Cr, Cu, Mo, Ni, Pb, Sb, Se, V, Zn.
flug sand	1	11	N1	[1]	(1000			-	-	As, Cd, Co, Cr, Cu, Mo, Ni, Pb, Sb, Se, Sn, V, Zn, SO4.
lava stone	1-3	12	N1	1-4 [1	100			-	-	As, Ba(1), Cd, Co(1), Cr, Cu, Hg(1), Mo, Ni, Pb, Sb(1), Se(1), V(2), Zn, Cl(2), F(1), SO4(2).
asphalt aggregate	1-2	32	N2	1	100			-	-	As, Ba, Cd, Co, Cr, Cu, Hg(1), Mo, Ni, Pb, Sb, Se, V, Zn.
asphalt cement:	1-4	15			100			-	-	As, Ba, Cd, Co(3), Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se(3), Sn(3), V, Zn, Cl(1), SO4(1).
with MSWI fly ash	1-3					100		Sb(1), Cl(1)	-	As, Ba(1), Cd, Cr, Cu, Hg(1), Mo(2), Ni, Pb, V(1), Zn, SO4(1).
with E fly ash	1-3				50	50		Mo(2)	-	As, Ba(1), Cd, Cr, Cu, Hg(1), Ni, Pb, Sb(1), V(1), Zn, Cl(1), SO4(1).
with E + MSWI fly ash	1					100		Sb	-	As, Ba, Cd, Cr, Cu, Mo, Ni, Pb, Se, V, Zn.
cement aggregate	4-9	42	N1	1-3	100			-	-	As, Ba, Cd, Co(7), Cr, Cu, Hg(6), Mo, Ni, Pb, Sb(7), Se(7), Sn(8), V(7), Zn, Cl(4), SO4(4).
cement concrete	1-3	13			100			-	-	As, Ba(2), Cd, Co(1), Cr, Cu, Hg, Mo, Ni, Pb, Sb(2), Se(1), Sn(1), V, Zn, Cl(2), SO4.
with E fly ash	1-2					50	50	Mo	Ba(1)	As, Cd, Cr, Cu, Hg, Ni, Pb, Sb(1), V, Zn, Cl, SO4(1).
with hydr. fly ash aggregate	3					67	33	Mo	-	As, Ba, Cd, Co, Cr, Cu, Hg, Ni, Pb, Sb, Se, Sn, V, Zn, SO4.
with MSWI bottom ash	1					(100)		Ba	-	As, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Sb, V, Zn, Cl, SO4.
masonry aggregate	1-4	43	N1/2	1-3	100			SO4(3)	-	As, Ba, Cd, Co(2), Cr, Cu, Hg(1), Mo, Ni, Pb, Sb(2), Se(2), Sn(3), V(2), Zn, Cl(3).
rough ceramic products	1-39	19			29	13	58	Mo(31)	As(39), V(32)	Cd(31), Cr(1).
with E fly ash	15-20	20					10	As	Mo(16), V(16)	Cd(15).
Ca-silicate bricks and blocks	1-2	23			100			-	-	As, Cd(1), Cr, Cu(1), Hg(1), Mo(1), Ni(1), Pb(1), Sb(1), V, Zn, Cl(1), SO4(1).
with E fly ash	1-2					100		Mo, Sb(1)	As, V	Ba(1), Cd, Cr, Cu, Hg, Ni, Pb, Zn, Cl, SO4.
porous masonry bricks	2						100	Mo	As, V, SO4	Cd, Cr, Cu, Hg, Ni, Pb, Zn, Cl.
aerated concrete	1	25			(100)			SO4	-	As, Ba, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Sb, V, Zn, Cl.
with E fly ash	2	26				100		SO4, Mo	-	As, Ba, Cd, Cr, Cu, Hg, Ni, Pb, Sb, V, Zn, Cl.
mixed aggregate certified	3-15	44	N1/2	1	86	14		SO4	-	Ba, Cd(3), Cr, Cu, Ni, Pb, Sb, V, Zn, SO4.
mixed aggregate non cert.	1-11				75	25		SO4(8)	Ba(11), Mo(11)	As(9), Ba, Cd(10), Co(2), Cr, Cu, Hg(1), Ni, Pb, Sb(4), Se(2), Sn(1), V(6), Zn, SO4(8).
sieve sand	3-19	45	N2	1-11	100			-	SO4(3), Sb(9)	As(12), Ba(9), Cd(9), Co(9), Cr, Cu, Hg(18), Mo(9), Ni(9), Pb(9), Se(9), Sn(8), V(9), Zn(9), Cl(3).
recycling breaker sand	1-18	46	N	[1]	56	44		SO4	Cu, V(17)	As(1), Ba(17), Cd(11), Cr, Hg(3), Mo(2), Ni, Pb, Sb(17), Zn, Cl(1).
constr. and demolition waste	5-16	47	N	1-11	60	40		Mo(5)	Cr(15), SO4(5)	As(6), Cd(6), Cu, Hg(15), Ni(5), Pb(6), Zn(6), Cl(5).
sand cement stabilisation	1	29				(100)		Ba, Cl	-	As, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Sb, V, Zn, SO4.
with E fly ash	1	30					(100)	Mo	V, Cr	As, Ba, Cd, Cu, Hg, Ni, Pb, Sb, Zn, Cl, SO4.
blast furnace slag mix	1-8	34			57	43		Ba, SO4(6)	-	As, Cd, Co(1), Cr, Cu, Mo, Ni(7), Pb, Sb(1), Se(1), V, Zn.
hydraulic mix aggregate	2	35				100		Mo	Ba	As, Cd, Cr, Cu, Hg, Ni, Pb, Zn.
lightly stabilised steel slag	1	37			(100)			-	-	As, Ba, Cd, Cr, Cu, Mo, Ni, Pb, V, Zn.
lightly stabilised E fly ash	1	40			(100)			-	-	As, Cd, Cr, Se, V, Cl, F, SO4.
phosphor acid gypsum	2	49	N	[2]			100	Cd, F	Mo, Zn, SO4	As, Cu, Pb, Se, Sb, V.
mine stone(NL)	2	51	N	2 [2-2		100		SO4	-	As, Ba, Cd, Cr, Cu, Mo, Ni, Pb, Sn, Zn, Cl.
sorted	4-8				100			-	-	As(6), Ba, Cd, Cr, Cu, Ni, Pb(6), Zn, Cl(4), SO4.
mine stone(Ger)	3-11				100			-	SO4(10)	As(10), Ba(8), Cd, Cr, Cu, Hg(3), Ni, Pb(9), Zn, Cl(6).
E fly ash	1-17	52	N2	2-8 [1	17		83	Se(6)	Mo(16)	As(12), Ba(5), Cd, Co(2), Cr, Cu(8), Hg(1), Ni(11), Pb(9), Sb(5), V(10), Zn(6), F(4), Cl(4), SO4(6).
E bottom ash certified	1-13	53	N1	1-42	55	45		Se(12)	-	As, Ba(9), Cd, Co(12), Cr, Cu, Hg(9), Mo, Ni, Pb, Sb(7), Sn(10), V, Zn, Cl(1), F(1), SO4(12).
E bottom ash non cert.	3-49				84	16		Se(46), SO4(45	-	As, Ba(46), Cd, Co(46), Cr, Cu, Hg(45), Mo(43), Ni, Pb, Sb(39), Sn(43), V(46),Zn(48), Cl(3), CN-comp(3), CN-free(3), F(3).
fluid bed fly ash	1-2	54	N	1-2	17		83	Mo(1)	see E fly ash	As(1), Ba(1), Cr, Cu(1), Pb(1), Sb(1), Zn(1).
coal gassing bottom ash	2-4	56	N	[2-4]	84	16		-	see E bottom ash	As, Ba, Cd, Cu, Mo, Pb, Se, V, Cl(2), F, SO4.
coal gassing fly ash	1	58	N	[1]	(100)			-	-	As, Ba, Cd, Cu, Mo, Pb, Se, V, Cl, F, SO4.
MSWI bottom ash	2-74	59	N2	2-46	4	13	83	Mo(72)	Cu, Pb, Sb(50), Sn(11), Cl(8)	As(72), Ba(16), Cd(72), Co(3), Cr(70), Hg(6), Ni(71), Se(8), V(12), Zn(72), F(2), SO4(11).
MSWI fly ash	1-17	60	N	1-15 [1-17]			100	Mo(15)	Cd, Pb(16), Se(7), Zn, Cl(14), SO4(14)	As(15), Ba(7), Co(1), Cr(16), Cu(16), Hg(3), Ni(16), Sb(7), Sn(6), V(7).
blast furnace slag	1-8	61	N	1 [1-8	67	33		SO4(6)	Ba(2)	As, Cd, Co(2), Cr, Cu, Hg(3), Mo(7), Ni, Pb, Sb(2), Se(2), Sn(1), V(6), Zn, Cl(5), F(1).
blast furnace foam slag	1-4	62	N1	1 [1-4	100			-	-	As, Ba(2), Cd, Co(1), Cr, Cu, Mo(2), Ni, Pb, Sb(1), Se(1), V(2), Zn, SO4(1).
granulated blast furnace slag		63	N1	1	(100)			-	-	As, Ba, Cd, Co, Cr, Cu, Mo, Ni, Pb, Sb, Se, V, Zn.
blast furnace slag sand		64	N	1-2	100				-	As, Cd, Cr, Cu, Hg, Mo, Ni, Pb, V, Zn, Cl, SO4.
jarosite end slag		65	N	1			(100)	Ba(1)	Sb, Mo, Hg	As, Cd, Co, Cr, Cu, Ni, Pb, Se, V, Zn.
LD slag	1-14	66	N	1-3 [1	14		71	Br(7)	Cl(12), F(12)	As(9), Ba(13), Cd(9), Co(6), Cr, Cu(10), Hg(1), Mo(9), Ni(9), Pb(10), Sb(5), Se(2), Sn(5), V, Zn(12), SO4(11).
phosphor slag	1-7	67	N	1-3		100		F(1)	SO4(3)	As, Ba(2), Cd(4), Co(2), Cr(4), Cu(4), Mo, Ni(4), Pb(4), Sb(2), Se(2), V(5), Zn, Cl(1).
ELO slag	1-4	68	N	1-2 [1-3]		25	75	Mo	Ba, Cr	As, Cd, Co(1), Cu, Hg(2), Ni, Pb, Sb(1), Se(1), V(2), Zn, Cl(1).
E fly ash aggregate	2-5	71					100	As, Mo, Se(2)	-	Cd(2), Cr(2), Ni(2), Pb(2), Sb(2), V(2), Zn.

Note: The evaluation of the products could only be done with a small number of measurements. The accompanying confidence intervals are mostly large because of this.

The values between brackets are based on only 1 measurement. The divisions presented in this table are the best estimators based on the sample check.

Table 12.7.2.a Comparison (binomial) of the researched construction material with the standard values for the composition of the oBB

16-Jul-96

construction material	n	ident. nr.	Bijl.1 cat. oBB	cat. construct material <S1	>S1	most crit	others critical	others not critical
clay	2-27	0	G	100		-	-	As, Ba(11), Cd(23), Co(6), Cr(13), Cu(13), Hg(3), Mo(23), Ni(12), Pb(12), Sb(9), Se(8), Sn(3), V, Zn(13), Cl(2), F(2), SO4(2).
loam	2	1	G	100		-	-	As, Ba, Co, Cr, Cu, Mo, Ni, Pb, Sb, Se, V, Zn.
gravel	1-3	2	G	100		-	-	As, Ba, Cd, Co(2), Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Sn, V, Zn, Cl(1), F(1), SO4(1).
natural sand	1-152	3	G	100		-	-	As(69), Ba(149), Cd(9), Co(21), Cr, Cu(151), Hg(7), Mo(66), Ni(151), Pb(138), Sb(67), Se(22), Sn(4), V(148), Zn(107), Cl(1), F(1), SO4(1).
natural sand	1	4	G	(100)		-	-	As, Ba, Cd, Co, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Sn, V, Zn.
lime stone	1-4	5	N1	100		-	-	As, Ba(3), Cd, Co(2), Cr, Cu, Hg(3), Mo(2), Ni, Pb, Sb(3), Se(3), Sn(2), V(3), Zn, Br(1), Cl(2), F(2), SO4(1).
basalt	1	8	N1	(100)		-	-	Cd, Cr, Cu, Pb, Zn.
flug sand	1-6	11	N1	100		-	-	As, Cd(3), Co(3), Cr, Cu, Hg(2), Mo(3), Ni, Pb(3), Sb(3), Se(3), Sn(3), V(3), Zn(3), Cl(2), SO4(1).
lava stone	1-9	12	N1	100		-	-	As, Ba(4), Cd(5), Co(4), Cr, Cu, Hg(4), Mo(4), Ni(9), Pb(6), Sb(5), Se(4), Sn(3), V(5), Zn(6), Cl(1), F(1), SO4(2).
asphalt aggregate	3	32	N2	100		-	-	As, Ba, Cd, Co, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Sn, V, Zn.
asphalt cement:	1-15	15		100		-	-	As, Ba, Cd, Co(3), Cr, Cu, Hg(3), Mo, Ni, Pb, Sb(10), Se(10), Sn(4), V, Zn, Cl(1), F(3), SO4(1).
with MSWI fly ash	3			100		-	-	As, Ba, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Sn, V, Zn, Cl, F, SO4.
with E fly ash	2-5			100		-	-	As, Ba, Cd, Cr, Cu, Hg(2), Mo, Ni, Pb, Sb, Se, Sn(2), V, Zn, Cl(2), F(2), SO4(2).
with E + MSWI fly ash	3-6			100		-	-	As, Ba, Cd, Co(3), Cr, Cu, Hg(3), Mo, Ni, Pb, Sb, Se, V, Zn.
with phosphor slag	2				100	F(2)	-	
with MSWI bottom ash	1				(100)	Cu(1)	-	As, Ba, Cd, Co, Cr, Hg, Mo, Ni, Pb, Sb, Se, Sn, V, Zn.
cement aggregate	2-13	42	N1	100		-	-	As, Ba(12), Cd, Co(8), Cr, Cu, Hg(10), Mo(10), Ni(12), Pb, Sb(12), Se(11), Sn(10), V(11), Zn, Cl(2), F(2), SO4(2).
cement concrete	1-3	13		100		-	-	As, Ba, Cd, Co(1), Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Sn, V, Zn, Cl(2), F(2), SO4.
with hydr. fly ash aggregat	2			100		-	-	As, Ba, Cd, Co, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Sn, V, Zn, SO4.
with E fly ash	4			100		-	-	As, Ba, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Sn, V, Zn, Cl, F, SO4.
with E + MSWI fly ash	3			100		-	-	As, Ba, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Sn, V, Zn, Cl, F, SO4.
masonry aggregate	2-8	43	N1/2	100		-	-	As, Ba(7), Cd, Co(3), Cr, Cu, Hg(5), Mo(5), Ni, Pb, Sb(7), Se(6), Sn(5), V(7), Zn, Cl(2), F(2), SO4(2).
rough ceramic products	2-30	19		100		-	-	As, Ba(2), Cd(27), Co(2), Cr(8), Cu(8), Hg(3), Mo(24), Ni(8), Pb(8), Sb(2), Se(2), Sn(2), V(24), Zn(8), Br(2), Cl(2), F(2), SO4(2).
with E fly ash	25	20		100		-	Mo	As, Cd, V.
Ca-silicate bricks and bloc	1-6	23		100		-	-	As, Ba, Cd, Co(1), Cr, Cu, Hg, Mo, Ni, Pb(2), Sb, Se(2), Sn (20, V, Zn, Cl(1), F(1), SO4(1).
with E fly ash	2-3			100		-	-	As, Ba, Cd, Cr, Cu, Hg, Mo, Ni, Pb(2), Sb, Se(2), Sn(2), V, Zn, Cl(2), F(2), SO4(2).
aerated concrete	1-5	25		100		-	-	As, Ba(4), Cd, Co(3), Cr, Cu(4), Hg(1), Mo, Ni, Pb(4), Sb(1), Se(4), Sn(1), V(4), Zn(4), Cl(1), F(1), SO4(1).
with E fly ash	2-7	26		100		-	-	As, Ba(2), Cd, Cr(6), Cu(3), Hg(2), Mo, Ni(6), Pb(2), Sb(3), Se(3), Sn(2), V(3), Zn(2), Cl(2), F(3), SO4(3).
mixed aggregate certified	15	44	N1/2	100		-	-	As, Ba, Cd, Co, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Sn, V, Zn, SO4.
mixed aggregate non cert.	3-16			100		-	Ni(2)	As, Ba(11), Cd, Co(4), Cr, Cu, Hg(9), Mo, Pb, Sb(4), Se(4), Sn(3), V(7), Zn, Cl(5), SO4(7).
sieve sand	10-51	45	N2	100		-	-	As(31), Ba(11), Cd(32), Co(10), Cr(32), Cu(32), Hg(31), Mo(11), Ni(13), Pb, Sb(11), Se(10), Sn(11), V(10), Zn(50).
recycling breaker sand	2-37	46	N	100		-	-	As(21), Ba(17), Cd(36), Co(17), Cr, Cu(36), Hg(18), Mo(17), Ni, Pb(36), Sb(17), Se(17), Sn(17), V(17), Zn(36), Cl(2), SO4(19).
constr. and demolition was	2-43	47	N	100		-	-	As(23), Ba(2), Cd(25), Co(2), Cr(25), Cu(25), Hg(23), Mo(2), Ni(5), Pb, Sb(2), Se(2), V(2), Zn.
sand cement stabilisation	1	29		(100)		-	-	As, Ba, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Sn, V, Zn, Cl, F, SO4.
with E fly ash	1	30		(100)		-	-	As, Ba, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Sn, V, Zn, Cl, F, SO4.
blast furnace slag mix	1-13	34		100		-	-	As, Ba(9), Cd, Co(1), Cr, Cu, Hg(6), Mo(12), Ni(12), Pb, Sb(2), Se(2), Sn(1), V(9), Zn, Cl(4), F(1), SO4(4).
hydraulic mix aggregate	1-3	35		67	33	Cr(3)	-	As(1), Ba(1), Cd(2), Cu, Hg(1), Mo(1), Ni(2), Pb(2), Zn(2).
lightly stabilised phosphor	1-2	36			(100)	F	-	As(1), Ba(1), Cd(1), Cr(1), Cu(1), Mo(1), Ni(1), Pb(1), Se(1), Sn(1), V(1), Zn(1), Cl(1), SO4(1).
lightly stabilised steel slag	1	37			(100)	V	-	As, Ba, Cd, Cr, Cu, Mo, Ni, Pb, Zn.
stabilised MSWI slag	2-6	38		17	83	Cu(6)	Pb(5), Zn(6)	As(4), Ba(3), Cd, Co(3), Cr(4), Hg(3), Mo, Ni(4), Sb(5), Se(5), Sn(3), V(5), Cl(2), F(2), SO4(2).
lightly stabilised E fly ash	1-5	40		100		-	-	As(1), Cd, Cu, Mo, Pb(1), Sb, Se, V, Zn, Cl(1), F, SO4(4).
smoke-gas desulphurizing	1	48	N	(100)		-	-	As, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, V, Zn, Cl.
phosphor acid gypsum	1-8	49	N		100	F(1), SO4(1)	-	As, Ba(3), Cd, Co(3), Cr(4), Cu(5), Hg(4), Mo(5), Ni(4), Pb(4), Sb(4), Se(4), V(5), Zn, Br(1), Cl(1).
mine stone(NL)	2-4	51	N	100			-	As(4), Ba(2), Cd(4), Cr(4), Cu(4), Hg(2), Ni(4), Pb(4), Zn(4).
sorted	4-12			100		-	-	As, Ba(9), Cd(10), Co(4), Cr(10), Cu(10), Hg(10), Mo(4), Ni, Pb, Sn(4), Zn, Cl(4), SO4(8).
others	2-31			100		-	Zn	As, Ba(20), Cd, Co(3), Cr, Cu(30), Hg(7), Mo(5), Ni(30), Pb, Sb(4), Se(3), Sn(50), V(4), Cl(15), F(2), SO4(16).
washed	12			100		-	-	As, Cd, Cr, Cu, Ni, Pb, Zn.
E fly ash	15-77	52	N2	100		-	Cd(73), Cu(65), Mo(58), Se(60)	As, Ba(63), Co(45), Cr(73), Hg(40), Ni(51), Pb(67), Sb(62), Sn(15), V(66), Zn(75), Br(39), Cl(33), F(44), SO4(17).
E bottom ash certified	5-10	53	N1	100		-	-	As, Ba(7), Cd, Co, Cr, Cu, Hg(7), Mo(8), Ni, Pb, Sb(8), Se, Sn, V, Zn, SO4(5).
E bottom ash non cert.	4-78			100		-	Cd(88), Cu(88), Se(81)	As, Ba(71), Co(74), Cr, Hg(74), Mo(66), Ni, Pb(77), Sb(69), Se(75), V, Zn, Br(4), Cl(9), F(4), SO4(40).
fluid bed fly ash	1-4	54	N	100		-	-	As, Ba(3), Cd(3), Co(2), Cr, Cu(3), Hg(2), Mo(2), Ni(1), Pb(3), Sb, Se(2), V(2), Zn(2), Br(2), Cl(1), F(2), SO4(
fluid bed bottom ash	1-3	55	N	100		-	-	As, Ba, Cd(2), Co(1), Cr, Cu(2), Ni(1), Pb(2), Sb, Se(2), V(2), Zn(2), Br(1), F(2), SO4(2).
coal gassing bottom ash	1-6	56	N	100		-	-	As, Ba, Cd(5), Co(1), Cr, Cu(5), Hg(4), Mo(5), Ni(5), Pb(5), Sb, Se(1), Sn(4), V(5), Zn, Br(1), F(4), SO4(1).
coal gassing fly ash	1-3	58	N	100		-	-	As, Ba(1), Cd, Co(2), Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se(2), Sn(1), V, Zn, F(1).
MSWI slag	3-173	59	N2	2	98	Cu(173)	Cd(170), Cr(170), Mo(161), Ni(165), Pb(165), Sb(155), Sn(102), Zn, Cl(110)	As(170), Ba(116), Co(106), Hg(21), Se(109), V(112), Br(10), CN-vrij(3), F(11), SO4(12).
MSWI fly ash	6-80	60	N	1	99	Cd(80)	Cr(78), Cu(79), Hg(16), Mo(67), Ni(72), Pb(72), Sb(68), Sn(57), Zn, Br(7), Cl(66), SO4(3)	As(78), Ba(66), Co(62), Se(65), V(68), F(6).
blast furnace slag	1-9	61	N	100		-	Mo(8)	As(9), Ba(7), Cd, Co(5), Cr(8), Cu, Hg(4), Ni(8), Pb(8), Sb(7), Se(7), Sn(5), V, Zn, Br(1), Cl(1), F(1), SO4(1).
blast furnace foam slag	1-5	62	N1	100		-	-	As, Ba(3), Cd, Co(2), Cr, Cu, Hg(3), Mo(4), Ni, Pb, Sb(2), Se(2), Sn(2), V(3), Zn, Cl(1), SO4(1).
granulated blast furnace sl	2	63	N1	100		-	-	As, Ba, Cd, Co, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Sn, V, Zn.
blast furnace slag sand	1-4	64	N	100		-	-	As, Ba, Cd, Cr, Cu, Hg(2), Mo(3), Ni, Pb, Sb(3), Se(1), Sn(2), V, Zn, Cl(2), F(2), SO4(2).
jarosite end slag	3-22	65	N		100	Cu(14)	Ba(14), Cr(14), Mo(10), Sb(12), Zn(12), Ni(12)	As(14), Cd(12), Co(12), Hg(5), Pb(14), Se(5), Sn(3), V(4).
LD slag	1-24	66	N		100	V(14)	Cr, Ni(21)	As(21), Ba(15), Cd(22), Co(2), Cu, Hg(5), Mo(5), Pb, Sb(4), Se(4), Sn(3), Zn(22), Cl(1), F(9), SO4(8).
phosphor slag	1-12	67	N		100	F(3)	-	As, Ba(8), Cd, Co(4), Cr(10), Cu(11), Hg(4), Mo(9), Ni(10), Pb(11), Sb(8), Se(8), Sn(5), V(10), Zn(11), Br(1), Cl(1), SO4(2).
ELO slag	1-14	68	N		100	Cr	Mo(10), Ni, Se(4)	As, Ba(9), Cd, Co(4), Cu, Hg(10), Pb, Sb(4), Sn(4), V(8), Zn, Cl(1), F(2), SO4(1).
E fly ash aggregate	1-10	71		100		-	Zn	As(9), Ba(1), Cd, Cr(9), Cu(2), Hg(1), Mo, Ni, Pb, Sb, Se(9), Sn(1), V, Cl(1), F(1), SO4(1).
hydr. stabilised	1-2	73			100	Cl(1)	Cd, Sb	As(1), Ba(1), Co(1), Cr(1), Cu, Hg(1), Mo, Ni, Pb, Se(1), Sn(1), V, Zn, SO4(1).
expanded clay aggregate	2-7	72		50	50	SO4(4)	-	As(6), Ba, Cd(6), Co(5), Cr, Cu, Hg(2),Mo(5), Ni, Pb(6), Sb(5), Se(6), Sn(5), V(6), Zn, Cl(2), F(4).

Note: The evaluation of the products could only be done with a small number of measurements. The accompanying confidence intervals are mostly large because of this.

The values between brackets are based on only 1 measurement. The divisions presented in this table are the best estimators based on the sample check.

Table 12.7.2.b Comparison (binomial) of the researched construction materials with the standard values of the composition (organic) of the oBB

16-Jul-96

construction material	n	identification nr	Bijl.1 cat. oBB	cat. constru material		most crit	others critical	others not critical
				<S1	>S1			
clay	1-4	0	G	100		-	-	BETX(1), Phen(1), Cl-ph(2), PAH(3), PCB-tot(2), Min.oil, OCl(2), Cl-free(2).
gravel	2	2	G	100		-	-	PAH.
natural sand	1-5	3	G	80	20	PAH	-	PAH, EOCl(1), Min. oil(3).
lava stone	2	12	N1	100		-	-	PAH.
asphalt aggregate								
recycling	2	32	N2	48	52	PAH	-	
with tar	2	32	N2		100	PAH	-	
others	2-3	32	N2	48	52	PAH	PAH	EOCl, Min. oil.
asphalt cement:								
others	11-18	15	V1	60	40	PAH(5)	-	
recycling	18	15	V1	67	33	PAH	-	
cement aggregate	1-8	42	N1	64	36	PAH	-	EOCl(2), Min. oil(1).
cement concrete	3	13	V1	100		-	-	PAH.
masonry aggregate	1-3	43	N1/2	33	67	PAH	Min. oil(1)	EOCl(2).
mixed aggregate certified	15	44	N1/2	36	64	Min.oil	PAH	
mixed aggregate non cert.	1-7			13	88	PAH(6)	Min. oil(2)	EOCl(1).
sieve sand	2-138	45	N2	3	97	PAH(135)	Min. oil(42), Xyl(15), EOCl(77)	Benz(15), Eth.b(15), Tol(15), PCB(2).
recycling breaker sand	2-35	46	N	10	90	PAH(3)	Min. oil	
constr. and demol. waste undefined	13-68	47	N	43	57	Min. oil(14)	PAH(67), EOCl(13)	
mine stone(NL)	1-4		N	91	9	PAH	-	PAH(1), PCBs.
mine stone sorted	1			91	9	PAH	-	PAH, PCBs.
mine stone (others)	1-47			91	9	PAH(23)	Phen.(2)	PCB(27), EOCl(1), OCl-free(6), Min. oil(2).
E fly ash	2	52	N2	100		-	-	PAH.
E bottom ash	2-5	53	N1	100		-	-	PAH(2).
MSWI bottom ash	11-18	59	N2	82	18	PAH(17)	-	EOCl(11), PAH-tot, OCl(11).
MSWI fly ash	1-13	60	N	100		-	-	PAH(12), PCB-tot(1), EOCl(10), OCl(10).
blast furnace slag	1-4	61	N	100		-	-	Phen(1), Cl-ph(1), PAH, PCB(1), EOCl(2), Min.oil(1), OCl(1), Cl-free(1).
blast furnace foam slag	2	62	N1	100		-	-	PAH.
granulated blast furnace slag	2	63	N1	100		-	-	PAH.
LD slag	2	66	N	100		-	-	PAH.
phosphor slag	2	67	N	100		-	-	PAH.
ELO slag	2	68	N	100		-	-	PAH.

Note: The evaluation of the products could only be done with a small number of measurements. The accompanying confidence intervals are mostly large because of this.

The values between brackets are based on only 1 measurement. The divisions presented in this table are the best estimators based on the sample check.

Table 12.7.2.c — Comparison (binomial) of the researched construction materials with the new adjusted standard values of the composition (organic) of the the Administrative Order for Construction Materials.

16-Jul-96

construction material	n	iden-tifi-cati-on nr	Bijl.1 cat. oBB	cat. constru material		most crit	others critical	others not critical
				<S1	>S1			
clay	1-4	0	G	100		-	-	BETX(1), Phen(2), Cl-ph(2), Arom.(2), OCl(2), Cl-free(2), PAH(3), PCB(2), Min.oil.
gravel	2	2	G	100		-	-	PAH.
natural sand	1-5	3	G	100		-	-	PAH(4), EOCl(1), Cl-free(1), Min. oil(3).
lava stone	2	12	N1	100		-	-	PAH.
asphalt aggregate								
recycling	2	33	N2	100		-	-	PAH.
with tar	2	33	N2		100	PAH	-	
others	2-3	33	N2	100		-	-	EOCl, PAH, Min. oil(2)
asphalt cement:	11-18							
others		15	V1	100		-	-	PAH(5)
recycling	18	15		100		-	-	PAH.
cement aggregate	1-8	42	N1	100		-	-	EOCl(2), PAH, Min. oil(1).
cement concrete	3	13	V1	100		-	-	PAH.
masonry aggregate	1-3	43	N1/2	100		-	-	EOCl(2), PAH, Min. oil(1)
mixed aggregate certified	15	44	N1/2	100		-	-	PAH, Min. oil(17)
mixed aggregate non cert.	1-7			100		-	-	PAH(6), EOCl(1), Min. oil(2).
sieve sand	2-138	45	N2	64	36	Min.oil(42)	Xyl(15), PAH(135), PCB(2), EOCl(77)	Benz.(15), Ethylb.(15),Tol(15).
recycling breaker sand	2-35	46	N	82	18	Min. oil	PAH(19)	
constr. and demol. waste undefined	13-68	47	N	64	36	Min. oil(14)	EOCl(13), PAH(67)	
mine stone(NL)	1-4			100		-	-	PAH(1), PCBs.
mine stone sorted	1			100		-	-	PAH, PCBs.
mine stone (others)	1-47			100		-	Phen(2)	PAH(23), PCB(27), EOCl(1), OCl-free(6),
								Min. oil(3), Phen(2).
E fly ash	2	52	N2	100		-	-	PAH.
E bottom ash	2-5	53	N1	100		-	-	PAH(2).
MSWI bottom ash	11-18	59	N2	100		-	-	PAH(17), EOCl(11), OCl(11).
MSWI fly ash	1-13	60	N	100		-	-	PAH(12), PCB-tot(1), EOCl(10), OCl(10).
blast furnace slag	1-4	61	N	100		-	-	Phen(1), Cl-ph(1), PAH, PCBs(1), OCl(1), Cl-free(1)
								PCB-tot(1), EOCl(2), Min.oil(1).
blast furnace foam slag	2	62	N1	100		-	-	PAH.
granulated blast furnace slag	2	63	N1	100		-	-	PAH.
LD slag	2	66	N	100		-	-	PAH.
phosphor slag	2	67	N	100		-	-	PAH.
ELO slag	2	68	N	100		-	-	PAH.

Note : for PAK see appendix 18

12.7.3 Evaluation of construction materials

12.7.3.1 Clay

General

column test emission:	1 observation
cascade + extrapolation emission:	0 observations
aqua regina composition:	5 observations
transformed total-destruction composition:	24 observations
organic compounds composition:	4 observations

Clay is categorized in the oBB as well in the Building Materials Decree into the category of construction materials which are allowed to become soil.

oBB inorganic composition: The composition of clay must be tested according to the target value soil quality. From the comparison, it appears that one or two measurements of Ba, Cd, Co, Cu, Cr, Ni, Mo, Zn, Cl and SO_4 lie above the target value soil quality. This is possible, in view of the definition of the target value[46]. In this comparison, there is a correction for the humus and lutum content (Lu 25%, Hu 10%). Of clay it is known that it bonds metals. The excessions of the target value soil quality which are mentioned are also regarded as significant outliers, except those of Ba, Cd, Co, Cr, Mo, Ni, Cl, and SO_4. Cd, Mo, and Cl are measured on the level of the detection limit. The remaining measurements do not show any excession of the target value soil quality. All the measurements lie below the S1 standard [0/23] for construction materials. A target value soil quality Se, Sb, V, SO_4 and Cl is not included in Milbowa; Se and SO_4 also do not (yet) have a correction for humus and lutum. The background values used are described for Se, V, and Sb in [4] and SO_4 and Cl in chapter 7. The measurements coincide with the variety of the Dutch soils. The SO_4 measurement concerns a so-called total-destruction. In view of the high level of the measurement value, it is probably a measurement of total sulphur (S) which is converted to SO_4. This usually results in too high values, because not all sulphur appears to be SO_4. The literature source does not clarify this point. From an RIVM study of the background contents of heavy metals in soils of unburdened Dutch

[46] The target value soil quality are based on the background values of metals in the unburdened Dutch soil and are chosen in such a way that 90% of the soils meet these standards (see chapter 7).

nature areas [27], it appears that the average concentrations of the measured compounds in soil lie well below the target value soil quality (see table 12.7.3.1.1.)

Table 12.7.3.1.1. Composition and emission from natural soils (n=25)

compound	composition (mg/kg) mean	composition (mg/kg) s.d	target value soil quality (*) (mg/kg)	Emission (mg/kg) mean	Emission (mg/kg) s.d.
As	10.8	12.0	29	0.29	0.34
Ba	59.4	100	200	0.38	0.38
Ca	1949	2448	-	141	176
Cd	0.26	0.33	0.79	0.009	0.009
Co	3.0	4.3	20	0.05	0.09
Cr	13.6	16.4	100	0.04	0.05
Cu	8.7	9.9	36	0.14	0.10
Hg	0.17	0.10	0.3	0.005	0.008
K	776	850	-	39.9	44.7
Mg	1515	2488	-	23.3	26.3
Mo	< 4	-	10	0.02	0.09
Na	328	312	-	40.8	44.3
Ni	10.6	15.3	35	0.16	0.27
Pb	32.1	28.0	85	0.35	0.45
Sb	< 0.6	-	(2.6)	0.004	0.009
Se	< 0.6	-	(1)	0.009	0.015
Sn	6.3	9.7	20	0.007	0.018
V	18.3	19.1	(68)	0.15	0.24
Zn	31.6	36.8	140	0.80	1.0
F			500		
Cyanide-free			1		
Cyanide-complex			5		
S-total			2		
Br			20		
Cl-sweet Cl-salty/brackish			(200) (**)		
SO_4-sweet SO_4-salty/brackish			-		

* The value is corrected for Lutum (25%) and Humus (10%).

** If the chloride concentration in the groundwater is greater than 5000mg/l, then no limits are set concerning the composition for chloride and sulphate.

<u>oBB organic compostion</u>: No excessions of the S1 standard for construction materials [0/2] are observed in the sample. For the screening of pesticides, the detection limit is greater than the S1 standard for construction materials.

New organic composition standards: Concerning its organic components, clay is a category 1 construction material. The detection limits are too high to evaluate whether the researched clay also meets the target value soil quality organic compounds.

oBB leaching: For this natural construction material, the oBB does not require an evaluation of the leaching behaviour. This construction material is placed into the category of construction materials which are allowed to become soil according to appendix 1.

An "evaluation" cannot take place because there is only one emission measurement available. Molybdenum (Mo) and antimony (Sb) both show an excession of the U1 standard for construction materials. Sb lies on the standard for construction materials and Mo is a factor 2 higher. It is known that the Mo and Sb concentrations can vary strongly in Dutch soil.

From table 12.7.3.1.1. (leaching of natural soils) it appears that Mo and Sb, measured in approximately 19 soils coming from unburdened nature areas, shows an average leaching (at cum-L/S=10) of 0.02 mg/kg and 0.004 mg/kg respectively; this is below the U1 standard for construction materials.

New leaching standards: After adjusting the standards for construction materials, the Mo and Sb, in case these standards for construction materials would be applicable, also fall under the U1 standard for construction materials.

Conclusion: There is no reason to accept that clay, coming from unpolluted locations, may not be applied as a construction material which is allowed to become soil. The composition is compared with the target value soil quality per compound. The available inorganic data and other research do not dispute this. For organic compounds, this could not be determined, because of the high detection limits. The RIVM expects that clay, coming from unpolluted locations, is always (100%) a construction material which meets the requirements for construction materials which are allowed to become soil.

The leaching observed (one observation) lies within the range of leaching values measured in Dutch soils.

12.7.3.2 Loam

General

column test emission: 0 observations

cascade + extrapolation emission: 0 observations

aqua regina composition: 0 observations

transformed total-destruction composition: 2 observations

organic compounds composition: 0 observations

Loam is a construction material which is allowed to become soil according to the oBB and the Building Materials Decree. This is to say that the composition must be tested according to the target value soil quality.

oBB inorganic composition: None of the contents exceed the S1 standard for construction materials [0/2]. Loam, on the basis of the composition, fits into the category of applicable construction materials. Ba and Co exceed the target value soil quality (see footnote under "Clay" concerning the target value soil quality).

Conclusion: There is no reason to accept that loam, originating from non-polluted locations, may not be applied as construction material which is allowed to become soil. The composition is compared with the target value soil quality per compound. The available inorganic data does not dispute this. For organic compound, this could not be determined because of the lack of data. The RIVM expects that loam, originating from non-polluted locations, is always (100%) a construction material which is allowed to become soil.

12.7.3.3 Gravel

General

column test emission: 2 observations

cascade + extrapolation emission: 0 observations

aqua regina composition: 2 observations

transformed total-destruction composition: 1 observation

organic compounds composition: 2 observations oBB inorganic composition: From the comparison, it appears that two of the three measurements for chromium (Cr), and one of the three measurements for Nickel (Ni) (see footnote under "Clay"), are greater than the target value soil quality. Chloride is measured by way of total destruction on the level of the detection limit. The lutum and humus content is 0 for gravel. A possible cause for the higher Ni and Cr concentrations is that with the sample preparation, the gravel is ground with apparatus containing parts made of Cr/Ni steel. In general, if the Ni or Cr content of a compound must be determined, the grinding must be carried out with equipment of which the parts susceptible to wear are made of wear-resistant wolfram carbide. Some labs grind with equipment made of chromium-nickel steel. Contamination of the sample with Cr and Ni then occurs. In view of the high Cr concentration, this may be a possible explanation for the "high" Cr and Ni content. The S1 standard for construction materials is not exceded [0/3].

oBB organic composition: In the data base, two observations for organic compounds in gravel are included. Both measurements concern analyses for PAHs. No excessions of the S1 standard for construction materials are found [0/2]. The target value soil quality for organic compounds are not exceded, as far as they have been measured, and do not concern detection limits.

New organic composition standards: see oBB organic composition.

oBB leaching: The Mo emission [1/2] exceeds the U1 standard for construction materials. As a result of this, gravel fits partly into category N2 construction materials, if the N standards for construction materials, as stated in appendix 2, would be applicable.

New leaching standards: After adaptation of the calculation method for the standards for construction materials, the highest measurement of Mo reaches just above the standard for construction materials. Gravel is expected to meet the criteria of a category 1 construction materials.

Conclusion: There is no reason to accept that gravel, originating from non-polluted locations, cannot be applied as a construction material which is allowed to become soil. The composition is compared with the target value soil quality per compound. The available (in)organic data does not dispute this.

The RIVM expects that gravel, originating from non-polluted locations, is always (100%) a construction material which is allowed to become soil. For the calculation of the emissions, the detection limits are included as measurement values. The "true" value will usually be lower.

12.7.3.4 Natural sand

General

column test emission:	5 observations
cascade + extrapolation emission:	1 observation
aqua regina composition:	8 observations
transformed total-destruction composition:	144 observations
organic compounds composition:	5 observations

Natural sand is categorized in the oBB as well in the Building Materials Decree as a construction material which is allowed to become soil. One analysis series appears to show outliers for all the measured emissions. The values are unlikely high, and are not included in the comparison[47].

oBB inorganic composition: Natural sand is a construction material which is allowed to become soil, that is to say, the composition must be tested according to the target value soil quality. From the comparison, it appears that cadmium (Cd) (1/8[1/10])[48] and several of the Cu, Ba, Mo, and Ni measurements exceed the target value soil quality (see footnote under "Clay"). Cd, Cu, and Mo are outliers. The remaining measurements are below the target value soil quality, keeping in mind the lutum and humus contents for sand. Cd and Mo are measured on the level of the detection limit. The chloride (Cl) content is measured once by way of total-destruction and concerns a detection limit. The S1 standard for construction materials is exceded by one Mo measurement [1/66]; this concerns a transformed value which is also an outlier.

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[47] Possible typing errors in the literature sources consulted and probable analysis mistakes in the research based on these consultations are not inquired of the author of the literature source by RIVM

[48] (a/b[c/d]): Between the round brackets: of the total measurements b, a measurements exceed the standard value. This concerns non-transformed and/or non extrapolated measurements. Between square brackets: of the total measurements d, c measurements exceed the standard value. The total d is now including transformed and/or extrapolated observations.

oBB organic composition: In the database for organic compounds, industrially used sand is also included under "natural sand". From the information available it is not possible to deduce how representative these samples are for natural sand. This probably concerns sand which is released during the cleansing of industrial terrains and must be dumped. For these samples, an excession of the S1 standard for construction materials for mineral oil has been observed twice (2/3). These are not included in the evaluation. Five measurements of PAHs have been taken, none of PCBs. One measurement of chrysene (1/5) just exceeds the S1 standard for construction materials (at 0,58 mg/kg). The PAHs which exceed the target value soil quality appear to be outliers, or lie on the detection limit level.

New organic composition standards: After raising the PAH standard for construction materials, chrysene also falls under the S1 standard for construction materials for PAHs [0/5].

oBB leaching: One emission measurement of both Mo [1/5] and Cd [1/6] lies above the U1 standard for construction materials. The Cd measurement lies on the U1 standard for construction materials and is a significant outlier; the Mo measurement lies a factor of two higher.

New leaching standards: After adapting the standards for construction materials, natural sand falls under the category 1 standard for construction materials, also for Mo and Cd, in case these standards for construction materials would be applicable.

Conclusion: There is no reason to accept that sand, originating from non-polluted locations, may not be applied as a construction material which is allowed to become soil. The composition is compared per compound with the target value soil quality. The available (in)organic data does not dispute this. The RIVM expects that sand, originating from non-polluted locations, is always (100%) a construction material which is allowed to become soil.

12.7.3.5 De-silted sea sand

General

column test emission:	1 observation
cascade + extrapolation emission:	0 observations
aqua regina composition:	1 observation
transformed total-destruction composition:	0 observations
organic compounds composition:	0 observations

In the oBB, de-silted sea sand is placed into the category of construction materials which is allowed to become soil. It is often applied as embankment. With the testing, a difference is made between applications on salty and/or brackish soils, and applications on soils with sweet groundwater. Salty and brackish soils are defined by DGM as soils with a groundwater Cl concentration greater than 5000 mg/l. The chloride standards for construction materials which are allowed to become soil as determined by DGM, are given in table 7.5.2. for the various areas. The Cl concentration of non-de-silted sea sand is always too high for application on soils with sweet groundwater and in sweet waters. The quality must therefore be adapted and tested according to the standards for construction materials which are allowed to become soil.

oBB inorganic composition: In the oBB, de-silted sea sand is a construction material which is allowed to become soil, that is to say, the composition must be tested according to the target value soil quality. From the comparison it appears that all material concentrations lie below the target value soil quality, and therefore also below the S1 standard for construction materials. The most critical parameters are chloride and sulphate. In order to make application of sea sand possible on soils with sweet groundwater, the sea sand is first de-silted.

In an de-silting experiment, 48 sets of three measurements are taken at various depths in an de-silting well-boat [36]. With each set, one sample is taken close above the bottom of the well-boat (0.2 - 0.3m), where the flushing is minimal. The Cl contribution of this lowest layer is approximately 10% of the average content. On average, the chloride concentration was below 200 mg/kg, thereby meeting the DGM proposed standard for chloride (200 mg/kg) for construction materials which are allowed to become soil. For the 48 results, no excessions of the chloride S1 standards for construction materials were noted. All the measured compounds lie below the S1 standard for construction materials.

Leaching oBB: Regarding the cations, de-silted sea sand shows no excession of the U1 standard for construction materials, based on one observation. The highest content of Cl (per set of the de-silting experiment mentioned earlier) is equal to the U1 standard for construction materials for Cl. The Cl leaching emission of this measurement-set of de-silted sea sand can therefore never be higher than the U1 standard for construction materials. Based on this data, de-silted sea sand meets the criteria for category N1 construction materials which are applicable on soils with sweet groundwater.

New leaching standards: see oBB leaching.

Conclusion: There is enough information available for a definite judgment. Technically, it is possible to de-silt sea sand up to the level of the category 1 construction materials (see notice RWS-DWW [37]). De-silted sea sand can then be regarded as a construction material which is allowed to become soil in areas with sweet groundwater.

12.7.3.6 Lime stone

General

column test emission:	0 observations
cascade + extrapolation emission:	0 observations
aqua regina composition:	2 observations
transformed total-destruction composition:	2 observations
organic compounds composition:	2 observations

Lime stone (powder) is classified under the N1 category in the oBB. Information about the leaching behaviour is not available for either lime stone or lime stone powder. For each of these compounds, one composition is determined after destruction with the help of aqua regina and one after total-destruction. Lime stone, also called marl, is made up of more than 75% $Mg(CaCO_3)_2$. Gypsum is a sulphate compound of calcium ($CaSO_4$) and is associated with lime stone. Portland cement, in which this compound is processed, contains approximately 30000mg/kg SO_4, which is also entirely available for leaching [38].

oBB inorganic composition: None of the compound concentrations measured exceed the S1 standard for construction materials [0/2]. Lime stone powder is both a non-prefabricated construction material as well as a supplement material in prefabricated construction materials.

Conclusion: There is not enough information available for a definite judgment. Lime stone (powder) is not often applied as a non-prefabricated construction material in the current construction practice. There is no leaching data available. Regarding composition, there do not appear to be any problems. The leaching will, in view of the composition, be limited. The RIVM expects that lime stone will fit 100% into the category 1 construction materials.

12.7.3.7 Basalt

General

column test emission:	0 observations
cascade + extrapolation emission:	0 observations
aqua regina composition:	0 observations
transformed total-destruction composition:	1 observation
organic compounds composition:	0 observations

Basalt is categorized in the oBB as N1. The number of compounds measured is limited.

oBB inorganic composition: None of the composition contents measured exceed the S1 standard for construction materials.

Conclusion: There is not enough information available for a definite judgment. Application as a non-prefabricated construction material will probably not create any environmental hygienic problems. It is expected that this construction material will fit 100% into the category 1 construction materials.

12.7.3.8 Flug sand

General

column test emission: 0 observations
cascade + extrapolation emission: 1 observation
aqua regina composition: 3 observations
transformed total-destruction composition: 3 observations
organic compounds composition: 0 observations

Flug sand is categorized in the N1 category in the oBB, and is of volcanic origin.

oBB inorganic composition: None of the concentrations measured exceed the S1 standard for construction materials (Mo[0/2]).

oBB leaching: None of the compounds measured exceed the U1 standard for construction materials. This conclusion agrees with appendix 1 of the oBB.

New leaching standards: see oBB leaching.

Conclusion: There is not enough information available. No environmental problems are expected for flug sand which will impede its application as a category 1 construction material.

12.7.3.9 Lava stone

General

column test emission: 2 observations
cascade + extrapolation emission: 1 observation
aqua regina composition: 7 observations
transformed total-destruction composition: 2 observations
organic compounds composition: 2 observations

One analysis set appeared to produce outliers for all the compound emissions which were measured (column test). These values are unlikely high, and are not included in the comparison[49]. According to appendix 1 of the oBB, lava stone is placed into category N1.

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[49] Possible typing errors in the literature sources consulted and probable analysis mistakes in the research based on this literature are not investigated by the RIVM with the author of the literature source.

<u>oBB inorganic composition</u>: All the concentrations, for as far as they have been measured, lie below the S1 standard for construction materials [0/7].

<u>oBB organic composition</u>: There are no excessions observed for the PAHs of the S1 standard for construction materials. No measurements were available for PCB and BETX.

<u>New organic composition standards</u>: see oBB organic composition.

<u>oBB leaching</u>: One arsenic (As)-[1/3], one Cd-(1/2[1/3]) and one Mo-(1/2[1/3]) emission measurement lie above the U1 standard for construction materials (Cd:0.03mg/kg and Mo: 0.8mg/kg). F(1/1) lies on the U1 standard for construction materials. As, Mo, and Cd are measured on the detection limit level or are outliers. Based on Mo and Cd, part of this construction material could be applied as a N2 construction material, and the rest as a N1 construction material.

<u>New leaching standards</u>: After adaptation of the calculation method for the standards for construction materials, lava stone, also for As, Mo, F, and Cd, would fit completely (including the outliers) into the category 1 construction materials [0/3].

<u>Conclusion</u>: Lava stone is a construction material of natural origin. Excession of the standards for construction materials is not likely. Non-polluted lava stone will be 100% applicable as a category 1 construction material.

12.7.3.10 Asphalt aggregate and crushed asphalt cement

<u>General</u>

test	number of observations in the data base									
	aggregate			crushed asphalt cement						
				without waste material						
	unknown	bitumen	tar	with tar	without tar	with E fly ash	with MSWI fly ash	with MSWI fly ash & E fly ash	with phosphor slag	with MSWI bottom ash
column test	2				4	3	3	1	0	0
cascade + extrapolation	0				0	0	0	0	0	0
aqua regina destruction	3				14	3	0	6	0	1
total-destruction and transformed	0				3	2	3	2	2	0
organic (unknown)		8	2	7	11					
organic (recycling)	2				18					

The emission behaviour of asphalt aggregate appears twice in the data base (column test).

Aside from this, four observations concern a column test on a crushed asphalt cement sample in which no waste materials are processed, and seven observations of crushed asphalt cement samples in which waste materials are processed. These products are in granular form and are all leached by way of the column test. They are considered to give an impression of the emission behaviour of asphalt aggregate in their second life cycle as non-prefabricated construction material. In the discussion it will be indicated which results concern which construction materials. Concerning the organic compounds, for both asphalt cement as well as asphalt aggregate, a distinction is made between asphalt aggregate with bitumen, asphalt aggregate with tar, and recycling asphalt aggregate. In the oBB, asphalt aggregate is placed into the category N2 construction materials, mostly on the basis of the prescence of PAHs.

oBB inorganic composition: For the inorganic compounds in asphalt aggregate and crushed asphalt cement with no waste materials, no excessions of the S1 standard for construction materials are found (Ni[0/17]).
Asphalt cement with MSWI and/or E fly ash (2-50% fly ash) do not show an excession of the S1 standard for construction materials, but crushed asphalt cement with more than 59% phosphor slag ([2/2] fluor measurements) and crushed asphalt cement with MSWI bottom ash (1/1 Cu measurement) do.

oBB organic composition: A division is made between asphalt aggregate on the basis of remaining/unknown asphalt aggregate, recycling asphalt aggregate, and asphalt aggregate in which tar has been processed.

Remaining/unknown asphalt aggregate: For the EOCl measurements, no excession have been observed. The two measurements of mineral oil [2/2] for asphalt aggregate from the group remaining/unknown exceed the S1 standard for construction materials. From this and other RIVM research [39], it appears that asphalt contains approximately 4600 mg/kg mineral oil. This concerns mostly the lighter oil fractions in bitumen. A high concentration in itself is not an indication that there will be an unacceptable emission.
Five measurements have been carried out for PAHs total, of which four of the five measurements are higher than the S1 standard for construction materials. Also several of the individual PAHs exceed the S1 standard for construction materials: naphthalene [2/8],

phenanthrene [5/8], anthracene [2/8], fluoranthene [5/8], chrysene [7/8], and benzo(a)pyrene [3/7], with chrysene being the most critical PAH. In two samples, the PAH contents are ten times higher than the other five samples (3*the S1 standard for construction materials for PAH total). The RIVM has not investigated whether these two samples contain a small amount of tar.

Recycling asphalt aggregate: Mineral oil is not measured. PAHs are measured for only two samples. Only chrysene [2/2] exceeds the S1 standard for construction materials.

Asphalt aggregate (with tar): Mineral oil is not measured in asphalt aggregate with tar. Two PAH measurements have been carried out. With the exception of benzo(k)fluoranthene, benzo(ghi)perylene, benzo(a)anthracene and indeno(1,2,3cd)pyrene, the PAH contents are higher than the S1 standards [2/2]. The average of 10 PAHs total is a factor of 5-10 above the S1 standard for construction materials. The asphalt aggregate with tar is not suitable for re-use on the basis of the PAHs in the testing according to the standards for construction materials.

Crushed asphalt cement (unknown/remaining): Some individual PAHs exceed the S1 standard for construction materials: chrysene [2/5], fluoranthene [1/5], phenanthrene [1/5], and naphthalene [2/5]. Chrysene is the most critical PAH.

Recycling crushed asphalt cement: PAHs total is not given, because the prescribed 10 individual PAHs are not measured. Of the individual PAHs, naphthalene [1/18], phenanthrene [2/18], anthracene [2/18], fluoranthene [5/18], chrysene [6/18], and benzo(a)pyrene [2/18] exceed the S1 standard for construction materials. Chrysene is the most critical PAH.

Crushed asphalt cement (with tar): PAHs total [7/7] exceeds the S1 standard for construction materials. Most of the individual PAHs also exceed the S1 standard for construction materials: chrysene [7/7], fluoranthene [7/7], phenanthrene [7/7], anthracene [7/7], benzo-anthracene [2/7], benzo (a) pyrene [7/7], indeno-pyrene [1/7], and naphthalene [7/7]. Chrysene is the most critical PAH.

Asphalt aggregate and crushed asphalt cement without tar show the same results concerning the PAHs, that is to say, that chrysene is the most critical parameter [7/8+2/2+2/5+6/18=17/33]. Altogether, approximately 52% (34-69%) of this construction material, based on chrysene [17/33 observations], will not be applicable according to the oBB.

New organic composition standards: In the Building Materials Decree, asphalt aggregate and asphalt cement do not have to be tested according to the composition standard for mineral oil for construction materials. After raising the S1 standards for construction materials for PAHs, the measurements of asphalt aggregate (remaining/unknown), recycling asphalt aggregate, crushed asphalt cement (remaining/un-known) and recycling crushed asphalt cement fall below the S1 standards for construction materials [0/8+0/2+0/5+0/18=0/33].

The PAH content in asphalt aggregate (tar-containing) and crushed asphalt cement (tar-containing) continue to exceed the S1 standards and are therefore not applicable according to the standards of the Building Materials Decree. These tar-containing aggregates can be applied in a special category of construction materials with special application requirements.

Asphalt aggregate and crushed asphalt cement without tar will show in the future a decreasing excession of the composition standard for PAHs in construction materials. Currently, on the basis of chrysene [0/33] approximately 0% (0-11%) exceed the the S1 standard for construction materials, and are therefore 100% applicable under the Building Materials Decree. Recycling crushed asphalt cement meets the requirements.

Leaching oBB: Asphalt aggregate fits into the category N1 construction materials [0/2] based on the leaching (two observations). The Cd, Sb, and Se emissions of 0.05 mg/kg which exceed the U1 standards for construction materials, in both asphalt aggregate as well as crushed asphalt cement, are detection limits[50].

The excession of the U1 construction materials standard for Mo (0.01 mg/kg) in asphalt aggregate is also a high detection limit. Crushed asphalt cement without additions of

[50] In the calculation of emission from a construction material, detection limits are regarded as realistic values (worse case approach). In actual fact, these emissions are smaller or equal to the presented leaching value.

waste materials shows an Mo [4/4] excession for the U1 standard for construction materials.

There is no reason to accept that there is a quality difference between asphalt aggregate and crushed asphalt cement without waste materials.

Under the oBB, a part would fit into the category N2 construction materials based on the Mo [4/6]. For the emission measurements of the crushed asphalt cement samples in which MSWI fly ash is processed, Cd (1/2[1/3]), this is an outlier, Cl(1/1) and Sb(1/1) the U1 standard for construction emissions.

The Mo emission from crushed asphalt cement with MSWI or E fly ash exceeds the U1 standard for construction materials in all cases (2/2[2/2] and 2/2[2/2]) respectively and therefore fits completely into category N2 construction materials. Regarding the Sb-(1/1) and Mo-[1/1] emission, the U1 standard for construction materials is exceded for crushed asphalt cement with MSWI+E fly ash.

For the remaining crushed asphalt cement samples in which waste materials are processed, no leaching data from the column test is available.

<u>New leaching standards</u>: After adaptation of the standards for construction materials, no excession of the U1 standard for construction materials is found for asphalt aggregate [0/2] and crushed asphalt cement [0/4] without addition of waste materials, nor detection limits exeeds the standards [0/2+0/4=0/6]. For crushed asphalt cement with E fly ash or E+MSWI fly ash, an excession of the U1 standard for construction materials is observed for Mo[1/2] and Sb[1/1]. For crushed asphalt cement with MSWI fly ash, the Cd is on the U1 standard, while Sb and Cl show a factor 2 excession. No column test leaching data is available for crushed asphalt cement with phosphor slag, jarosite end slag (see appendix 12), or MSWI bottom ash.

<u>Conclusion</u>: Concerning the leaching behaviour of inorganic compounds, asphalt aggregate and crushed asphalt cement without waste materials are category 1 construction materials. No excession of the U1 standard for construction materials is observed. It is expected that, based on the leaching, 0% (0-46%) of this construction material will exceed the U1 standard. Based on the leaching tests of crushed asphalt cement samples, crushed asphalt cement containing MSWI fly ash and/or E fly ash as filling material, or containing MSWI bottom ash or phosphor slag as gravel replacements, may be

repositioned as category 2 construction materials in their second life cycle as non-prefabricated construction material. This will be dependent on the percentage of added secondary raw material(s); especially Mo seems to be critical time and again.

Asphalt on the basis of bitumen now contains approximately 0.5 mg/kg PAH total according to the branch union VBW asphalt. With the current quality of the new asphalt, a raising of the S1 standard for construction materials for PAHs is not necessary for this construction material. There is, however, still an "inheritance" from the past, namely, roads in which tar-asphalt has been processed. With the selective dismantling of these asphalt roads, it is possible that certain layers or repairs still contain tar. A minute polluting of the aggregate with tar is then possible. So as not to hinder the re-use of this aggregate, DGM has increased the S1 standards for PAHs (75 mg/kg for PAH total).
After adaptation of the PAH composition standard for construction materials by DGM, there are no more excessions for asphalt aggregate (bitumen [0/8]), recycling asphalt aggregate [0/2], crushed asphalt cement (remaining [0/5]) and crushed asphalt cement (recycling [0/18]). Based on the organic substanaces, asphalt aggregate [2/2] and asphalt cement [7/7] with tar cannot at all be admitted for re-use as a non-prefabricated construction material, and asphalt aggregate without tar or with a very small amount of tar can be completely admitted[51]. Therefore it fits 100% into category 1 construction materials. As better techniques become available to estimate the tar content of asphalt[52] [40], the seperation between bitumen asphalt and tar asphalt will become better.
For asphalt containing tar, DGM has included a so-called special category in the Building Materials Decree. Tar-containing asphalt can be applied in large-scale projects under special conditions. In this sub-class, tar-containing asphalt aggregate is completely applicable.
Based on the available measuring methods, asphalt and asphalt aggregate contain a substantial amount of mineral oil (4600 mg/kg). Since testing for mineral oil is not necessary, this does not lead to the non-applicability of this construction material.

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[51] A test method is still being developed by the RIVM for the leaching behaviour of organic compounds. Based on the organic compounds content, usually the PAH content, it is expected that part of the asphalt aggregate with tar will not be applicable as granular construction material but only as a special category construction material under certain application requirements.

[52] These methods are evaluated in the CROW committee WM14

12.7.3.11 Cement aggregate

General

test	number of observations in the data base				
	cement aggregate	broken cement concrete			
		without waste material	with E fly ash	hydraulically stabilised E fly ash aggregate	with MSWI bottom ash
column test	9	3	2	3	1
cascade + extrapolation	0	0	0		0
aqua regina destruction total-destruction	11	0	0		0
transformed	2	3	4	2	3
organic	9	3	0		0

An indication for the emission behaviour of cement aggregate can also be obtained from leaching tests of broken cement concrete samples which are leached with the column test. Waste materials (MSWI bottom ash 8%, E fly ash 5-8% or jarosite end slag (see appendix 12)) are added as gravel replacements to six broken concrete samples. The leaching tests are carried out on relatively fresh material. Stabilization by way of aging has not yet taken place.

According to appendix 1 of the oBB, certified cement aggregate is placed into category N1. By certified cement aggregate, the oBB means construction material which is obtained and produced with a certain measure of selectiveness and care, and whereby the quality improves with further developments of technology, regulation, and certification.

Non-certified cement aggregate is not placed into a category in the oBB. Currently, there is still hardly any certified cement aggregate on the market, but the certification according to the regulations and the procedures of the Certification Council (RvC) is developing. In the branch concerned, there is an own certification system. Washed cement aggregate which is leached in view of the Mammoth research, is more or less to be seen as such for inorganic compounds.

oBB inorganic composition: All the contents are below the S1 standard [0/15] for construction materials for both cement aggregate as well as broken cement concrete without waste materials. This is also the case for broken cement concrete with MSWI bottom ash, E fly ash, and hydraulically stabilised E fly ash aggregate.

oBB organic composition: One mineral oil measurement is done for cement aggregate. The detection limit is higher than the S1 standard for construction materials [1/1]. This measurement is not included in the evaluation. Mineral oil and PCBs are not measured in broken cement concrete.

For naphthalene [1/8], chrysene [4/8], and fluoranthene [1/8], excessions of the S1 standard have been observed for cement aggregate. Based on the chrysene, part of the cement aggregate does not apply for re-use as a non-prefabricated construction material.

Broken cement concrete does not show an excession of the U1 standard for PAHs. This is normal for clean broken cement concrete. Only during the use and the demolition phase, is pollution with organic compounds possible.

New organic composition standards: One mineral oil measurement is done for cement aggregate. This lies below the adjusted S1 standard for construction materials [1/1]. After adapting the S1 standards for PAHs, there is no excession anymore of PAHs [0/8+0/3=0/11].

oBB leaching:

Cement aggregate and broken concrete cement without waste materials: of the nine Mo emission measurements of cement aggregate, eight are above the U1 standard (8/9[8/9]). This means that a large part of this construction material could be applied as an N2 construction material. Barium (Ba) is also critical (2/8[2/8] measurements). The remaining excessions (Cd, Sb, Se, and Cu) concern detection limits or outliers.

With regards to the excession of the U1 standard (Mo(3/3) and Ba(1/2)), the same emission pattern is achieved for broken cement concrete (without waste materials being processed in it, and leached with the column test). The excession of Ni and Se appear to be detection limits. Based on Mo, broken cement concrete would fit completely into the N2 category of construction materials. Broken cement and cement aggregate together show an Mo excession [8/9+3/3=11/12].

Broken cement concrete with waste materials: Mo exceeds the U1 standard (3/3) and the U2 standard (2/3) for construction materials in cement concrete hydraulically stabilised fly ash aggregate. Se (3/3) is measured as being on the detection limit level. Mo is an element which is present in E fly ash and in construction and demolition waste.

One Mo emission (1/2) exceeds the U2 standard, and Ni(1/2) and Ba(1/1) exceed the U1 standard in broken cement concrete with E fly ash.
Ba(1/1) and Mo(1/1) exceed the U1 standard in broken cement concrete with MSWI bottom ash.

New leaching standards:
Cement aggregate and broken cement concrete without waste materials: After adaptation of the calculation for the leaching emission, cement aggregate fits into the category 1 construction materials, because Ba[1/9] (35 mg/kg) concerns an outlier, and the excessions of Cd, Sb, and Se concern detection limits (see footnote under asphalt aggregate). Broken cement concrete in which no waste materials are processed, also fit into category 1 construction materials.
The excession of Mo[1/3] concerns an outlier, and that of Ba (5.9 mg/kg) is equal to the leaching standard. Cement concrete and concrete aggregate together do not show an excession [0/10] after correction for outliers.

Broken cement concrete with waste materials: With regards to the U1 standard for construction materials, Ba(1/1) and Mo(1/1[1/2]) exceed for broken cement concrete with E fly ash, Mo(3/3[3/3]) exceeds for broken cement concrete with hydraulically stabilised E fly ash aggregate, and Ba (1/1) exceeds for broken cement concrete with MSWI bottom ash. Broken cement concrete with E fly ash (Mo:1/2) and with hydraulically stabilised E fly ash aggregate (Mo:1/3[1/3]) also exceed the U2 standard for construction materials.
For cement aggregate in which waste materials are processed, it is possible that application in category 1 construction materials (as non-prefabricated construction material in the second life cycle) is restricted. Application in road base layers with a thickness of 20 cm allows for broader application possibilities for Ba, but not for Mo.

Conclusion: As the result of lowering the target value of Ba by implementing Milbowa, cement aggregate in the form of unstabilised road base material would be only partly applicable in thin layers under category 1 conditions. After raising the allowable immission to approximately 6500mg/m^2, the re-use of cement aggregate in unstabilised road bases is not impeded anymore (100% category 1 construction material [0/10]).
If the leaching behaviour of broken cement concrete with waste materials is representative

for the cement aggregate of the future (second life cycle), then the emission behaviour of Mo and Ba could make its applicability as a category 1 construction material more difficult. The Mo originates partly from E fly ash which can be applied in cement concrete. After raising the composition standard for PAHs for construction materials, PAHs do not impede re-use anymore [0/11]. Mineral oil appears as pollution in construction aggregates. It probably originates from the asphalt waste in the cement aggregate. In the SKK certificate is stated that cement aggregate may contain maximum 5% (m/m) asphalt. Theoretically, this leads to 229 mg/kg mineral oil[53].

Not enough information is available concerning the appearance of mineral oil in cement aggregate. By raising the mineral oil standard to 500 mg/kg, no problems are expected for its re-use. In a random sample, the RIVM measured a content of 94 mg/kg. Through selective demolition and processing of cement aggregate, organic compounds could be prevented and/or removed. The applicability will improve as a result of this.

[53] The content of mineral oil in asphalt (according to GC NEN 5733) is 4590 $\pm$ 3800. According to the VBW asphalt, asphalt contains 4-6% bitumen, depending on its application. According to the RAW Standard 1990 for mix aggregates, cement aggregates, and masonry aggregates, the asphalt content may not be higher than 5% (m/m), 5% (m/m), and 10% (m/m) respectively. This means that, based on the current measuring method, construction recycling aggregates may contain mineral oil up to:
- mix aggregate 229 mg/kg
- cement aggregate 229 mg/kg
- masonry aggregate 459 mg/kg

The standard in the oBB was 250 mg/kg. The SKK strives to keep the asphalt content as low as possible. Despite this, it appears from recent research that 4 of the 15 samples of mix aggregate contained more than 5% (m/m) recognizable asphalt. Besides asphalt, of course, there are also other sources of mineral oil. In view of the previous, DGM has raised the standard for mineral oil for construction materials to 500 mg/kg. Asphalt cement and asphalt aggregate do not have to be tested according to the standard for mineral oil.

12.7.3.12 Masonry aggregate

General

test	number of observations in the data base								
	masonry aggregate	broken rough ceramic products		broken aerated concrete		broken calcium-silicate bricks and blocks		broken porous masonry bricks	broken mortar
		without waste materials	with E fly ash	without waste materials	with E fly ash	without waste materials	with E fly ash		
column test	4	0	0	1	2	1	2	2	0
cascade + extrapolation	0	39	20	0	0	1	0	0	0
aqua regina destruction	6	5	0	0	0	1	0	0	1
total-destruction	0	25	25	5	7	5	3	3	0
organic	4	0	0						0

In the comparison, information about broken products which can be part of masonry aggregate such as rough ceramic products, cement, mortar, aerated concrete blocks, and calcium-silicate bricks and blocks is also included. An evaluation on the basis of only a broken product gives an indication for the leaching behaviour, but does not give a definite answer concerning the current and the future quality of masonry aggregate. In the discussion, it will be indicated which result belongs to which product. According to appendix 1 of the oBB, certified masonry aggregate is placed in category N1, and non-certified masonry aggregate in N2.

oBB inorganic composition: With the exception of one outlier (rough ceramic products [Mo:1/25]), the S1 standard for construction materials is not exceded for either masonry aggregate or for broken products. Based on the oBB, masonry aggregate is completely applicable [0/24] with respect to its composition.

oBB organic composition: In one measurement, the detection limit of mineral oil is higher than the S1 standard for construction materials (350 mg/kg). One RIVM measurement of a masonry aggregate gives a mineral oil content of 98 mg/kg. Mineral oil is not included in the evaluation.

For phenanthrene (1/3), fluoranthene (1/3), and chrysene (2/3) is masonry aggregate, an excession of the S1 standard for PAHs has been observed. Chrysene is the most critical compound [2/3].

New organic composition standards: One measurement of mineral oil is carried out (<350 mg/kg); this measurement was below the adapted S1 standard for construction materials.
After raising the S1 construction materials standards for PAHs, there are no more excessions [0/3].

oBB leaching: The Mo concentrations (4/4[4/4] measurements) in masonry aggregate lie above the U1 construction materials standard. This means that this construction material would be allowed to be applied as N2 construction material. The highest SO_4 emission (1/3) is an outlier. The remaining excessions (Cd, Sb, and Se) are detection limits.
Washed masonry aggregate which is leached in view of the Mammoth research, is to be regarded as certified masonry aggregate. The emissions from this single observation lie below the U1 construction materials standard. The emissions from rough ceramic products which are made only of clay and which have undergone cascade tests which are extrapolated to an equivalent for the column test, show excessions of the U1 construction materials standard for As[35/39], Cd[1/31], Mo[30/31], and V[23/32]. The compounds As[10/39] and Mo[20/31] also exceed the U2 standard. Based on these givens, broken ceramic products could be partly applicable as non-prefabricated construction materials under the standard setting of the oBB, based on the Mo. If E fly ash is added to the rough ceramic products, then the U1 standard is exceded by As([16/20]), Mo([14/16]), and V([10/16]), and the U2 standard is exceded by As[3/20] and Mo[2/16]. Based on the As, a part would not be applicable anymore as a non-prefabricated construction material. The analyses of rough ceramic products involve test series. For broken calcium-silicate bricks and blocks without E fly ash, none of the compounds exceed the U1 standard for construction materials (Ni is measured at the detection limit level). If E fly ash is added, then As(1/2[1/2]), Mo(2/2[2/2]), Ni(1/2[1/2]), Sb(1/1[1/1]) and V(2/2[2/2]) exceed the U1 standard. Ni concerns a measurement on the detection limit level. For broken aerated concrete without E fly ash, only Mo[1/1] exceeds the U1 standard, and SO_4[1/1] the U2

standard. If E fly ash is processed in the aerated concrete, then Cr[2/2], Mo[2/2], V[1/2] and SO_4[2/2] exceed the U1 standard, and Mo[1/2] also exceeds the U2 standard. The products mentioned containing E fly ash are test series. Aerated concrete is not applied outside and therefore does not fall under the regulations of the Building Materials Decree. Aerated concrete can, however, appear in construction and demolition waste.

E fly ash is processed in porous masonry brick. The bricks are not applied outside. If these bricks are broken and leached with the column test, then As(2/2), Mo(2/2), Ni(2/2), V(2/2) and SO_4(2/2) exceed the U1 construction material standard, and Mo(2/2) also exceeds the U2 standard. In general, the emissions appear to be dependent on the amount of added waste material and the process circumstances. A part of the products with waste materials described here are produced and researched only experimentally.

New leaching standards: After adapting the calculation of leaching emissions from construction materials, masonry aggregate fits into the category 1 construction materials (Mo:[0/4]). The excessions observed (Cd, Sb, and Se) are detection limits (see footnote under asphalt aggregate) or are outliers (sulphate:1/2[1/3]). Washed masonry aggregate which is to be seen as certified masonry aggregate, has a remarkably low SO_4 leaching. The SO_4 originates from portland cement (30000mg/kg SO_4 which is completely available for leaching [38]). By sieving the fine material, the softer cement will be seperated, and contribute less to the SO_4 emission. Rough ceramic products in which no waste materials are processed and which are broken and leached with the column test, continue to exceed the U1 and the U2 construction materials standard, although in lesser degree. The compounds As[25/39], Mo[22/31] and V[14/32] exceed the U1 standard. Mo[18/31] also exceeds the U2 standard. Part of the broken rough ceramic products would not be applicable as non-prefabricated construction material. Masonry aggregate in its current form, nevertheless, does meet the criteria for category 1 construction materials.

If E fly ash is added to the rough ceramic products, the U1 standard is exceded by As[9/20], Mo[2/16], and V[5/16], and the U2 standard is only exceded in the outliers. This concerns measurements taken from test series. In these test series, the amount of E fly ash was constantly changed, as well as the baking temperature. There is no mention, therefore, of bricks of regular production.

Through changes in the process conditions, the emission appears to be influenced in a positive way, despite a relatively large addition of E fly ash. Other metals than this one and Cd are not measured. None of the compounds in broken calcium-silicate bricks and blocks exceed the U1 construction materials standard. If E fly ash has been added to the calcium-silicate bricks and blocks, then excessions of the U1 standard have been observed for As(1/20), Mo(2/2), Sb(1/1) and V(1/2). These compounds are characteristic for E fly ash. These are test bricks with relatively large amounts of E fly ash (25-40% E fly ash). Information about the leaching behaviour with lower dosages was not available. As(1/2), V(2/2) and SO_4(2/2) in porous masonry bricks exceded the U1 standard. Both Mo emissions (2/2) also exceded the U2 standard; this would lead to its non-applicability as non-prefabricated construction material.

For broken aerated concrete, the only excession observed was for sulphate(1/1). Broken aerated concrete with E fly ash indicated an excession of the U1 standard for sulphate(2/2) as well as for Mo(2/2). Mo is typical for E fly ash. No seperate leaching tests have been done to mortar and cement.

Conclusion

Mo, As, and V appear to be the most critical compounds for rough ceramic products. Especially SO_4 and Mo will leach from aerated concrete and cement-like materials. These compounds do not leach as such from masonry aggregate in concentrations which exceed the U1 standard for construction materials. This could mean that As, V, and Mo are for the most part emitted or fixed to the matrix during the phase of the application of the ceramic products. The washing of masonry aggregate and the removal of the soft parts from the masonry aggregate appears to be an effective way to reduce the emission of harmful compounds; this is valid especially for SO_4. Selective demolition and processing of masonry aggregate is expected to contribute to the improvement of the product, although quantification of this is not yet possible. A number of products in which waste materials are processed which could at last end up in the masonry aggregate during the waste phase, would affect the quality in a negative way. With this, the dosage of the waste materials, and certainly also the production circumstances of the products, are of importance. The addition of E fly ash does not change remarkably the emission pattern of rough ceramic products. This, however, concerns bricks in a test series.

Masonry aggregate is a category 1 construction material (100%(40-60%)[0/4]). The re-use of masonry aggregate is not impeded after raising the composition standards of PAHs for construction materials. Masonry aggregate can be polluted with mineral oil (see also the footnote under cement aggregate). By raising the standard for mineral oil to 500 mg/kg, the mineral oil is not expected to impede re-use.

12.7.3.13 Mix aggregate

General

test	certified mix aggregate	non-certified and mix aggregates with unknown quality
emission column test	15	7
emission cascade + extrapolation	0	4
composition aqua regina	15	16
composition total-destruction transformed	0	0
composition organic compounds	15	8

Mix aggregate is a mix of cement and masonry aggregate whereby the cement aggregate part is at least 50%. A distinction can be made between certified and non-certified mix aggregate. Certified mix aggregate is certified by SKK. Certified mix aggregate is placed into the N1 category in the oBB; non-certified mix aggregate into category N2.

oBB inorganic composition: Only Ni exceeds the S1 standard for construction materials. This appears to be outliers of a non-certified mix aggregate (Ni:[2/16]). Certified mix aggregate does not exceed the S1 standard [0/15]. After correction for outliers, (certified) mix aggregate does not exceed the S1 standard [0/14+0/15=0/29].

oBB organic composition: Mineral oil [3/15] in certified mix aggregate lies above the S1 standard for construction materials for mineral oil. For non-certified mix aggregate, no mineral oil excessions of the S1 standard are found [0/2]. After correction for the outliers, a few measurements [2/14+0/2=2/16] of mix aggregate exceed the S1 standard for mineral oil. For non-certified mix aggregate, excessions of the S1 standard for construction materials are observed for naphthalene (2/7), fluoranthene (6/7), chrysene

(7/8) and 10 PAHs-total (1/7). As a result of this, on the basis of chrysene being the most critical compound, mix aggregate is not suitable for re-use as a construction material. A few PAH-total measurements [2/14] of certified mix aggregate exceed the S1 standard for construction materials. Chrysene is the most critical compound [10/15]. The highest measurement is an outlier.

New organic composition standards: After raising the standard for mineral oil to 500 mg/kg, no excessions of the S1 standard for construction materials for mineral oil are measured (0/15). Mix aggregate (certified + non-certified) exceeds the S1 standard in several cases [3/17].
No excessions of the standards for construction materials for PAHs have been observed [0/8+0/15=0/23] for either certified or non-certified mix aggregate.

oBB leaching: For certified mix aggregate, only sulphate [3/15] and Mo[5/15] exceed the U1 standard for construction materials. The highest values of V, Cu, and SO_4 are outliers. In non-certified mix aggregate, SO_4 [2/8] exceeds the U1 standard. Ba[2/11], Cu[2/11], and Mo[9/11] in non-certified mix aggregate exceed the U1 standards. Mo[3/9] also exceeds the U2 standard, so that a part is not applicable. The highest value is an outlier. The excessions of Pb and V are outliers, and Cd, Sb, and Se are measured on the detection limit level.

New leaching standards: For the certified mix aggregates, only sulphate [3/15] excedes the U1 standard for construction materials. The highest SO_4 measurements involve outliers. Mo does not exceed the U1 standard anymore. Application in thin layers does not bring the SO_4 measurements within the allowed immission limits. For non-certified mix aggregate, Ba[2/11], Mo[3/11], and SO_4[2/8] exceed the U1 standard for construction materials. The highest Mo emission and both of the Ba emissions are outliers. Cd, Sb, and Se are detection limits (see comment with asphalt aggregate). V and Pb are outliers. Through application in thin layers, Mo and Ba also fall within the allowable immission ranges.

Conclusion[54]

Mix aggregate is a mix of cement and masonry aggregate. Non-certified mix aggregate fits for 25% (3-65%) into the category 2 construction materials on the basis of Mo[2/10] and SO_4[2/8], the rest fits into category 1.

The SO_4 emissions from certified mix aggregate exceed the U1 standard [2/14] after correction for outliers. It is expected that Mo[2/10] and SO_4[2/14] are the critical parameters. The applicability will not improve by application in thin layers, as a result of the SO_4 emission. Sulphate can be brought under the requirements of category 1 construction materials. Quality improvement can be achieved by selective demolition and processing of the aggregate. The SO_4 emission could be reduced through, for example, sieving of the fine material, washing, or wind sifting. Keeping the waste originating from aerated concrete (inside walls) and gypsum-like materials separated from the rest of the brick fraction could also limit the emission of SO_4.

Mineral oil and PAHs did not impede re-use. A careful comparison between certified and non-certified material shows an insignificant difference. Mix aggregate certified by SKK does give a greater chance of better quality.

12.7.3.14 Sieve sand

General

column test emission:	19 observations
cascade + extrapolation emission:	0 observations
aqua regina composition:	58 observations
transformed total-destruction composition:	10 observations
organic compounds composition:	182 observations

A system for the certification of sieve sand is being developed. In the oBB, certified sieve sand is placed into the category of N2 construction materials; non-certified is not categorized.

oBB inorganic composition: No excession of the S1 standard for construction materials (Ni[0/13]).

[54] For the effects of the latest VROM-DGM adaptation of the PAH-total composition standard of 75 mg/kg to 50 mg/kg for construction and demolition waste and the products made of this, refer to appendix 18.

oBB organic composition: Xylene (4/15), mineral oil(26/42) and EOCl (7/77) also exceed the S1 standards. For the PAHs, excessions have also been observed (PAH-tot.:53/135). The most individual PAHs with chrysene [131/135] as the most critical compound exceed the S1 standards. The highest values of most of the compounds are outliers. Most of the sieve sand samples concern sieve sand which was offered to a dump site. A number of sieve sand samples is analysed with the goal of determining expected pollution. There is mention of a positive selection. One can ask, therefore, as to how representative these samples are for sieve sand. Selective demolition and processing results in better quality sieve sand.

New organic composition standards: Mineral oil [15/24], EOCl-total[7/77], and PCBs-total[2/2] still exceed the S1 standard for construction materials. The number of PCB measurements is so small that these are not included in the evaluation. The available PCB measurements do not exceed the S1 standard. After raising the S1 standard for construction materials for PAHs, a part still exceeds the S1 standard, with PAH-total as the most critical parameter [19/135]. The highest value is an outlier.

oBB leaching: Cu(7/19) and SO_4(1/3; 755 mg/kg is the standard) exceed the U1 standard for construction materials. The remaining excessions are outliers (V and Sb) or detection limits (Cd, Mo, Sb, and Se). Based on Cu, a part will fit into the category N2 construction materials, the rest in category N1.

New leaching standards: SO_4(1/3) is on the U1 standard for construction materials. The remaining excessions of the U1 standard which were observed concerned detection limits (Cd, Sb, Se; see comment asphalt aggregate) or outliers (Sb). Sb is measured once with a concentration of 0.01 mg/kg (Sb:[1/9]). The remaining Sb emissions are detection limits. After adapting the standards for construction materials, sieve sand would fall partly into category 2 on the basis of SO_4(1/3). Applied in thin layers, SO_4 also falls under the U1 standard for construction materials. Sulphate is equal to the standard.

Conclusion[55]

Sieve sand manifests itself on the basis of inorganic compounds as category 1 construction material. Sb[0/8] and SO_4[0/3] are critical compounds.

12.7.3.15 Recycling breaker sand

General

test	non-certified/unknown	certified
emission column test	17	
emission cascade + extrapolation	1	
composition aqua regina	37	
composition total + transformation	1	
composition organic compounds	23	15

Recycling breaker sand is not categorized according to appendix 1 of the oBB. This construction material is also applied in products.

oBB inorganic composition: None of the compounds measured exceed the S1 standard for construction materials (Cr[0/36]).

oBB organic composition: All the PAHs more or less exceed the S1 standards for construction materials (PAH-tot.[8/19]), with chrysene as the most critical compound [3/3+15/17=18/20]. This would mean that recycling breaker sand is largely non applicable as non-prefabricated construction material. Mineral oil [16/35] in recycling breaker sand also exceeds the S1 standard for construction materials. The highest value concerns an outlier.

For the certified recycling breaker sand, almost all the chrysene measurements [13/15], and part of the PAH-tot. [6/15] exceed the S1 standard for construction materials. For certified recycling breaker sand, two of the fifteen observations exceed the S1 standard for mineral oil [2/15].

[55] For the effects of the latest VROM-DGM adaptation of the PAH-total composition standard of 75 mg/kg to 50 mg/kg for construction and demolition waste and the products made of this, refer to appendix 18.

New organic composition standards: On the basis of PAH-total[4/19] and chrysene [3/20], part of the recycling breaker sand will not be applicable as non-prefabricated construction material. For the certified recycling breaker sand, a part will not be applicable, based on the PAH-total[2/15], chrysene[1/15] and mineral oil[2/15]. Mineral oil [7/35] remains the most critical compound for recycling breaker sand as a whole. The highest value is an outlier. Based on mineral oil, a part of the recycling breaker sand will not be applicable.

oBB leaching: The emissions of SO_4[8/18], Mo[9/18], V[6/17] and Cu[4/18] lie above the U1 standard for construction materials. This means that recycling breaker sand on the basis of Mo can for a part be applied as category N2 construction material, and for a part as N1 construction material.

New leaching standards: After adapting the standards for construction materials, recycling breaker sand would still fit partly into the category 2 construction materials for SO_4(7/16[8/18]). The highest measurement is an outlier. One or two measurements of V(1/17) and Cu(1/17) also exceed the U1 standard, but are outliers. Mo does not exceed the U1 standard anymore. Application in thin layers is not a solution.

Conclusion[56]

As for most of the waste materials originating from construction recycling, SO_4 also here is the most critical compound. The SO_4 probably comes from the cement, aerated concrete, and gypsum. In recycling breaker sand, the softer parts of the construction rubble, such as cement, will especially be present. An increased SO_4 emission is therefore to be expected. A number of products which are applied inside a building and therefore do not fall under the jurisdiction of the Building Materials Decree, end up in the construction and demolition waste in the waste phase. Some of these products contain relatively large amounts of sulphate. It is possible to reduce the sulphate emission by way of selective demolition.

Also by washing the recycling breaker sand, the SO_4 emission could be decreased. SO_4 is a compound of which the U1 standard has already been raised by DGM. Based on

[56] For the effects of the latest VROM-DGM adaptation of the PAH-total composition standard of 75 mg/kg to 50 mg/kg for construction and demolition waste and the products made of this, refer to appendix 18.

SO_4[7/17], 41% (18-67%) fits into category 2.

Through pollution with organic compounds, the usability will also be influenced negatively. Based on PAH-total[3/18] and mineral oil[6/34], approximately 11% (17-64%) will not be applicable as non-prefabricated construction material. It is not likely that organic and inorganic compounds are correlated. If the recycling breaker sand comes from certified industries, then, on the basis of mineral oil[2/15] and PAH-total[2/15], 13% (2-40%) will not be applicable.

12.7.3.16 Undefined construction and demolition waste

General

column test emission:	10 observations
cascade + extrapolation emission:	6 observations
aqua regina composition:	31 observations
transformed total-destruction composition:	12 observations
organic compounds composition:	81 observations

Undefined construction and demolition waste is all the non-prefabricated, largely stone-like construction waste, sometimes indicated as construction rubble, etc, which is not one of the construction recycling materials mentioned in chapter 12.7.3.10 up to and including 12.7.3.15. Undefined construction and demolition waste is not placed into a category in the oBB. According to appendix 1 of the oBB, only construction recycling materials, such as sieve sand, recycling breaker sand, cement aggregate, masonry aggregate, and mix aggregate are placed into categories.

oBB inorganic composition: No excession of the S1 standard for construction materials (Cd[0/25]). Sulphate is not measured. SO_4 is often a critical parameter for construction recycling materials.

oBB organic composition: All the individual PAHs exceed the S1 standard for construction materials, chrysene [23/67] being the most critical. Also PAH total [14/68) and mineral oil (8/14) exceed the S1 standards for construction materials. The highest measurements are still outliers.

New organic composition standards: After adapting the S1 standard for construction materials, a small part of the undefined construction and demolition waste would not be re-used as non-prefabricated construction material, based on chrysene [7/67]. Mineral oil [5/14] remains the most critical, also after raising the standard to 500 mg/kg; after correction for an outlier, approximately one quarter [4/13] appears to exceed the S1 standard for construction materials.

oBB leaching: The Mo concentration [2/5] lies above the U2 standard. SO_4[2/5], Mo[3/5] and Cd[1/6] exceed the U1 standard for construction materials. Cr is an outlier.

New leaching standards: After adaptation of the standards for the allowable emission from construction materials, the U1 standard for construction materials is still exceded only by Mo[2/5], SO_4[2,5], and Cr (outlier). Undefined construction and demolition waste will be partly applicable as category 2 construction material based on Mo and sulphate, and for the rest as category 1 construction material.

Conclusion[57]

Sorting the construction rubble into cement aggregate, masonry aggregate, and mix aggregate gives a better product. Based on the available measurements, undefined construction and demolition waste for a large part (approximately 25%(25-81%)) cannot be applied, based on the organic compounds (especially mineral oil[4/13]). Based on Mo[2/5] and SO_4[2/5], a part fits into the category of 2 construction materials.

12.7.3.17 Stabilized mixes evaluated as N construction material

Many of the (cement) stabilized mixes which are applied in road base construction, can be researched with the diffusion test for prefabricated construction materials without too many problems. Only if the release from a product is not diffusion controlled, must the construction material be tested, under certain conditions, with the column test for non-prefabricated construction materials (see chapter 10). In the past, samples of these construction materials were researched with the column test. If the product meets the requirements for non-prefabricated construction materials, then it also meets the require-

[57] For the effects of the latest VROM-DGM adaptation of the PAH-total composition standard of 75 mg/kg to 50 mg/kg for construction and demolition waste and the products made of this, refer to appendix 18.

ments for prefabricated construction materials. In such cases, this information can count in the evaluation of the prefabricated product, since as a result of the prescribed reduction, the leachable surface area of the product will become greater.

12.7.3.17.1 Sand cement stabilisation

General

column test emission:	1 observation
cascade + extrapolation emission:	0 observations
aqua regina composition:	0 observations
transformed total-destruction composition:	0 observations
organic compounds composition:	0 observations

oBB inorganic composition: No excession of the S1 standard for construction materials.

oBB leaching: Ba(1/1), Mo(1/1) and Cl(1/1) exceed the U1 standard for construction material each with one measurement.

New leaching standards: Ba(1/1) and Cl(1/1) still exceed the U1 standard for construction materials.

Conclusion: An evaluation as non-prefabricated construction material is not possible because of the lack of data.

12.7.3.17.2 Sand cement stabilisation with E fly ash

General

column test emission:	1 observation
cascade + extrapolation emission:	0 observations
aqua regina composition:	0 observations
transformed total-destruction composition:	0 observations
organic compounds composition:	0 observations

oBB inorganic composition: No excession of the S1 standard for construction materials oBB leaching: V(1/1), Sb(1/1), and Cr(1/1) exceed the U1 standard for construction materials, and Mo(1/1) the U2 standard. This concerns only one measurement. Mo and V are typical for E fly ash.

New leaching standards: V(1/1) and Cr(1/1) still exceed the U1 standard for construction materials, and Mo(1/1) the U2 standard. Sb is on the U1 standard for construction materials.

Conclusion: An evaluation as non-prefabricated construction material is not possible.

12.7.3.17.3 Blast furnace slag mix

General

column test emission:	4 observations
cascade + extrapolation emission:	4 observations
aqua regina composition:	12 observations
transformed total-destruction composition:	0 observations
organic compounds composition:	0 observations

Blast furnace slag mix is a mix of blast furnace slag, LD slag and blast furnace slag sand.

oBB inorganic composition: No excession of the S1 standard (V[0/9]).

oBB leaching: Ba(1/4[4/8]) and SO_4(2/3[2/6]) exceed the U1 standard, and Ba(1/4[1/8]; 46 mg/kg, outlier) also the U2 standard. Ba and SO_4 are typical for blast furnace slag and V for steel slag. The emissions of Se(1/1) and Mo(1/1) are detection limits.

New leaching standards: Ba(1/4[4/8]) and SO_4(2/3[2/6]) still exceed the U1 standard for construction materials. The highest measurement of Ba (46 mg/kg) concern an outlier. Se is a detection limit. In layers of 70 cm, Ba[3/7] remains the most critical compound. Applied in thin layers of 20-30cm thick, the Ba emission stays within the imission requirements of category 1 construction materials, with the exception of an outlier; SO_4 does not.

Conclusion: Evaluated as a non-prefabricated construction material, blast furnace slag mix will be 66% applicable as category 1 construction material, based on SO_4[2/6] and when applied in thin layers of 20-30cm. This is the usual application thickness. In The Netherlands, approximately 1000 ktons is imported, mostly from Germany. In Germany, this construction material is researched with the S4-DIN test of the fraction of 8-11 mm. The DIN tests are regarded as emissions at L/S=10. With increasing granulated blast furnace slag and/or LD slag[58], the blast furnace slag mix will fit more into the category 1 construction materials.

12.7.3.17.4 Hydraulic mix aggregate

General

column test emission:	1 observation
cascade + extrapolation emission:	1 observation
aqua regina composition:	2 observations
transformed total-destruction composition:	1 observation
organic compounds composition:	0 observations

Hydraulic mix aggregate is a mix of LD slag or ELO slag and mix aggregate.

oBB inorganic composition: Cr(1/3) exceeds the S1 standard for construction materials. This element is typical for LD slag and ELO slag.

oBB leaching: Ba(1/1[1/2]) and Mo(1/1[2/2]) exceed the U1 standard. Ba, Mo, and SO_4 (not measured) are typical compounds for LD slag, ELO slag, and mix aggregate.

New leaching standards: Ba(1/1[1/2]) and Mo(1/1[2/2]) exceed the U1 standard for construction materials. Mo remains critical, even if the construction material is applied in thin layers of 20-30 cm thick.

[58] Provided it is not cooled with seawater, see chapter 10.5.1.34.

Conclusion: Evaluated as non-prefabricated construction materials, hydraulic mix aggregate would be applicable as category 2 construction material [100% (16-100%)], based on the Mo[2/2]. This evaluation, however, takes place on the basis of a small number of measurements, and data concerning several specific compounds such as Cl, Br, and SO_4 is missing. The excessions are typical for compounds in LD slag, ELO slag, and construction recycling materials.

12.7.3.17.5 Lightly stabilised phosphor slag

General

column test emission:	0 observations
cascade + extrapolation emission:	0 observations
aqua regina composition:	1 observation
transformed total-destruction composition:	0 observations
organic compounds composition:	0 observations

oBB inorganic composition: F exceeds the S1 standard. This element is typical for phosphor slag.

oBB leaching: No measurement data.

New leaching standards: No measurement data.

Conclusion: Conclusion is not possible because of the lack of leaching data (especially F).

12.7.3.17.6 Lightly stabilised steel slag

General

column test emission:	0 observations
cascade + extrapolation emission:	1 observation
aqua regina composition:	1 observation
transformed total-destruction composition:	0 observations
organic compounds composition:	0 observations

oBB inorganic composition: V(1/1[1/1]) exceeds the S1 standard. This element is typical for LD slag.

oBB leaching: No excession of the U1 standard for construction materials.

New leaching standards: see oBB leaching.

Conclusion: Lightly stabilised steel slag is not evaluated as a non-prefabricated construction material because of the lack of leaching data for compounds which are typical for LD slag (Cl, Br, and F).

12.7.3.17.7 Stabilised MSWI bottom ash

General

column test emission:	4 observations
cascade + extrapolation emission:	0 observations
aqua regina composition:	0 observations
transformed total-destruction composition:	0 observations
organic compounds composition:	0 observations

oBB inorganic composition: Cu(3/4[5/6]), Pb(1/4[1/5]) and Zn(2/4[2/6]) exceed the S1 standard. These metals together with Mo are typical for MSWI bottom ash.

oBB leaching: No information is available.

New leaching standards: See oBB leaching.

Conclusion: Evaluation as a non-prefabricated construction material is not possible becasue of the lack of leaching data.

12.7.3.17.8 Lightly stabilised E fly ash

General

column test emission:	1 observation
cascade + extrapolation emission:	0 observations
aqua regina composition:	1 observation
transformed total-destruction composition:	0 observations
organic compounds composition:	0 observations

oBB inorganic composition: No excession of the S1 standard.

oBB leaching: Se[1/1] exceeds the U1 standard, but is a detection limit. Another element typical for E fly ash is Mo. No information is available about this element.

New leaching standards: See oBB leaching.

Conclusion: Evaluation as a non-prefabricated construction material is not possible, because of the lack of leaching data for Mo.

12.7.3.18 Smoke-gas desulphurizing gypsum

General

column test emission:	0 observations
cascade + extrapolation emission:	0 observations
aqua regina composition:	1 observation
transformed total-destruction composition:	0 observations
organic compounds composition:	0 observations

This compound is not placed into a category in the oBB.

oBB inorganic composition: None of the compounds measured exceded the S1 standard.

Conclusion: evaluation is not possible because of the lack of leaching data.

12.7.3.19 Phosphor acid gypsum

General

column test emission:	0 observations
cascade + extrapolation emission:	2 observations
aqua regina composition:	0 observations
transformed total-destruction composition:	9 observations
organic compounds composition:	0 observations

Phosphor acid gypsum is hardly applied currently; most of it is discharged. The development of aggregates and products in which phosphor acid gypsum is processed and which can be applied outside is underway. There are as yet no applications on the market as a non-prefabricated construction material. Phosphor acid gypsum is not categorized in the oBB.

oBB inorganic composition: Fluoride (F) and SO_4 are measured only once in phosphor acid gypsum. Both of these concentrations [1/1] are a factor 2 above the S1 standard.

oBB leaching: The Cd-[2/2], F-[2/2] and SO_4 emission [2/2] measurements are so high that this construction material as such, based on the available data, is not suitable for application as a non-prefabricated construction material. Excession of the U2 standard takes place by these compounds.
Also Mo[1/2] and Se[1/2] appear critical and exceed the U2 standard for construction materials. Other compounds (As, Cu, and Zn) exceed the U1 standard.

New leaching standards: After adapting the standards for construction materials, there are no changes in the categorization. Cd[2/2] and F[2/2] exceed 20 and 10 times respectively the U2 standard. Mo and SO_4 are no longer critical, but Mo[1/2] does show an excession of the U1 standard, just as Zn[1/2] and SO_4[2/2]. Phosphor acid gypsum is not suitable as a non-prefabricated construction material, based on the data available.

Conclusion: Phosphor acid gypsum as a non-prefabricated construction material does not (100% (16-100%)) meet the immission requirements of the Building Materials Decree based on this sample. In view of the high contents and high emission of Cd[2/2], F[2/2] and SO_4, the chance that another sample will give a more favorable evaluation is small.

12.7.3.20 Mine stone

General

test	The Netherlands	current productions		
		sorted	washed	other or unknown
column test	2			
cascade + extrapolation	0	8		11
aqua regina destruction	2	8	12	30
transformed total-destruction	2	4		5
organic	4	1	1	42

Mine stone is not categorized in the oBB. With regards to red (burnt) mine stone, no data is available. Both column tests concern Dutch mine stone. The rest of the observations in the data base involve control-measurements to mine stone of current productions originating from selected samples from German and Belgian mines.
In the discussion, a distinction is made between Dutch mine stone and foreign mine stone from current productions. This last group is divided into sorted, washed, and unknown treatment.

oBB inorganic composition: For Zn[1/31], an excession of the S1 standard is observed once. This was a measurement taken after aqua regina destruction to the group of remaining mine stone, and is a significant outlier. Independent of the quality, all [0/30] the mine stone examined met the S1 standard.

oBB organic composition:
Mine stone (other/unknown): Mineral oil [2/2] from the category unknown mine stone exceeds the S1 standard. In both measurements, this concerns a detection limit. At the same time, an excession is noted for phenols[1/2] and PCBs-total[1/50]. Phenol is measured twice at the detection limit level. It is not known whether these samples are representative for mine stone from current productions. In the other groups, these compounds are not measured. These compounds are not included in the evaluation. Various individual PAHs (Naph[2/25], Fla[5/40]) with chrysene being the most critical compound [3/24] exceed the S1 standard. The highest measurements are often outliers.
Mine stone (The Netherlands, sorted, washed): These other categories of mine stone (The

Netherlands [0/1], sorted [0/1]) do not exceed the S1 standard in view of the PAHs. For the PCBs, excessions are also not noted. Mineral oil is not measured.

New organic composition standards: After adapting the standards for construction materials for PAHs, only naphthalene exceeds [1/26] the S1 standard in the group of unknown mine stone. This involves an outlier. Application of mine stone from current productions is possible based on PAHs [0/25].
Both of the mineral oil measurements (detection limits) are below the adapted standard for mineral oil (500 mg/kg).

oBB leaching: For sorted mine stone, Zn[1/8] exceeds, and for the group of unknown mine stone, As[1/10] and SO_4[1/10] exceed the U1 standard. Each time, this involves outliers. Dutch mine stone is a N2 construction material according to the standards for construction materials in appendix 2 oBB, based on Mo[2/2], Cd[2/2] and SO_4[2/2]. For mine stone from current productions, no excessions [0/7+0/9=0/16] of the U1 standard are observed after correction for outliers.

New leaching composition: After adapting the standards for construction materials, sorted mine stone fits into the category 1 construction materials. No information is available for washed mine stone concerning leaching behaviour. The group of unknown mine stone originating from current productions meets the requirements of category 1 construction materials for all the compounds, except sulphate [1/10]. The sulphate emission involves an outlier. Mine stone from current productions will be completely [0/16] applicable as a category 1 construction material. Dutch mine stone meets the requirement for category 2 construction materials; SO_4 exceeds [2/2] the U1 standard for construction materials.

Conclusion: The emission from the German and Belgian mine stone which was evaluated, completely meets the inorganic criteria in the Building Materials Decree, with SO_4[0/16] as most critical compound, and is applicable as category 1 construction material. PAHs[0-/17] do not impede re-use. Application of Dutch mine stone seems to be possible as category 2 construction material, because of the SO_4 emission.

12.7.3.21 E fly ash

General

column test emission: 9 observations

cascade + extrapolation emission: 9 observations

aqua regina composition: 10 observations

transformed total-destruction composition: 70 observations

organic compounds composition: 2 observations

In appendix 1 (oBB), this construction material is divided into the category N2 constructi-on materials. Currently all E fly ash is used in the cement and concrete blocks industry.

oBB inorganic composition: Based on aqua regina destruction, no excessions of the S1 standard were observed. Based on the total composition and transformation to an equivalent for aqua regina destruction, Cd[1/73], Cu[2/65], Mo[1/58], and Se[1/60] appear to exceed the S1 standard. The highest observations also constantly appear as outliers. In view of the number of measurements which do not exceed the S1 standard, and the fact that the excession measurements are outliers, it can be stated that E fly ash in general does not [0/63] exceed the S1 standard.

oBB organic composition: No excession of the S1 standard by the PAHs[0/2]; PCBs and aromates not measured. The "production process" makes the prescence of organic compounds in standard-exceeding concentrations unlikely.

New organic composition standards: See oBB organic composition.

oBB leaching: The emission of Mo(7/7[13/16]), Sb(3/4[3/5]), Se(2/2[5/6]) and V(2/5[2/10]) exceed the U2 standards for construction materials. Several compounds, including As(4/6), Cr(7/9), Se[5/6], Mo[16/16], Sb[3/5], V[9/10], and SO_4(5/5) exceed the U1 standard. This construction material will be inapplicable for a part as N constructi-on material according to the standards for Mo and Se for construction materials in appendix 2 oBB. If the transformed data is not taken into consideration, then E fly ash is applicable as N construction material on the basis of Mo.

New leaching standards: After adapting the standards for construction materials, the categorization does not change much. A large part will not be applicable, based on Mo(7/7[11/16]) and Se(2/2[5/6]). Sb is no longer a critical compound. As(1/6), Cr(7/9), Sb(3/4), V(6/6), F(1/3) and SO_4(5/5) exceed the U1 standard. The application of E fly ash in layers of 30 cm does not offer a solution, in view of the measure by which Mo exceeds the U2 standard.

Conclusion: The leaching of Mo[11/16] and Se[5/6] is so high (mean: approximately 15 times the U2 standard for construction materials) that it is unlikely that E fly ash will fit either completely or mostly within the limits of a category 2 construction material as given in the Building Materials Decree (non-prefabricated construction material). 82% (54-96%) would not be applicable, based on the information available for Mo and Se. Organic compounds do not exceed the S1 standard. Because of the production process, organic compounds in standard-exceeding concentrations are not likely.

12.7.3.22 E bottom ash

General

test	certified	non-certified/unknown
column test	6	36
cascade + extrapolation	7	13
aqua regina destruction	5	40
transformed total-destruction	5	38
organic	5	

In appendix 1, certified E bottom ash is placed into the category of N1 construction materials. The criteria for certified E bottom ash are described in [41].

oBB inorganic composition: The compounds measured after destruction with aqua regina do not exceed the S1 standard in this sample. Several concentrations obtained after transformation, such as Cd[1/88], Cu[1/88] and Se[2/81], usually still significant outliers, exceed the S1 standard. This always involves non-certified E bottom ashes. In view of the number of measurements, it can be concluded that E bottom ash does not exceed the S1 standard for construction materials (Se[0/79]).

oBB organic composition: No excession of the S1 standard for PAHs[0/5]. All the PAHs are measured as being on the detection limit level. Other organic compounds are not measured. Organic compounds in amounts which exceed the standard are not likely because of the production process.

oBB leaching: If a distinction is made between certified and non-certified E bottom ash, it appears that certified E bottom ash does not differ with non-certified E bottom ash, with the exception of SO_4, As, Cu, and Ni. The certification takes place on the basis of SO_4, Pb, and As with a 3-step cascade test [41]. For these compounds the certification seems to work. Mo and Se which are also typical for E bottom ash are barely or not at all influenced by the certification. Based on Mo[7/13] and Se[8/12] respectively, certified E bottom ash will be indicated for a category N2 construction material. The highest values are outliers. Also Ba[3/4], V[2/3] exceed the U1 standard for construction materials. Cd and Zn are outliers. Non-certified E bottom ash will, based on Mo[31/43], be applicable for a large part as an N2 construction material. The rest is applicable as an N1 construction material. Several other compounds (Se[25/46], As[4/49], Ba[6/46], Cd[4/49], Cu[2/49], Ni[6/49], Sb[2/39], V[3/46], Zn[2/48] and SO_4[8/45]) exceed the N1 standard for construction materials. The highest observations are usually outliers. After correction for outliers, Mo[36/54] appears to be the most critical compound for E bottom ash (certified or not).

New leaching standards: In the evaluation, a distinction can be made between certified and non-certified/unknown E bottom ash. For the compounds Mo and Se, there is no difference. Co[1/46] is a detection limit. Concerning Ba and V, more excessions are observed for certified E bottom ash. For sulphate, certified E bottom ash meets the U1 standards for construction materials, and non-certified E bottom ash does not.

Certified E bottom ash will be half applicable as a category 2 construction material, based on Se[6/12]; the greatest value is an outlier. Applied in thin layers of approximately 20-30 cm, almost all certified E bottom ash will be applicable as category 1 construction material (Se[1/12], SO_4[0/12]). As a result of Se[7/46] and SO_4[8/45], non certified E bottom ash will be partly applicable as a category 2 construction material. Non-certified E bottom ash will, applied in layers of approximately 20, based on Se[7/46] and SO_4[8/45], be applicable for a large part (approximately 82%) in the category 1 construction materials, and for 18% (8-32%) in category 2.

Conclusion: Regarding the critical compound (Se), there appears to be little difference between certified and non-certified E bottom ash. If E bottom ash is evaluated on the basis of Se ([5/11+17/45=22/56]), 39% (27-53%) fits into the category 2 construction materials, and the rest into category 1. Applied in thin layers, the applicability is remarkably greater. Then 11% (4-22%) fits into category 2 based on Se[0/11+6/45=6/56]. In such a case, there is a difference in the quality between non-certified and certified E bottom ash; expecially for SO_4. Certified E bottom ash will be completely applicable as a category 1 construction material, if applied in layers of 20-30 cm.

The construction material is often applied in the groundwater. This would preferably have to be category 1 E bottom ash. Non-certified E bottom ash will fit into the category 1 construction materials for approximately 87%, if applied in thin layers. The prescence of organic compounds in concentrations which exceed the standard is not likely. This is confirmed by the available data.

12.7.3.23 Fluid bed E fly ash

General

column test emission:	2 observations
cascade + extrapolation emission:	0 observations
aqua regina composition:	2 observations
transformed total-destruction composition:	2 observations
organic compounds composition:	0 observations

In appendix 1, fluid bed E fly ash is not categorized.

oBB inorganic composition: No excessions of the S1 standard (Cu[0/3]).

oBB leaching: The Mo concentration (1/1[1/1]) is above the U2 standard. Fluid bed E fly ash is not applicable according to the oBB, based on this sample. Cu(1/1) is above the U1 standard.

New leaching standards: After adapting the standards for construction materials, the catagorization does not change, except that Cu no longer exceeds the U1 standard.

Conclusion: There is only one measurement available. Just as with E fly ash, Mo appears to be the most critical compound for the leaching. It is probable that the applicability of fluid bed E fly ash will not differ greatly from that of E fly ash. This would mean that fluid bed E fly ash for its greatest part would not be usable as a construction material under the Building Materials Decree.

12.7.3.24 Fluid bed E bottom ash

General

column test emission:	0 observations
cascade + extrapolation emission:	0 observations
aqua regina composition:	0 observations
transformed total-destruction composition:	3 observations
organic compounds composition:	0 observations

In appendix 1, fluid bed E bottom ash is not categorized.

oBB inorganic composition: None of the measurements exceed the S1 standard for construction materials. In composition, the construction material is like E bottom ash (Cu[0/2]).

oBB leaching: No data is available concerning the leaching.

Conclusion: A conclusion is not possible based on the data available. For now, classified as E bottom ash.

12.7.3.25 Coal gassing E bottom ash

General

column test emission:	0 observations
cascade + extrapolation emission:	4 observations
aqua regina composition:	0 observations
transformed total-destruction composition:	6 observations
organic compounds composition:	0 observations

In appendix 1 of the oBB, coal-gassing E bottom ash is not categorized.

oBB inorganic composition: None of the measurements exceed the S1 standard (Cu[0/5]).

oBB leaching: The F and Se emissions ([1/4]) are above the U1 standards. Both times, this involves a significant outlier.

New leaching standards: After adapting the standard for construction materials, all the emissions [0/4] are under the U1 standard for construction materials, including the outliers.

Conclusion: Coal-gassing E bottom ash is 100% applicable as category 1 construction material. Noticeable is that Mo barely leaches [0/4] but the Mo content (composition) is higher than the Mo content in E bottom ash.

12.7.3.26 Coal gassing fly ash

General

column test emission:	0 observations
cascade + extrapolation emission:	1 observation
aqua regina composition:	0 observations
transformed total-destruction composition:	3 observations
organic compounds composition:	0 observations

In appendix 1, coal-gassing E fly ash is not categorized.

oBB inorganic composition: None of the measurements exceeds the S1 standard [0/3].

oBB leaching: The Mo and Se concentration (each [1/1] measurement) lie between the U1 and the U2 standard for construction materials. Coal gassing E fly ash will be applicable as N2 construction material according to the oBB.

New leaching standards: After adapting the standards for construction materials, none of the compounds seem to exceed the U1 standard [0/1].

Conclusion: This construction material is difficult to evaluate because of the limited number of observations. Based on these observations, the construction material would be indicated as a category 1 construction material. In comparison with E fly ash, a number of compounds, such as Zn, Se, and V appear in the fixed matrix and in low concentrations. This is not true for Mo, however, whose concentration is comparable.

12.7.3.27 MSWI bottom ash

General

column test emission: 70 observations

cascade + extrapolation emission: 5 observations

aqua regina composition: 169 observations

transformed total-destruction composition: 27 observations

organic compounds composition: 18 observations

In appendix 1, this construction material is categorized as a N2 construction material.

oBB inorganic composition: All the Cu concentrations (146/149[170/173]) exceed the S1 standard. The compounds Cd(10/1491[17/170]), Pb(55/149[63/165]), Sb(4/141[9/155]), Sn(9/99[9/102]) and Zn(127/149[145/173]) are critical.

oBB organic composition: Chrysene (3/17) just exceeds the S1 standard value. Based on chrysene, a small part would not be usable. No excession of EOCl. PCBs are measured.

New organic composition standards: The Mo emission (63/70[65/72]>U2,[72/72]>U1) is largely above the U2 standard for construction materials, whereby almost all MSWI bottom ash is not applicable as construction material under the oBB. Further, the compounds Cu(31/70[33/74]), Sb(4/50[4/50]) and SO_4(1/11[1/11]) also partly exceed the U2 standard, and Cd(8/68[8/72]), Ni(3/68[3/71]), Pb(14/69[14/74]), Zn(5/68[6/72]), Cl(8/8-[8/8]) and SO_4(11/11[11/11]) exceed the U1 standard.

New leaching standards: After adapting the standards for construction materials, it appears that Mo is greater than the U2 standard ([69/72]>U1 and 43/70[45/72]>U2). Cu is also critical (38/70[41/74]). A part of the Cu emission measurements exceed the U2 standard for construction materials. Cd(2/68[2/72]), Pb(7/68[7/74]), Sb(42/50[42/56]), Cl(8/8[8/8]) and SO_4(11/11[11/11]) exceed the U1 standard. By applying MSWI bottom ash in layers of 20-30 cm, which is usual in road construction, a slightly larger part will be applicable as category 2 construction material.

Conclusion: MSWI bottom ash, on the basis of Mo, is for more than half (63%(50-74%)) not usable as a construction material. It was determined seperately whether the critical compounds are correlated. Mo and Cu do not appear to be correlated; on the one hand this means that the percentage of MSWI bottom ash which is not applicable on the basis of all the critical compounds together is much larger (calculated >63%+20%=83%), and on the other hand, even if the Mo-containing waste would be rejected as waste for burning, more than 55% (43-67%) would still be excluded[59] [42]. A large part of the MSWI bottom ash will only be applicable in large scale projects in a so-called "special category" under certain isolation requirements. The VvAV has started research to improve the quality of MSWI bottom ash whereby the application of MSWI bottom ash as a category 2 construction material becomes possible. PAHs and EOCl do not cause a problem for re-use.
Aside from this, it was researched as to whether quality differences of the bottom ash occur between the MSWIs. This, however, based on the available data, does not seem to be the case.

12.7.3.28 MSWI fly ash

General

column test emission:	15 observations
cascade + extrapolation emission:	2 observations
aqua regina composition:	59 observations
transformed total-destruction composition:	21 observations
organic compounds composition:	13 observations

MSWI fly ash is not categorized in the oBB.

oBB inorganic composition: Almost all the measurements of Cu(57/58[74/79]), Cd(59/59[79/80]), Sn(51/54[54/57]), Pb(58/59[69/72]) and Zn(59/59[78/80]), measured for MSWI fly ash (aqua regina and total with transformation) exceed the S1 standard for construction materials. Furthermore, the elements Hg, Sb, Ni, Mo and SO_4 are critical. This means that MSWI fly ash is not usable as non-prefabricated construction material based on the Cd composition.

[59] Recent research indicates that the leaching of Cu reduces as the result of "aging" of the MSWI bottom ash.

oBB organic composition: No excessions of the S1 standards for PAHs[0/12], EOCl[0/11] and pesticides. PCBs and mineral oil are not measured.

oBB leaching: The emissions measurements of Mo(15/15[15/15]) and Cd(15/15[15/17]) are so high above the U2 standard, that as a result, MSWI fly ash, on the basis of the Mo emissions, is not applicable as construction material under the oBB. Furthermore, the compounds Cl(11/12[12/14]), SO_4(11/12[12/14]), Zn(12/15[12/17]), Pb(11/14[11/16]) and Se(3/7[3/7]) are critical.

New leaching standards: After adapting the standards for construction materials, nothing changes in the division of MSWI fly ash. Based on Mo(15/15[15/15]) and Cd(15/15[16/17]), MSWI fly ash will not be applicable under the Building Materials Decree. Also other compounds such as Cl, SO_4, Zn, Pb and Se remain critical, and the number of excessions does not change. The application of MSWI fly ash in layers of 30 cm also does not result in an improvement of the applicability.

Conclusion: MSWI fly ash is to be placed in the category of construction materials which are not suitable (100%(75-100%)) to be used as non-prefabricated construction material under the Building Materials Decree. This catagorization is on the basis of enough observations. The most critical compound is Mo[15/15]. As such, it is also not applied. See also prefabricated construction materials. PAHs[0/12] and EOCl[0/11] are measured, but do not cause a problem for re-use.

12.7.3.29 Blast furnace slag

General

column test emission:	3 observations
cascade + extrapolation emission:	6 observations
aqua regina composition:	4 observations
transformed total-destruction composition:	6 observations
organic compounds composition:	4 observations

Blast furnace slag is not categorized in the oBB.

oBB inorganic composition: Once (1/8), an excession of the S1 standard is observed for Mo (extrapolated total-destruction). This appears to be a significant outlier.

oBB organic composition: No excession of the S1 standard for construction materials for PAHs[0/4], PCBs[0/1], and Phenols[0/1]. With the screening of the OCl pesticide concentration, the detection limit is higher than the S1 standard.

New organic composion standards: See oBB organic composition.

oBB leaching: Ba once exceeds (133mg/kg) the U2 standard ([1/2] measurements). This involves an extrapolated cascade test. In comparison with the blast furnace slag mix in which a relatively large amount of blast furnace slag is processed, this is a very high value which is noted as an outlier. The Mo and Ba emissions (Ba:1/1, Mo:2/2[3/7] measurements) are above the U1 standard. The highest Mo emission involves an outlier. Furthermore, V(2/3[2/6]), Se[1/2], SO_4(1/1[2/6]) and Cl(1/1[1/5]) are critical.

New leaching standards: Mo does not exceed anymore, but because of Ba(1/1) and V(1/3), blast furnace slag for a part remains a category 2 construction material. Also Cl(1/1[1/5]) and SO_4(1/1[2/6]) exceed the U1 standard. Both of the high SO_4 emissions are outliers. Based on V and SO_4, a part of the blast furnace slag will be applicable as a category 2 construction material, and the rest as a category 1 construction material.

Conclusion: Blast furnace slag as a non-prefabricated construction material will fit for 67% into the category 1 construction materials based on SO_4[2/6]. Organic compounds are not a problem. Blast furnace slag is often applied in so-called blast furnace slag mixes. The SKH is working on certification for blast furnace slag mixes [43]. In this certification, it is expressly stated that "the application of blast furnace slag in contact with (still-standing) water must be avoided", in order to limit emissions of SO_4 and (poly) sulphides. The prescence of organic compounds in concentrations which exceed the standard are not likely in view of the production process.

12.7.3.30 Blast furnace foam slag

General

column test emission:	1 observation
cascade + extrapolation emission:	3 observations
aqua regina composition:	5 observations
transformed total-destruction composition:	0 observations
organic compounds composition:	2 observations

Blast furnace foam slag is placed into category N1 or V1 in the oBB.

oBB inorganic composition: No excession of the S1 standard for construction materials (Cd[0/5]).

oBB organic composition: No excession of the S1 standard for construction materials for PAHs[0/2]. Other organic compounds are not measured.

oBB leaching: The V emission (1/1[1/12] measurements) are just above the U1 standard.

New leaching standards: After adapting the allowable V immission to 2400mg/m^2, blast furnace foam slag fits completely into the category 1 construction materials [0/2].

Conclusion: Based on the limited sample, blast furnace foam slag appears to be a category 1 construction material. The prescence of organic compounds in concentrations which exceed the standard are not likely in view of the production process.

12.7.3.31 Granulated blast furnace slag

General

column test emission:	1 observation
cascade + extrapolation emission:	0 observations
aqua regina composition:	2 observations
transformed total-destruction composition:	0 observations
organic compounds composition:	2 observations

Aggregated blast furnace slag is put into category N1 construction materials in the oBB.

oBB inorganic composition: No excession of the S1 standard for construction materials [0/2].

oBB organic composition: No excession of the S1 standard for PAHs [0/2]. Other organic compounds are not measured.

oBB leaching: The emissions (1 measurement) are all below the U1 standard.

New leaching standards: After adapting the standards for construction materials, nothing changes for the evaluation of granulated blast furnace slag.

Conclusion: The granulated blast furnace slag is produced by deterring liquid slag with a very powerful water spray. During this process, leaching will take place, which is good for the product. Categorization as a category 1 construction material is self-evident. The prescence of organic compounds in concentrations which exceed the standard is not likely in view of the production process.

12.7.3.32 Blast furnace slag sand

General

column test emission:	2 observations
cascade + extrapolation emission:	0 observations
aqua regina composition:	2 observations
transformed total-destruction composition:	2 observations
organic compounds composition:	0 observations

Blast furnace slag sand is not categorized in the oBB.

oBB inorganic composition: No excession of the U1 standard [0/4].

oBB leaching: The emissions (2 measurements) are both below the U1 standards.

New leaching standards: After adapting the standards for construction materials, nothing changes for the evaluation of blast furnace slag sand.

Conclusion: Blast furnace slag sand is made up of granulated and/or blast furnace slag. Blast furnace slag is placed into the category 2 construction materials, based on the sample. The measure of the components granulated blast furnace slag and blast furnace slag of the sample at hand is unknown. As more blast furnace slag is present, blast furnace slag sand will increasingly show the characteristics of a category 2 construction material. Based on the available data [0/2], blast furnace slag sand is 100% a category 1 construction material.

12.7.3.33 Jarosite end slag

General

column test emission:	1 observation
cascade + extrapolation emission:	0 observations
aqua regina composition:	6 observations
transformed total-destruction composition:	24 observations
organic compounds composition:	0 observations

Jarosite end slag is not placed into a category in the oBB. The material is not applied as non-prefabricated construction material. Through contamination, a number of Mo and Cr measurement values are not representative, and therefore not included in the evaluation.

oBB inorganic composition: Almost all the composition measurements of jarosite end slag of Cu(6/6[14/14]), Ni(4/4[9/12]), Sb(2/2[12/12]) and Zn(5/6[11/12]) exceed the S1 standard for construction materials. Based on Cu, jarosite end slag is not applicable as a construction material.

oBB leaching: The emissions of Ba, Mo and Sb exceed the U2 standard for construction materials (all 1/1 measurements). This means that jarosite end slag is not applicable as a granular construction material, based on a one-time sample check. Cd and Hg exceed the U1 standard for construction materials. As a result of Fe interference with the spectometric measurements of the metals, the detection limits are relatively high.

New leaching standards: Ba, Sb and Mo continue to show excessions of the U2 standard for construction materials (all 1/1 observation) and Hg the U1 standard for construction materials.

Conclusion: Jarosite end slag is not applicable as a non-prefabricated construction material according to the criteria of the Building Materials Decree, and also will not become applicable in view of the measure of the Ba and Mo excessions. Research as to the applicability of jarosite end slag as a gravel replacement in cement concrete is not yet complete. The results of this experiment are shown in appendix 12.

12.7.3.34 LD slag

General

column test emission:	15 observations
cascade + extrapolation emission:	1 observation
aqua regina composition:	18 observations
transformed total-destruction composition:	11 observations
organic compounds composition:	2 observations

In appendix 1, LD slag as a prefabricated product (volume larger than 50cm^3) is placed into the category of V1 construction materials, if applied in streaming salty surface water. For land and sweet water applications, this material is not placed into a category. Non-prefabricated applications of LD slag (0-44mm) do not occur often. LD slag is applied in stabilised road base constructions, and in water construction as dump stone. Both applications are prefabricated applications.

oBB inorganic composition: V exceeds (5/5[14/14] measurements) the S1 standard. The compounds Cr(4/18[5/24]) and Ni(3/18[4/21]) appear to be critical based on this sample check. The exceeding metals are typical for LD slag.

oBB organic composition: No excession of the S1 standard for construction materials for PAHs[0/2]. PCBs and other organic compounds are not measured.

oBB leaching: Of the eight Cd emission measurements (1/8), one is on the U1 standard; this is an outlier. The Mo emission measurements (3/8[4/9]) exceed the U1 standard (of which two transformations). The remaining metals (Cd, Hg, and Pb) are outliers or detection limits.
Hot liquid steel slag is cooled with seawater. Seawater contains approximately 19,400 mg Cl/l and 67 mg Br/l (Cl/Br=174)[37]. This relationship is in general also found for the leaching, keeping in mind the spreading (Cl/Br=290). The chloride and the bromium in the steel slag therefore originates from seawater. Chloride and bromium leach out easily (equal mobility). Cl(6/12[6/12]) and Br(6/7[6/7]) exceed the U1 standard, and Br(6/7[6/7]) also the U2 standard. One bromium emission does not exceed the leaching standard, this LD slag is cooled with air. F(5/12[5/12]) also exceeds the U1 standard. Based on Br, a large part of the LD slag will not be applicable under the oBB. In the oBB, application in streaming salty surface water was allowed, which in view of the emitting compounds would not cause any problems.

New leaching standards: After adapting the calculation of the standards and raising the allowable immission of Ba, V, and F by DGM, the metals no longer exceed the U1 standard. Br(6/7[6/7]), Cl(6/12[6/12]) and F(4/12[4/12]) still do exceed the U1 standard. Br(5/7[5/7]) also exceeds the U2 standard. Based on this, a large part of the LD slag would not be applicable as non-prefabricated construction material.

Conclusion: Steel slag is applied in The Netherlands as a component of hydraulic mixes (blast furnace slag mixes) in road construction and as dump stone in salt water construction. Currently, the emphasis is on applications in road construction. Applications as non-prefabricated construction material on or in the soil do not occur.
At this time, the producer of steel slag developes an other cooling method with sweet water. By adapting the cooling method, the steel slag is expected to meet the requirements of the Building Materials Decree [44]. Through changes in the production process, the leaching of fluoride has reduced noticeably in the last months, according to the producer. After adapting the cooling process, F[4/12] is the most critical parameter on the basis of which a part (33%(10-66)) of the LD slag can be used as category 2 construction material and the rest as category 1 construction material. If "air-cooled LD slag" is applied in

layers of 20-50 cm thick, which is usual in road construction, all steel slag would be applicable as category 1 construction material (100%). Non-air cooled LD slag preferably would have to be used in salt water construction. Application as an element of hydraulic mix aggregate is also possible in the category 1 construction materials. The prescence of organic compounds in concentrations which exceed the standard is not likely in view of the production process.

12.7.3.35 Phosphor slag

General

column test emission:	7 observations
cascade + extrapolation emission:	1 observation
aqua regina composition:	5 observations
transformed total-destruction composition:	7 observations
organic compounds composition:	2 observations

In appendix 1, phosphor slag as prefabricated construction material (volume larger than $50cm^3$) is placed into the category 1 construction materials, if applied in streaming salty surface water. For land and sweet water applications, this construction material is not placed into a category. The usual application of phosphor slag in road construction is in stabilised road bases (see prefabricated applications).

oBB inorganic composition: F(1/1[3/3]) exceeds the S1 standard.

oBB organic compisition: No excession of the S1 standard for construction materials for PAHs[0/2]. PCBs and other organic compounds are not measured.

oBB leaching: Although it is generally known that F is the most critical compound in phosphor slag, only one emission observation is found in the database (19 mg/kg). Based on this sample, phosphor slag fits completely into the N2 category (U1-oBB-leaching standard = 5mg/kg), because F(1/1[1/1]) but also SO_4[2/3] exceed the U1 standard for construction materials. Mo(3/6[3/7]) is critical.

New leaching standards: Adaptation of the standards for the allowable emission from construction materials, leads to an emission limit of U1=5.5 mg F/kg. DGM has raised the maximum allowable immission for F in order to ensure the re-use of phosphor slag as prefabricated construction material for those applications which occur the most. This raising also influences the standard setting for non-prefabricated construction materials (U1=13 mg F/kg). Also then, the less usual application of non-prefabricated phosphor slag (0-40mm) does not fall under the category 1 conditions (h=0.7m). Mo is no longer critical. If, however, phosphor slag would be applied in road bases of approximately 30cm, a common layer thickness in road construction, then phosphor slag would be partly applicable under category 1 conditions. Sulphate [2/3] remains critical, however, so that phosphor slag fits for a large part into the category 2 construction materials.

Conclusion: Based on the limited samples, phosphor slag is a category 2 construction material (100%). The results from research as to the actual-practice relevance of the column test [45], by which phosphor slag (as it is applied in road construction) is leached in large columns up flow and down flow, confirm this conclusion. Also here, the F and SO_4 emissions exceed the U1 standard for construction materials. Phosphor slag, however, is not used as a non-prefabricated construction material (0-40mm). As a non-prefabricated construction material, 67% (10-100%) of the phosphor slag would, based on the SO_4, fit into the category 2 construction materials if applied in thin layers of 20-30cm. Recently DGM raised the allowable immission for sulphate from non-prefabricated construction materials to 100000mg/m^2 (1136mg/kg at h=70cm). The prescence of organic compounds in standard exceeding concentrations are not likely in view of the production process.

12.7.3.36 ELO slag

General

column test emission:	2 observations
cascade + extrapolation emission:	2 observations
aqua regina composition:	10 observations
transformed total-destruction composition:	4 observations
organic compounds composition:	2 observations

ELO slag (electric oven steel slag) is not categorized in the oBB. ELO slag is currently not used as a non-prefabricated construction material, but it is used in hydraulic mix aggregate.

oBB inorganic composition: The S1 margin is continuously exceeded by Cr (10/10[14/14] observations). Under the oBB, ELO slag as a non-prefabricated construction material, is not usable. The compounds Ni(8/10[8/14]) and Mo(3/6[3/10]) are critical.

oBB organic composition: No excession of the S1 standard by PAHs. PCBs and other organic compounds are not measured.

New organic composition standards: See oBB organic composition.

oBB leaching: The Mo emissions(2/2([3/4])) are above the U2 standard, which results in ELO slag being mostly inapplicable as a non-prefabricated construction material (0-30mm) under the oBB. Ba(2/2[3/3]) and Cr(1/2[1/3]) exceed the U1 standard for construction materials.

New leaching standards: After adapting the standards for construction materials, the end evaluation of ELO slag does not change.

Conclusion: 75% (20-99%) of the ELO slag (Mo[3/4]) is not applicable as a non-prefabricated construction material under the conditions of the Building Materials Decree. At the moment, it is also not being applied as such. A part is applicable as a category 2 construction material. Application in thin layers is not a solution. The prescence of organic compounds in concentrations which exceed the standard are not likely in view of the production process.

12.7.3.37 Artificial aggregate

Artificial aggregates are distinguished according to E fly ash aggregate, expanded clay aggregate, and hydraulically stabilised E fly ash aggregate.

12.7.3.37.1 Hydraulically stabilised E fly ash aggregate

General

column test emission:	0 observations
cascade + extrapolation emission:	0 observations
aqua regina composition:	0 observations
transformed total-destruction composition:	2 observations
organic compounds composition:	0 observations

oBB inorganic composition: Cd[1/2], Sb[1/2], and Cl[1/1] exceed the S1 standard.

oBB leaching: No information is available.

Conclusion: Insufficient information.

12.7.3.37.2 Expanded clay aggregate

General

column test emission:	0 observations
cascade + extrapolation emission:	0 observations
aqua regina composition:	5 observations
transformed total-destruction composition:	2 observations
organic compounds composition:	0 observations

oBB organic composition: Only SO_4[2/4] exceeds the S1 standard.

oBB leaching: No information is available.

Conclusion: Insufficient information available.

12.7.3.37.3 E fly ash aggregate

General

column test emission:	5 observations
cascade + extrapolation emission:	0 observations
aqua regina composition:	4 observations
transformed total-destruction composition:	6 observations
organic compounds composition:	0 observations

oBB inorganic composition: Zn[1/10] exceeds the S1 standard; this is an outlier.

oBB leaching: As[5/5], Mo[5/5], Se[2/2], V[2/2] and Sb[1/2] exceed the U1 standard. Mo[2/5] also exceeds the U2 standard for construction materials.

New leaching standards: Based on As[5/5], Mo[5/5] and Se[2/2], this artificial aggregate is applicable as a category 2 construction material (excession of the U1 standard for construction materials).

Conclusion: This aggregate is applied as a gravel substitute in cement concrete. Application as a non-prefabricated construction material does not occur at the moment. The critical compounds are characteristic for E fly ash.

12.7.4 Evaluation of construction materials for application in waterway construction

In table 12.7.4.1., the U1 standards for non-prefabricated construction materials for applications on or in the soil (RIVM) are compared with the U1 standards for construction materials in water construction (RIZA). It appears that most of the U1 standards in water construction are equal to or slightly higher than the U1 standards for applications on or in the soil. The V1 standards for prefabricated construction materials are exactly alike!

Table 12.7.4.1. Comparison of the leaching standards U1 for non-prefabricated construction materials for dry application (RIVM) and for wet application (RIZA).

height	0,7	0,7
infiltration	300	600
density	1550	1550
	U1 dry application on or in the soil (mg/kg)	U1 waterway construction (mg/kg)
As	0,88	0,83
Ba	5,48	5,5
Cd	0,03	0,03
Co	0,42	0,43
Cr	1,25	1,27
Cu	0,72	0,73
Hg	0,02	0,02
Mo	0,28	0,29
Ni	1,09	1,1
Pb	1,90	1,93
Sb	0,05	0,04
Se	0,04	0,04
Sn	0,27	0,27
V	1,56	1,34
Zn	3,82	3,88
Br	2,87	2,88
Cl	599,08	681
F	13,00	13
SO_4	1136	805
CN-tot	0,07	0,07
CN-free	0,01	0,01

In surface waters, RIZA in general does not consider isolated applications possible. It is therefore not possible and/or useful to develop standard requirements for applications in surface waters. This means that application of category 2 construction materials and type B construction materials in water construction must be evaluated per case and therefore remains under a permit requirement (see Part 1 RIZA). The RIVM has evaluated the consequences for the construction materials which are applied in the surface water. The construction materials which are of importance to water construction are reproduced in table 12.7.4.2. (according to V&W-DWW).

Table 12.7.4.2. In 1992, the following amounts of loose granular construction materials were processed.

construction material	amount	type	note
crushed natural stone	600 kt	V	**no leaching data**
slags	300 kt	V/N	V = 250 kt N = 50 kt applied mixed
mine stone	400 kt	V/N	V = 250 kt N = 150 kt applied mixed
gravel	20 kt	N	
broken stone (broken stone 5-40mm)	400 kt	N/V	V = 300 kt N = 100 kt can be applied mixed **no leaching data**
concrete (elements) - blocks - pillars - mats	 6000 m^2 135000 m^2 50000 m^2	V	

The evaluation of construction materials for application in water construction took place based on the measurement results given to the RIVM, and evaluated at h=70cm.

Crushed natural stone:	no leaching data but does not appear to be a problem (category 1 construction material).
slags:	- phosphor slag as non-prefabricated construction material not applicable (100% category 2 construction material) - phosphor slag as prefabricated construction material applicable (F standard raised to allow application of phosphor slag as prefabricated construction material!) - LD slag as non-prefabricated construction material applicable after carrying out of processing changes by producer, otherwise not applicable. - LD slag as prefabricated construction material applicable.
Mine stone:	imported mine stone applicable as non-prefabricated construction material (100% cat. 1.). Dutch mine stone not applicable (cat. 2). Concerning mine stone as prefabricated construction material, no (leaching) data available. Application will not cause any problems because non-prefabricated is usually more critical.
Gravel/sand:	applicable as non-prefabricated construction material (100% cat. 1).
Broken stone:	No leaching data available. Will probably not cause any problems.
Concrete elements:	applicable as prefabricated construction material.

So far the construction materials given by V&W-DWW. Should other construction materials have to be evaluated, then this can take place based on Part 2 of this report, since the standard setting for cat. 1 construction materials barely differs. The conclusions in Part 2 must be read as follows:

All construction materials (or parts thereof) in category 1 are applicable in surface waters. All construction materials (or parts thereof) in category 2 or type B application (prefabricated construction materials only) are not applicable in surface water. These are, of course, applicable on or in the soil in dry isolated applications.

12.8 Prefabricated construction materials

12.8.1 Introduction

Since it was known in advance that DGM is planning to cancel the composition standard for inorganic compounds, only the leaching has been kept in mind in the conclusions. The composition standard for organic compounds is included in the conclusions. Periodical reports of the comparisons with the standards for construction materials were given several times to DGM during the composition of this report.

On the basis of these periodical reports, the standards for construction materials are adjusted to ensure the re-use of certain construction materials. The adjustments of Ba, F, V, and PAHs are processed in appendix A.

Based on very limited amounts of available data, also for prefabricated materials, it is only possible to evaluate the sample check. Additions to prefabricated construction materials are therefore possible, in greatly differing percentages and clearly differing effects concerning leaching emissions from prefabricated construction material (see for example calcium-silicate bricks and blocks with E fly ash).

The first evaluation took place in view of the old standards for construction materials from the oBB dated 26/06/1991. The new standards for construction materials are calculated by the RIVM on the basis of the current information, with the exception of the compounds PAHs, fluor, vanadium, and barium for which the standards for construction materials are raised by VROM-DGM.

With the new standards for construction materials, for two types of applications, different U1 standards for construction materials are suggested. A distinction is made between type A applications, such as stabilised road bases, embankments, qays and banks, and type B applications, such as roofs and walls. For type B applications, a higher emission is accepted in the diffusion test, because this type of application is wetted for only a limited time in actual practice. This results in the same immission in the soil for type A and type B applications.

Through isolation of a type A application, this is also wet for a limited time only. Based on current knowledge, this wetting time is difficult to quantify. The isolation factor is

fixed in such a way that the V2 standard for construction materials for the A application lines up with the V1 standard for construction materials of a type B application. For a closer examination of the difference between type A and B applications, refer to 8.2.4. If in the text category V1, V1 construction material or U1 standard for construction materials is mentioned without specification of the type of application, then it concerns both type A as well as type B applications. In the evaluation of the prefabricated construction materials, the emissions are compared with the new standards such as they are valid for most of the compounds. The evaluation of construction materials with a $pD_e<10$ in type B and isolated type A applications with respect to the new standards will be "worst case" in some cases (small pD_e, small h). This is also valid for construction materials with $pD_e<11$ in unisolated type A applications.
In the evaluation, the calculations are made with upper limits. This is to say that, with a measurement result smaller than the detection limit, the value of the detection limit is valid. Tin is measured mostly with a high detection limit (>U1 standard for construction materials). The results for tin are therefore not relevant, and not included in the evaluation of the sample check.

For the leaching emissions, the most important aspects of the calculation of the sample check with regards to the leaching standards for construction materials in table 12.8.1a. (old leaching standards for construction materials) and 12.8.1b. (new leaching standards) are reproduced. In table 12.8.2a (old inorganic composition standards), table 12.8.2b. (old organic composition standards) and table 12.8.2c. (new organic composition standards), the most important aspects of the evaluation with regards to the composition criteria is reproduced.

The standards for unisolated applications of prefabricated construction materials on the sediment bed of the surface water are equal to the standards for the soil. This means that prefabricated construction materials which fit into the V1-A category, may also be applied on the sediment bed of the surface water.

Table 12.8.1a Comparison (binomial) of the construction materials researched with the standard values for the leaching emissions of the oBB (26/06/1991)

construction material	identification nr.	Bijl.1 cat. oBB	n	category construction material V1 %	V2-A & V1-B %	not applic. %	most critical	others critical	others not critical
lime stone	5	V1							
basalt	8	V1							
cement concrete	13	V1	1-8	100					As(3), Ba, Cd(3), Co(6), Cr, Cu, Mo(7), Ni, Pb(3), Sb(2), Se(2), Sn(1), V(3), Zn, Cl(2), F(2), SO4(3)
cement concrete +	14								
with ardealite			2-4	100					As, Ba(2), Cd(2), Co(2), Cr(2), Cu, Mo, Ni, Pb(2), Sn(2), V(2), Zn(2), SO4(2)
with MSWI bottom ash (8%)		V1	2-3	100					As, Ba, Cd, Cr, Cu, Mo, Ni, Pb, Sb, Se, V, Zn(2), Cl, F, SO4
with E fly ash (5-8%)			4	100					As, Ba, Cd, Cr, Cu, Mo, Ni, Pb, Sb, Se, V, Zn, Cl, F, SO4
with lytag			2	100					As, Cu, Mo, Ni
asphalt cement	15	V1	1-4	100					As, Ba, Cd, Cr, Cu, Mo, Ni, Pb, Sb, Se, V, Zn, Cl(1), F(3), SO4(1)
asphalt cement +	16								
with MSWI bottom ash			3	100					As, Cd, Cr, Cu, Ni, Pb, Zn
with E MSWI fly ash		V1	4	100					As, Ba, Cd, Cr, Cu, Mo, Ni, Pb, Sb, Se, V, Zn
with MSWI fly ash (2%)		V1	3		100		Cl	Cd	As, Ba, Cr, Cu, Mo, Ni, Pb, Sb, Se, V, Zn, F, SO4
with E fly ash (6%)		V1	2	100					As, Ba, Cd, Cr, Cu, Mo, Ni, Pb, Sb, Se, V, Zn, Cl, F, SO4
with phosphor slag (59%)		V1	1	(100)					F
rough ceramic products	19	V1	1-11	60	40		F(5)	V	As, Ba(10), Co(10), Cr(10), Cu(10), Mo(1), Ni(10), Pb(10), Sb(10), Se(10), Sn(10), Zn(10), SO4(10)
Ca-silicate bricks and blocks	23	V1	1-2	100					As, Ba, Cd(1), Cr, Cu(1), Mo, Ni(1), Pb(1), Sb(1), Se(1), V, Zn, Cl(1), F(1), SO4(1)
Ca-silicate bricks and blocks +	24								
with E fly ash (9%)		V1	1	(100)					As, Ba, Cr, Mo, V, Zn
with lownox fly ash (9%)			1	(100)					As, Ba, Ni, V
with fluid bed ash (29%)			1			(100)	SO4		As, Ba, Ni, V
with ash lime (8%)			1	(100)					As, Ba, Ni, V
aerated concrete	25	V1	13		8	92	SO4		As(1), Ba(1), Cd(1), Cr(1), Cu(1), Mo(1), Ni(1), Pb(1), Sb(1), Se(1),V(1),Zn(1), Cl,F(1)
sand cement stabilization	29	V1	1	(100)					As, Ba, Cd, Cr, Cu, Mo, Ni, Pb, Sb, Se, V, Zn, F, SO4
sand cement stabilization +	30								
with E fly ash (73%)			1			(100)	Mo		As, Ba, Cd, Cr, Cu, Ni, Pb, Sb, Se, V, Zn, Cl, F, SO4
blast furnace slag mix	34	V1							
hydraulic mix aggregate	35								
lightly stabilised phosphor slag	36	V2	2		100		F		
lightly stabilised steel slag	37								
stabilised MSWI bottom ash	38	V2	8		25	75	Mo		As, Cd, Cr, Cu, Ni, Pb, Zn
lightly stabilised E fly ash	40								
blast furnace slag	61		3	33	67		SO4		Ba, Cr, Cu, Ni, V, Zn
LD slag	66		1-6	33	67		V	Mo(1), F	As(1), Ba, Cd(1), Cr(1), Cu(1), Hg(1), Ni(1), Pb(1), Zn(1), SO4(5)
phosphor slag	67	V1	1	(100)					As, Cd, Cu, Pb, V, Zn, F, SO4
copper slag	69		6-12	8	50	42	Cu		As(6), Cr(6), Ni, Pb, Zn

Note:
The evaluation of the products could only be done with a small number of measurements. The accompanying confidence intervals are mostly large because of this.
The values between brackets are based on only 1 measurement. The divisions presented in this table are the best estimators based on the sample check.

Table 12.8.1b Comparison (binomial) of the researched construction materials with the adjusted leaching standard values of the Administrative Order for Construction Materials

construction material	iden-tifi-cati-on nr.	Bijl.1 cat. oBB	n	category construction material			most crit	others crit	others not critical
				V1 %	V2-A & V1-B %	not applic. %			
lime stone	5	V1							
basalt	8	V1							
cement concrete	13	V1	1-8	100					As(3), Ba, Cd, Co(6), Cr, Cu, Hg(1), Mo, Ni, Pb(3), Sb(2), Se(2), Sn(1), V(3), Zn,
									Cl(2), F(2), SO4(3)
cement concrete +	14								
with ardealite			2-4	100					As, Ba(2), Cd(2), Co(2), Cr(2), Cu, Hg(2), Mo, Ni, Pb(2), Sn(2), V(2), Zn(2), SO4(2)
with MSWI bottom ash (8%)		V1	2-3	100					As, Ba, Cd, Cr, Cu, Mo, Ni, Pb, Sb, Se, V, Zn(2), Cl, F, SO4
with E fly ash (5-8%)			4	100					As, Ba, Cd, Cr, Cu, Mo, Ni, Pb, Sb, Se, V, Zn, Cl, F, SO4
with lytag			2	100					As, Cu, Mo, Ni
asphalt cement	15	V1	1-4	100					As, Ba, Cd, Cr, Cu, Mo, Ni, Pb, Sb, Se, Sn(1), V, Zn, Cl(1), F(3), SO4(1)
asphalt cement +	16								
with MSWI bottom ash			3	100					As, Cd, Cr, Cu, Mo, Ni, Pb, Zn
with E MSWI fly ash		V1	3	100					As, Ba, Cd, Cr, Cu, Mo, Ni, Pb, Sb, Se, Sn, V, Zn, F, Cl, SO4
with MSWI fly ash (2%)		V1	4	100					As, Ba, Cd, Cr, Cu, Mo, Ni, Pb, Sb, Se, V, Zn
with E fly ash (6%)		V1	2	100					As, Ba, Cd, Cr, Cu, Mo, Ni, Pb, Sb, Se, Sn, V, Zn, Cl, F, SO4
with phosphor slag (59%)		V1	2	100					F
rough ceramic products	19	V1	5-11	100					As, Ba(10), Co(10), Cr(10), Cu(10), Hg(10), Mo, Ni(10), Pb(10), Sb(10), Se(10), Sn(10), V, Zn(10), F(5), SO4(10)
Ca-silicate bricks and blocks	23	V1	1-2	100					As, Ba, Cd(1), Cr, Cu(1), Mo, Ni(1), Pb(1), Sb(1), Se(1), V, Zn, Cl(1), F(1), SO4(1)
Ca-silicate bricks and blocks +	24								
with E fly ash (9%)		V1	1	(100)					As, Ba, Cr, Mo, V, Zn
with lownox fly ash (9%)			1	(100)					As, Ba, Ni, V
with fluid bed ash (29%)			1			(100)	SO4		As, Ba, Ni, V
with ash lime (8%)			1	(100)					As, Ba, Ni, V
aerated concrete	25	V1	13		100		SO4		As(1), Ba(1), Cd(1), Cr(1), Cu(1), Mo(1), Ni(1), Pb(1), Sb(1), Se(1), V(1), Zn(1), Cl, F(1)
sand cement stabilization	29	V1	1	(100)					As, Ba, Cd, Cr, Cu, Mo, Ni, Pb, Sb, Se, V, Zn, Cl, F, SO4
sand cement stabilization +	30								
with E fly ash (73%)			1			(100)	Mo		As, Ba, Cd, Cr, Cu, Ni, Pb, Sb, Se, V, Zn, Cl, F, SO4
blast furnace slag mix	34	V1							
hydraulic mix aggregate	35								
lightly stabilised phosphor slag	36	V2	2	100					F
lightly stabilised steel slag	37								
stabilised MSWI bottom ash	38	V2	8		100		Mo(6)		As, Cd, Cr, Cu, Ni, Pb, Zn
lightly stabilised E fly ash	40								
blast furnace slag	61		3	67	33		SO4		Ba, Cr, Cu, Ni, V, Zn
LD slag	66		1-6	100					As(1), Ba, Cd(1), Cr(1), Cu(1), Hg(1), Mo(1), Ni(1), Pb(1), V, Zn(1), F, SO4(5)
phosphor slag	67	V1	1	(100)					As, Cd, Cu, Pb, V, Zn, F, SO4
copper slag	69		6-12	8	50	42	Cu		As(6), Cr(6), Ni, Pb, Zn

Note:
The evaluation of the products could only be done with a small number of measurements. The accompanying confidence intervals are mostly large because of this.
The values between brackets are based on only 1 measurement. The divisions presented in thius table are the best estimators based on the sample check.

TABLE 12.8.2a Comparison (binomial) of the construction materials researched with the standard values for the inorganic composition of the oBB (26/06/1991)

construction material	iden-tifi-cati-on nr.	Bijl.1 cat. oBB	n	category construction material		most critical	others critical	others not critical
				S1 <S1 %	not applic. >S1 %			
lime stone	5	V1	1-4	100				As, Ba(3), Cd, Co(2), Cr, Cu, Hg(3), Mo(2), Ni, Pb, Sb(3), Se(3), Sn(2), V(3), Zn, Br(1), Cl(2), F(2), SO4(1)
basalt	8	V1	1	(100)				Cd, Cr, Cu, Pb, Zn
cement concrete	13	V1	1-3	100				As, Ba, Cd, Co(1), Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Sn, V, Zn, Cl(2), F(2), SO4
cement concrete +	14							
with ardealite			2	100				As, Ba, Cd, Co, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Sn, V, Zn, SO4
with MSWI bottom ash (8%)		V1	3	100				As, Ba, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Sn, V, Zn, Cl, F, SO4
with E fly ash (5-8%)			4	100				As, Ba, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Sn, V, Zn, Cl, F, SO4
with lytag								
asphalt cement	15	V1	1-15	100				As, Ba, Cd, Co(3), Cr, Cu, Hg(4), Mo, Ni, Pb, Sb(10), Se(10), Sn(4), V, Zn, Cl(1),F(3),SO4(1)
asphalt cement +	16							
with MSWI bottom ash			1	(100)				As, Ba, Cd, Co, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Sn, V, Zn
with E MSWI fly ash		V1	3-6	100				As, Ba, Cd, Co(3), Cr, Cu, Hg(3), Mo, Ni, Pb, Sb, Se, V, Zn
with MSWI fly ash (2%)		V1	3	100				As, Ba, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Sn, V, Zn, Cl, F, SO4
with E fly ash (6%)		V1	2-5	100				As, Ba, Cd, Cr, Cu, Hg(2), Mo, Ni, Pb, Sb, Se, Sn(2), V, Zn, Cl(2), F(2), SO4(2)
with phosphor slag (59%)		V1	2		100	F		
mortar with E fly ash	18	V1	1	(100)				As, Cd, Cu, Mo, Sb, Se, V, Zn, F, SO4
rough ceramic products	19	V1	2-30	100				As, Ba(2), Cd(27), Co(2), Cr(8), Cu(8), Hg(3), Mo(24), Ni(8), Pb(8), Sb(2), Se(2), Sn(2), V(24), Zn(8), Br(2), Cl(2), F(2), SO4(2)
Ca-silicate bricks and blocks	23	V1	1-6	100				As, Ba, Cd, Co(1), Cr, Cu, Hg, Mo, Ni, Pb(2), Sb, Se(2), Sn(2), V, Zn, Cl(1), F(1),SO4(1)
Ca-silicate bricks and blocks +	24							
with E fly ash (9%)		V1	1	(100)				As, Ba, Cd, Cr, Cu, Hg, Mo, Ni, Sb, V, Zn
with lownox fly ash (9%)								
with fluid bed ash (29%)								
with ash lime (8%)								
aerated concrete	25	V1	1-5	100				As, Ba(4), Cd, Co(3), Cr, Cu(4), Hg(1), Mo, Ni, Pb(4), Sb(1), Se(4), Sn(1), V(4) Zn(4), Cl(1), F(1), SO4(1)
sand cement stabilization	29	V1	1	(100)				As, Ba, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Sn, V, Zn, Cl, F, SO4
sand cement stabilization + with E fly ash (73%)	30		1	(100)				As, Ba, Cd, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Sn, V, Zn, Cl, F, SO4
blast furnace slag mix	34	V1	1-13	100				As, Ba(9), Cd, Co(1), Cr, Cu, Hg(6), Mo(12), Ni(12), Pb, Sb(2), Se(2), Sn(1), V(9), Zn, Cl(4), F(1), SO4(4)
hydraulic mix aggregate	35		1-3	100				As(1), Ba(1), Cd(2), Cr, Cu, Hg(1), Mo(1), Ni(2), Pb(2), Zn(2)
lightly stabilised phosphor slag	36	V2	1-2		100	F		As(1), Ba(1), Cd(1), Cr(1), Cu(1), Mo(1), Ni(1), Pb(1), Se(1), Sn(1), V(1), Zn(1), Cl(1),SO4(1)
lightly stabilised steel slag	37		1	(100)				As, Ba, Cd, Cr, Cu, Mo, Ni, Pb, V, Zn
stabilised MSWI bottom ash	38	V2	2-6	33	67	Cu(6)		As(4), Ba(3), Cd, Co(3), Cr(4), Hg(3), Mo, Ni(4), Pb(5), Sb(5), Se(5), Sn(3), V(5), Zn, Cl(2), F(2), SO4(2)
lightly stabilised E fly ash	40		1-5	100				As(1), Cd, Cu, Mo, Pb(1), Sb, Se, V, Zn, Cl(1), F, SO4(4)
blast furnace slag	61		1-9	100				As(9), Ba(7), Cd(9), Co(5), Cr(8), Cu(9), Hg(4), Mo(8), Ni(8), Pb(8), Sb(7), Se(7), Sn(5), V(9), Zn(9), Br(1), Cl(1), F(1), SO4(1)
LD slag	66		1-24	43	57	V(14)	Cr	As(21), Ba(15), Cd(22), Co(2), Cu, Hg(5), Mo(6), Ni(21), Pb, Sb(4), Se(4), Sn(3), Zn(22), Cl(1), F(9), SO4(8)
phosphor slag	67	V1	1-12		100	F(3)		As, Ba(8), Cd, Co(5), Cr(10), Cu(11), Hg(4), Mo(9), Ni(10), Pb(11), Sb(8), Se(8), Sn(5), V(10), Zn(11), Br(1), Cl(1), SO4(2)
hydr. stabilised E fly ash aggregate	73		1-2	50	50	Cd, Sb		As(1), Ba(10, Co(1), Cr(1), Cu, Hg(1), Mo, Ni, Pb, Se, Sn, V, Zn, Cl(1), SO4(1)

Note:

The evaluation of the products could only be done with a small number of measurements. The accompanying confidence intervals are mostly large because of this.

The values between brackets are based on only 1 measurement. The divisions presented in this table are the best estimators based on the sample check.

TABLE 12.8.2b Comparison (binomial) of the researched construction materials with the standard values for composition for organic compounds from the oBB (26/06/1991).

construction material	iden-tifi cati-on nr.	Bijl.1 cat. oBB	n	category construction material		most critical	others critical	others not critical
				S1 <S1 %	not applic. >S1 %			
cement concrete	13	V1	2-3	100				PAHs
asphalt cement:								
recycling			18		28	Chr, Fla	Ph, Naph	PAHs
with tar			7		100	PAH-tot, Naph, Ph, Fla, Chr, BaP	An	PAHs
bitumen	15	V1	4-11		40	Chr	Naph, Ph, Fla	PAHs
blast furnace slag	61		1-4	100				PAHs, phenols(1), Cl-phenols
LD slag	66		2	100				PAHs
phosphor slag	67	V1	2	100				PAHs

Note:

The evaluation of the products could only be done with a small number of measurements. The accompanying confidence intervals are mostly large because of this.

The values between brackets are based on only 1 measurement. The divisions presented in this table are the best estimators based on the sample check.

TABLE 12.8.2c Comparison (binomial) of the researched construction materials withe the standard values for the adjusted composition standard for organic compounds of the Administrative Order for Construction Materials.

construction material	iden-tifi cati-on nr.	Bijl.1 cat. oBB	n	category construction material S1 <S1 %	not applic. >S1 %	most critical	others critical	others not critical
cement concrete	13	V1	2-3	100				PAHs
asphalt cement:								
recycling			18	100				PAHs
with tar			7		100	PAH10(tot), Chr	Ph, An, Naph, Fla, BaP	PAHs
bitumen	15	V1	4-11	100				PAHs
blast furnace slag	61		1-4	100				PAHs, phenols(1), Cl-phenols
LD slag	66		2	100				PAHs
phosphor slag	67	V1	2	100				PAHs

Note:

The evaluation of the products could only be done with a small number of measurements. The accompanying confidence intervals are mostly large because of this.

The values between brackets are based on only 1 measurement. The divisions presented in this table are the best estimators based on the sample check.

12.8.2 Evaluation of prefabricated construction materials

12.8.2.1 Lime stone

General

aqua regina composition:	2 observations
transformed total-destruction composition:	2 observations

oBB inorganic composition: No excessions of the S1 standard are observed.

Conclusion: A conclusion is not possible because of the absence of leaching data.

12.8.2.2 Basalt

General

aqua regina composition:	0 observations
transformed total-destruction composition:	1 observation

oBB inorganic composition: No excession of the S1 standard is observed.

Conclusion: A conclusion is not possible because of the absence of leaching data.

12.8.2.3 Cement concrete

General

diffusion test emission:	8 observations
aqua regina composition:	0 observations
transformed total-destruction composition:	3 observations

The evaluation of cement concrete with regards to leaching emissions took place on the basis of one to eight measurements. The number of measurements of compounds varies per material.

oBB inorganic composition: No excessions of the S1 standard are observed.

oBB organic composition: The contents of the 10 PAHs are measured three times. No excessions of the S1 standard for construction materials were observed.

New organic composion standards: Also with regards to the new S1 standard for construction materials, no excessions are observed for the three measurements of the 10 PAHs.

oBB leaching: The detection limit for the emissions of cadmium are above the old U1 standard for five of the eight diffusion tests of cement concrete. With one measurement, the detection limit of mercury, selenium, and antimony is above the old U1 standard for construction materials. These measurements are not included in the evaluation.
One measurement of the emission of molybdenum is relatively high with respect to the other measurements. This is an outlier, and this measurement is, therefore, not included in the evaluation. Based on the sample check, 100% fits into the V1 category. In appendix 1 of the oBB, cement concrete is also placed into category V1.

New leaching standards: With the exception of one measurement of high detection limits for selenium and antimony, all the measurements are below the leaching standards for construction materials. Cement concrete is therefore 100% (63-100%) applicable under V1 criteria.

Conclusion: Cement concrete fits 100% (63-100%)(Cd) into the category 1 construction material.

12.8.2.4 Cement concrete with addition of waste materials

For cement concrete with an addition of E fly ash, MSWI bottom ash, jarosite end slag (see appendix 12) or artificial aggregate, data is available.
For cement concrete with E bottom ash and other N1 materials, no comparison can take place because data concerning composition and/or leaching emission is missing. These prefabricated construction materials are placed into category V1 in appendix 1 of the oBB.

12.8.2.4.1 Cement concrete with hydraulically stabilised E fly ash

General

diffusion test emission:	4 observations
aqua regina composition:	0 observations
transformed total-destruction composition:	2 observations

oBB inorganic composition: No excessions of the S1 standards for construction materials are observed.

oBB leaching: The detection limits of mercury, antimony, and selenium are higher than the U1 standard for construction materials. For these compounds, a comparison is not possible. The leaching standards for construction materials are not exceeded. Based on this sample check, cement concrete with hydraulically stabilised E fly ash is a V1 construction material.

New leaching standards: For antimony and selenium, a comparison is not possible because the detection limits are also above the new category 1 standard for construction materials. The new leaching standards for construction materials are not exceeded by the remaining compounds (metals).

Conclusion: Cement concrete with hydraulically stabilised E fly ash is 100%(16-100%)-(Hg) a category 1 construction material.

12.8.2.4.2 Cement concrete with MSWI bottom ash

General

diffusion test emission:	3 observations
aqua regina composition:	0 observations
transformed total-destruction composition:	3 observations

The cumulative emissions of a number of compounds from three concrete paving blocks with 6.8%, 7% and 9.7% MSWI bottom ash (originating from three plants) are determined.

oBB inorganic composition: No excessions are observed.

oBB leaching: For concrete paving blocks with MSWI bottom ash, all cumulative emissions are smaller than the U1 standard. On the basis of this, these prefabricated construction materials with low percentages of MSWI bottom ash are classified for approximately 100% (confidence interval: 29-100%) as V1 construction materials.

New leaching standards: Concrete paving blocks with MSWI bottom ash are also categorized for 100% (29-100%) into the category 1 on the basis of the new standards for construction materials.

Conclusion: Based on the sample check, cement concrete with a small percentage of MSWI bottom ash is 100% (29-100%) a category 1 construction material.

12.8.2.4.3 Cement concrete with E fly ash

General

diffusion test emission:	4 observations
aqua regina composition:	0 observations
transformed total-destruction composition:	4 observations

Cement concrete with a small percentage of E fly ash is researched as partial cement substitute and/or filler. Leaching data is available for the following prefabricated construction materials:

Concrete with 7.8% neutral E fly ash
Concrete with 7.8% alkalic E fly ash
Concrete paving block with 5.4% E neutral fly ash
Concrete paving block with 5.4% E alkalic fly ash

oBB inorganic composition: No excessions are observed.

oBB leaching: With the measurements of cement concrete with E fly ash, no excessions of the U1 standard for construction materials were observed. The conclusion therefore, is, that, based on the sample check, cement concrete with E fly ash is regarded as 100% V1 construction material. In appendix 1 of the oBB, cement concrete with low percentages of E fly ash is also classified as a V1 construction material.

New leaching standards: Based on the sample check, cement concrete with a small percentage of E fly ash remains classified for 100%(40-100%) as a category 1 construction material.

Conclusion: Cement concrete with a small percentage of E fly ash is, based on the sample check, for 100%(40-100%) a category 1 construction material.

12.8.2.4.4 Cement concrete with E fly ash aggregate

General

diffusion test emission: 2 observations

oBB leaching: The cumulative emissions from cement concrete with E fly ash aggregate are under the U1 standards for construction materials.

New leaching standards: The cumulative emissions are also below the new leaching standards for construction materials. Based on this sample check, cement concrete with E fly ash aggregate is a category 1 construction material.

Conclusion: Based on the sample check, cement concrete with E fly ash is for 100%(16-100%) a category 1 construction material.

12.8.2.5 Asphalt cement

General

diffusion test emission: 6 observations
aqua regina composition: 14 observations
transformed total-destruction composition: 3 observations

oBB inorganic composition: No excessions of the S1 standard for construction materials are observed.

oBB organic composition: A distinction has been made between samples from research of asphalt cement in which in past production a minimum of 20% old asphalt has been processed (recycling asphalt), and remaining asphalt concrete samples (remaining).
Asphalt cement (recycling): in the research of asphalt cement in which old asphalt has been processed, eighteen asphalt cores were examined for PAH contents. In 28%(10-53%) of these asphalt cores, the chrysene and fluoranthene contents exceed the S1 standard for

construction materials [5/18]. This is 11% and 8% for phenanthrene and naphthalene respectively.

Asphalt cement (tar): For the remaining asphalt cement samples, in seven samples the contents of 10 PAHs total are higher than the S1 standard for construction materials. In view of the high PAH contents, these seven samples probably contain tar products. In these seven samples with (suspected) tar, 100%(59-100%) exceeds the S1 standard for 10 PAHs total [7/7]. Also the individual contents of naphthalene, phenanthrene, anthracene, fluoranthene, chrysene, and benzo(a)pyrene in these seven samples mostly exceed the S1 standard for construction materials.

Asphalt cement (remaining): For the other 11 samples, five had their individual contents determined, and six had only the 10 PAHs total determined. In 40% of the samples [2/5], the chrysene content exceeds the S1 standard (5-85%), and in one sample the naphthalene, phenanthrene, and/or fluoranthene contents exceed the S1 standard for construction materials.

<u>New organic composion standards</u>

Asphalt cement (recycling): In view of the new standards for construction materials for PAHs, no excessions of the S1 standard are observed anymore for the 18 asphalt cores in which old asphalt is processed.

Asphalt cement (tar): In the seven samples which (suspected) contain tar, the chrysene content and the 10 PAHs total exceed the S1 standard for construction materials [7/7]-(100%(59-100%) excession). Also for phenanthrene, anthracene, naphthalene, fluoranthene, and benzo(a)pyrene, excessions are observed.

Asphalt cement (remaining): In the other eleven asphalt cement samples, no excessions of the S1 standard are observed anymore [0/11].

Based on the sample check, asphalt cement without tar, and asphalt cement in which 20% old asphalt cement is processed, can be used under the Building Materials Decree. But the researched asphalt cement samples which (are suspected to) contain tar, exceed the S1 standard for construction materials.

<u>oBB leaching</u>: Based on this sample check, asphalt cement is regarded for 100% as V1 construction material. In appendix 1 of the oBB, this material is also categorized into category V1.

New leaching standards: No excessions of the standard for prefabricated construction materials are observed. From this follows that 100% is applicable as category 1 construction material.

Conclusion: Recycling asphalt cement is 100%(81-100%)(PAHs) applicable as category 1 construction material. Also asphalt cement with bitumen is 100%(48-100%) applicable as category 1 construction material. Asphalt cement with tar is for 100%(59-100%) not applicable on the basis of the PAHs contents. Asphalt cement with tar is applicable in the so called "special category" under certain isolation requirements.

12.8.2.6 Asphalt cement with additions of waste materials

Asphalt cement with the following additions are researched with the help of the diffusion test:

3*	2% MSWI fly ash (from 3 plants)
2*	6% E fly ash (pH neutral and alkalic)
3*	E fly ash (55-70% of the filler) and MSWI fly ash (0-15% of the filler)
1*	E fly ash (40-60% of the filler) and MSWI fly ash (20-30% of the filler)
3*	MSWI bottom ash
2*	58.5% phosphor slag (1* drilling cores, 1* marshall tablet).
4*	50% jarosite end slag (see appendix 12).
10*	jarosite end slag test samples (see appendix 12).

12.8.2.6.1 Asphalt cement with MSWI bottom ash

General

diffusion test emission:	3 observations
aqua regina composition:	1 observation
transformed total-destruction composition:	0 observations

oBB inorganic composition: No excession of the S1 standard is observed.

oBB leaching: For the prefabricated construction materials, asphalt cement with 2% MSWI fly ash, the emissions of chloride exceed the U1 standard for construction materials. For one MSWI fly ash sample, an excession of the cadmium U1 standard for construction materials was observed. Based on this data, asphalt cement with MSWI fly ash is characterized for 100%(29-100%) as V2 construction material. Asphalt cement with MSWI fly ash is placed into category V1 in the oBB in relation to the continuity and the expected product improvement.

New leaching standards: No excessions of the category 1 standard for prefabricated construction materials are observed. Based on the sample check, this prefabricated construction material is 100% (29-100%) classified as a category 1 construction material.

Conclusion: Based on the sample check, asphalt cement with a small amount of MSWI fly ash is 100%(29-100%) a category 1 construction material.

12.8.2.6.3 Asphalt cement with a combination of E fly ash and MSWI fly ash

General

diffusion test emission:	4 observations
aqua regina composition:	6 observations
transformed total-destruction composition:	0 observations

oBB inorganic composition: No excessions of the S1 standard for construction materials are observed.

oBB leaching: No excessions of the U1 standard are observed. From this follows that 100%(40-100%) falls into category V1.

New leaching composition: No excessions of the category 1 standard for construction materials are observed. Based on the sample check, 100%(40-100%) is applicable under the category 1 criteria.

Conclusion: Based on the sample check, asphalt cement with a small amount of MSWI and E fly ash is 100%(40-100%) a category 1 construction material.

12.8.2.6.4 Asphalt cement with E fly ash

General

diffusion test emission:	2 observations
aqua regina composition:	3 observations
transformed total-destruction composition:	2 observations

oBB inorganic composition: No excessions of the S1 standard for construction materials are observed.

oBB leaching: For asphalt cement with E fly ash (small percentage, 6%), no excessions of the U1 standard for construction materials are observed. The sample check is classified for approximately 100% in agreement with appendix 1, of the oBB.

New leaching composition: The emissions from asphalt cement with 6% E fly ash do not exceed the category 1 standard. Based on the sample check, this prefabricated construction material is classified for 100% as a category 1 construction material.

Conclusion: Based on this sample check, asphalt cement with a small amount of E fly ash is 100%(16-100%) a category 1 construction material.

12.8.2.6.5 Asphalt cement with phosphor slag

General

diffusion test emission:	2 observations
aqua regina composition:	0 observations
transformed total-destruction composition:	2 observations

The emission from a marshall tablet and from a drill core is determined.

oBB inorganic composition: In 100% of the samples, the fluor content exceeds the S1 standard.

oBB leaching: No excession of the U1 standard is observed for the marshall tablet of asphalt cement with 59% phosphor slag. For the drill cores of asphalt cement with phosphor slag, an excession of the U1 standard for fluor is observed. With the drilling of the core, two new surfaces are created, while the marshall tablet is made in the lab. In the evaluation, the emission from the drill core did not play a large role, because in applications by which no new surfaces are created, the marshall tablet gives a better prediction (see also chapter 12). For asphalt cement with phosphor slag, no evaluation is possible because of insufficient information. Asphalt cement with phosphor slag is placed into category V1 in appendix 1.

New leaching standards: For both the marshall tablet and the drill core, no excessions of the category 1 standard for construction materials are observed. Based on the sample check, asphalt cement with 59% phosphor slag is classified as a category 1 construction material for 100%.

Conclusion: Based on the sample check, asphalt cement with phosphor slag is 100%(29-100%) a category 1 construction material.

12.8.2.7 Mortar

General

aqua regina composition:	1 observation
transformed total-destruction composition:	3 observations

oBB inorganic composition: No excessions of the S1 standard for construction materials are observed.

Conclusion: For mortar no conclusion is possible because of the absence of leaching data.

12.8.2.8 Mortar with E fly ash

General

aqua regina composition:	0 observations
transformed total-destruction composition:	1 observation

oBB inorganic composition: There is one transformed value, whereby no excession of the S1 standard for construction materials is observed.

Conclusion: For mortar with E fly ash, no conclusion is possible because of the absence of leaching data.

12.8.2.9 Rough ceramic prefabricated construction materials

General

diffusion test emission:	11 observations
aqua regina composition:	5 observations
transformed total-destruction composition:	25 observations

oBB inorganic composition: No excessions of the S1 standard for construction materials is observed.

oBB leaching: The detection limits for cadmium are higher than the U1 standard, and in 3 samples also higher than the U2 standard. For mercury, an evaluation is also not possible because the detection limit lies above the U1 standard. The evaluation of molybdenum can only take place on the basis of one measurement because with the remaining samples the detection limit is higher than the U1 standard for construction materials.
In appendix 1, rough ceramic prefabricated construction materials (bricks) are placed into the V1 category. Based on the sample check, 40% is a V2 material because the emission of fluor from 2 bricks exceeds the U1 standard for construction materials[2/5]. The vanadium emission from 2 bricks also exceeds the U1 standard [2/11].

New leaching standards: The detection limit is above the category 1 standard only for cadmium. In view of the new leaching standards for construction materials, no excessions are observed.

Conclusion: Based on the sample check, rough ceramic prefabricated construction materials are 100%(69%-100%) category 1 construction materials.

12.8.2.10 Calcium-silicate bricks and blocks

General

diffusion test emission: 2 observations

aqua regina composition: 1 observation

transformed total-destruction composition: 5 observations

oBB inorganic composition: No excessions of the S1 standard are observed.

oBB leaching: No excessions of the U1 standards are observed for the two calcium-silicate bricks and blocks samples. Calcium-silicate bricks and blocks is categorized for approximately 100%(16-100%) as a U1 construction material based on these leaching data, and in agreement with appendix 1 of the oBB.

New leaching standards: No excessions of the category 1 standard are observed. Based on the sample check, this material is classified for 100%(16-100%) as a category 1 construction material.

Conclusion: Based on the sample check, calcium-silicate bricks and blocks is 100%(16-100%) a category 1 construction material.

12.8.2.11 Calcium-silicate bricks and blocks with additions of waste materials

Stand tests are carried out for:

1* Calcium-silicate bricks and blocks with 8.7% E fly ash

2* Calcium-silicate bricks and blocks with 37.3% E fly ash (both basis as well as neutral)

1* Calcium-silicate bricks and blocks with 8.7% lownox fly ash

1* Calcium-silicate bricks and blocks with 7.5% ash lime

The evaluation of calcium-silicate bricks and blocks with 37.3% E fly ash (both pH alkalic as well as neutral) and with 28.8% fluid bed E fly ash is reproduced in appendix 12. For calcium-silicate bricks and blocks with remaining N1 materials, which are placed into category V1 according to appendix 1 of the oBB, no data is available.

12.8.2.11.1 Calcium-silicate bricks and blocks with E fly ash (9%)

General

diffusion test emission:	1 observation
aqua regina composition:	0 observations
transformed total-destruction composition:	1 observation

The composition and the leaching emission for calcium-silicate bricks and blocks is determined with 8.7% E fly ash. For the result of a test experiment with calcium-silicate bricks and blocks with 37% E fly ash, see appendix 12.

oBB inorganic composition: No excessions of the S1 standard are observed.

oBB leaching: With the one measurement of a small addition of E fly ash (9%) to calcium-silicate bricks and blocks, no excession of the standards is observed. Calcium-silicate bricks and blocks with E fly ash is placed into category V1 in the oBB.

New leaching standards: For calcium-silicate bricks and blocks with 9% E fly ash, also no excession is observed with respect to the new leaching standards for construction materials.

Conclusion: For calcium-silicate bricks and blocks with E fly ash, no evaluation is possible because of lack of information.

12.8.2.11.2 Calcium-silicate bricks and blocks with lownox fly ash

General

diffusion test emission:	1 observation

oBB leaching: The single measurement of calcium-silicate bricks and blocks with 9% lownox fly ash does not exceed any U1 standards for construction materials.

New leaching standards: Calcium-silicate bricks and blocks with 9% lownox fly ash also does not exceed any new category 1 standards for construction materials.

Conclusion: For calcium-silicate bricks and blocks with a small percentage of lownox fly ash, no evaluation is possible because of lack of information.

12.8.2.11.3 Calcium-silicate bricks and blocks with ash lime

General

diffusion test emission:	1 observation

oBB leaching: The single measurement of calcium-silicate bricks and blocks with 8% ash lime shows no excession of the U1 standards.

New leaching standards: Calcium-silicate bricks and blocks with 8% ash lime also shows no excession of the new category 1 standards for construction materials.

Conclusion: For calcium-silicate bricks and blocks with a small percentage of ash lime, an evaluation is not possible due to the lack of information.

12.8.2.12 Aerated concrete units

General

diffusion test emission:	13 observations
aqua regina composition:	0 observations
transformed total-destruction composition:	5 observations

oBB inorganic composition: No excessions of the S1 standard are observed.

oBB leaching: The sulphate emission exceeds the V1 standard for construction materials of the type A applications [13/13] in 92% of the aerated concrete units. Aerated concrete units in outside walls is categorized as a V1 construction material in appendix 1.

New leaching standards: The sulphate emission exceeds the V1 standard for construction materials of the type A applications [13/13]. Aerated concrete units in type A applications is therefore only possible under V2 conditions. Aerated concrete units are applicable in the usual applications (type B applications, such as in outside walls) under V1 criteria.

Conclusion: Based on the sample check, aerated concrete in the usual application (type B) is 100%(75%-100%) a category 1 construction material.

12.8.2.13 Sand cement stabilization

General

diffusion test emission:	1 observation
aqua regina composition:	0 observations
transformed total-destruction composition:	1 observation

oBB inorganic composition: No excession of the S1 standard is observed.

oBB leaching: The chloride emission is relatively higher in this single test than to be expected based on the knowledge of this material. The high chloride emission is likely the result of a measurement mistake. The remaining emissions are smaller than the U1 standard. Sand cement stabilization is placed into category V1 in appendix 1.

New leaching standards: The probable measurement mistake of chloride is lower than the leaching standard for construction materials. The remaining emissions from sand cement stabilization are also smaller than the new standards for construction materials.

Conclusion: No evaluation is possible for cement sand stabilization due to the lack of information.

12.8.2.14 Sand cement stabilization with E fly ash (73%)

General

diffusion test emission:	1 observation
aqua regina composition:	0 observations
transformed total-destruction composition:	1 observation

One measurement of sand cement stabilization with a high percentage (72.5%) E fly ash is available.

oBB inorganic composition: No excession of the S1 standard for construction materials is observed.

oBB leaching: The selenium emission exceeds the U1 standard. The molybdenum emission from sand cement stabilization with E fly ash is higher than the U2 standard concerned. This material is not categorized in the oBB.

New leaching standards: Also with regards to the new leaching standards, the molybdenum emission exceeds the category 2 standard for construction materials of a type A application [1/1]. The selenium emission exceeds the category 1 standard concerned [1/1].

Conclusion: No evaluation is possible for sand cement stablization with E fly ash.

12.8.2.15 Blast furnace slag mix

General

diffusion test emission[60]:	0 observations
aqua regina composition:	12 observations
transformed total-destruction composition:	1 observation

oBB inorganic composition: No excessions of the S1 standard are observed.

Conclusion: No evaluation is possible for blast furnace slag mix because of the lack of usable data from the diffusion test. The emission of sulphate must be watched. Based on the column test measurements, blast furnace slag mix is applicable in thin layers under the Building Materials Decree. See also non-prefabricated construction materials (12.7.3.17.3.).

12.8.2.16 Hydraulic mix aggregate

General

aqua regina composition:	3 observations
transformed total-destruction composition:	0 observations

Hydraulic mix aggregate is a mix of steel slag (ELO or LD slag) and mixed aggregate of

[60] The research in which 15 mixes of the 8 leaching fractions are investigated, is not included in the evaluation (33%>new V2 standard). Based on two measurements carried out on all 8 fractions, it appears that the leaching of sulphate from these samples is not determined by diffusion. Perhaps during the test, a conversion into sulphate took place, but this is not investigated. The results could also not be used as "worst case" because in the end phase the r.c.>0.5.

masonry aggregate and concrete aggregate. Leaching emissions are known for the individual components (see 12.7.12.), but no data is available for the mix.

oBB inorganic composition: No excessions of the S1 standard is observed.

Conclusion: A conclusion is not possible because of the absence of leaching data.

12.8.2.17 Lightly stabilised phosphor slags

General

diffusion test emission:	2 observations
aqua regina composition:	0 observations
transformed total-destruction composition:	2 observations

oBB inorganic composition: In both cases, a fluor excession of the S1 standard for construction materials is observed.

oBB leaching: Based on these two measurements, approximately 100% of the lightly stabilised phosphor slag fits into the V2 category, because the fluor emission exceeds the U1 standard.

New leaching standards: Stabilised phosphor slag is classified for 100%(16-100%) as a category construction material.

Conclusion: Based on the sample check, lightly stabilised phosphor slag is 100%(16-100%) applicable as category 1 construction material.

12.8.2.18 Lightly stabilised steel slags

General

aqua regina composition:	1 observation
transformed total-destruction composition:	0 observations

oBB inorganic composition: No excession of the S1 standard is observed.

Conclusion: A conclusion is not possible because of the lack of leaching data.

12.8.2.19 Stabilised MSWI bottom ash

General

diffusion test emission:	8 observations
aqua regina composition:	4 observations
transformed total-destruction composition:	2 observations

oBB inorganic composition: The copper content exceeds the S1 standard concerned. Based on aqua regina destruction, 50%(7-93%) does not apply for use as a construction material. With transformations, this is 67%(22-96%).

oBB leaching: For two samples, the detection limit for molybdenum is higher than the U1 standard concerned (but below the U2 standard for construction materials). For the remaining six samples, the molybdenum emission exceeds the U2 standard. The results are dependent on the cement type used. Based on this sample check, 75%(35-97%) cannot be applied as construction material [6/8].

New leaching composition: The result depends on the type of cement used. For two samples, the detection limit for molybdenum is higher than the category 1 standard concerned for construction materials of a type A application. These are not included in the evaluation. With the remaining six samples, the molybdenum emission exceeds the category 1 standard for construction materials, so that 100% is applicable as a category 2 construction material in type A applications.

Conclusion: Based on the sample check, stabilised MSWI bottom ash is 100%(54-100%) applicable as category 2 construction material.

12.8.2.20 Lightly stabilised E fly ash

General

aqua regina composition:	0 observations
transformed total-destruction composition:	5 observations

oBB inorganic composition: No excessions of the S1 standard are observed.

Conclusion: A conclusion is not possible because of the lack of leaching data.

12.8.2.21 Blast furnace slag

General

diffusion test emission:	3 observations
aqua regina composition:	4 observations
transformed total-destruction composition:	6 observations

oBB inorganic composition: No excessions of the S1 standard for construction materials are observed.

oBB organic composition: The PAHs are measured four times. No excessions of the S1 standard were observed.

New organic composion standards: With the four measurements of PAHs, no excessions of the S1 standard are observed.

oBB leaching: The sulphate emission exceeds the U1 standard [2/3] in 67% of the samples.

New leaching standards: With regards to the new leaching standards for construction materials, 33% exceeds the category 1 standards for sulphate [1/3].

Conclusion: Based on the sample check, blast furnace slag is 33%(1-91%) applicable as a category 2 construction material. The rest is applicable as a category 1 construction material. This categorization agrees with the categorization which took place based on non-prefabricated blast furnace slag.

12.8.2.22 LD slag

General

diffusion test emission: 6 observations

aqua regina composition: 18 observations

transformed total-destruction composition: 11 observations

oBB inorganic composition: The vanadium composition exceeds the S1 standard in 57% of the samples, and the chromium content exceeds in 4% of the samples.

oBB organic composition: The PAHs are measured two times. No excessions of the S1 standard are observed.

New organic composion standards: With two PAH measurements, no excessions of the S1 standard were observed.

oBB leaching: The one measurement of the cumulative molybdenum emission exceeds the U1 standard for construction materials. In 67% of the samples, the vanadium emission [4/6] exceeds the U1 standard, and in 17% of the samples, the fluor [1/6] emission exceeds the U1 standard for construction materials.

New leaching standards: With regards to the new standards for construction materials, no excessions are observed anymore. LD slag can therefore be applied as a category 1 construction material.

Conclusion: Based on the sample check, LD slag is 100% (54-100%) a category 1 construction material.

12.8.2.23 Phosphor slag

General

diffusion test emission: 1 observation

aqua regina composition: 5 observations

transformed total-destruction composition: 7 observations

In contrast to the NVN 7432, the diffusion test is carried out with phosphor slag with demi-water instead of with demi-water made acidic to pH=4. This is the only given for the leaching emission from phosphor slag and is included in the evaluation as an indication.

oBB inorganic composition: The fluor content in phosphor slag is higher than the S1 standard for construction materials.

oBB organic composition: Two measurements of the PAHs are available. For the PAHs, no excessions of the S1 standards are observed.

New organic composion standards: With the two measurements of the individual PAHs, no excessions of the S1 standards for construction materials are observed.

oBB leaching: For the one sample, no excessions of the U1 standards for construction materials are observed. In appendix 1, this material is put into the V1 category.

New leaching standards: This one measurement also does not show an excession of the new leaching standards.

Conclusion: For the evaluation of phosphor slag, insufficient information is available.

12.8.2.24 Copper slag

General

diffusion test emission: 12 observations

oBB leaching: Approximately 42%(15-27%) of the amount of copper slag does not appear to be applicable for use under the oBB, because the copper emission exceeds the U2 standard for construction materials. The copper emission exceeds the U1 standard in 92% of the samples. The U1 standard for construction materials is also exceded in several samples by zinc (17%) and by lead (8%). This material is not categorized in the oBB.

New leaching standards: The evaluation of copper slag in view of the new leaching standards is the same as that of the old standards. This means that also in view of the new leaching standards for construction materials, approximately 42% of the copper slag is also not applicable under the Building Materials Decree because the emission of copper exceeds the category 1 standard.

Conclusion: Based on the sample check, copper is 42%(15-75%) not applicable as a construction material under the Building Materials Decree. 50% is applicable as category 2 construction material, and 8% as category 1 construction material.

12.8.2.25 Hydraulically stabilised E fly ash aggregate

General

aqua regina composition:	0 observations
transformed total-destruction composition:	2 observations

oBB inorganic composition: In 50% of the samples, the antimony and the cadmium concentration exceeds the S1 standard.

Conclusion: A conclusion is not possible because of the lack of leaching data.

12.9 Summary of the characterization of granular construction materials

The evaluation and classification of the construction materials took place on the basis of the results which were available during the reporting period.

12.9.1 Granular construction materials of natural origin

In the oBB, this group is divided into natural construction materials (raw materials) which also appear in the Dutch soil[61], and natural construction materials which do not appear in the Dutch soil. According to the oBB, the first group needs only to be tested according to the target value soil quality.

When excession of the target value soil quality occurs, application in category 1 (N1-construction material) is possible. The second group (foreign natural materials) must meet the requirements for non-prefabricated construction materials. From this research it appears that, after adapting the standards, all the natural construction materials examined, independent of their origin, meet the criteria for category 1 construction materials. The construction materials examined were clay, gravel, natural sand, de-silted sea sand, lime stone, basalt, flug sand, and lava stone. The natural construction materials originating from the Dutch soil (the first 4) do not exceed the target value soil quality.

12.9.2 Construction recycling materials

Aggregates such as asphalt aggregate, concrete aggregate, masonry aggregate and mix aggregate originating from construction waste in which only primary raw materials are processed, in general fit completely or for the most part into category 1 (N1 construction materials). Sieve sand and recycling breaker sand are category 1 construction materials based on the metals. Sulphate is a critical compound which causes a part of the construction recycling materials to be moved into category 2. Sulphate can be removed through washing. It must be mentioned here that for some compounds, sometimes only one measurement was available. The conclusions, therefore, are based more on the group of construction recycling materials as a whole rather than on the individual construction materials. There is a chance that aggregate, sieve sand and recycling breaker sand, from prefabricated construction materials in which waste materials are processed, move up to

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[61] Foreign soil which in structure is the same as Dutch soil may also be applied as soil if the soil meets the G standard for construction materials.

category 2 construction materials. Whether this happens depends on the leaching of the critical compounds from the prefabricated construction material and on (aging) processes which lead to the stabilization of the metals in the prefabricated construction material during the application phase. The PAH and mineral oil contents (composition) will, after DGM raises the S1 standard value, not lead to rejection for re-use of the regular construction recycling materials. In sieve sand, and to a lesser degree also in recycling breaker sand, organic compounds are present which could lead to a partial rejection of the non-prefabricated construction material.

12.9.3 Secondary raw materials origination from industrial processes

In this category, a distinction must be made between waste materials which can also be applied as independent granular construction material in non-prefabricated applications, and waste materials which are always applied as filler or as gravel substitute in prefabricated construction materials. E fly ash, MSWI fly ash, jarosite slag, ELO slag and chromium slag all belong in the category last mentioned. The effects of these secondary raw materials on the emission behaviour of prefabricated construction materials in which these materials are processed, is discussed elsewhere in this report.

The waste materials which can also be applied independently in the form of unstabilised raising material, addition material, and/or road base material are MSWI bottom ash, E bottom ash, blast furnace slag, and phosphor slag, all as category 2 construction materials. MSWI bottom ash will be almost completely non-applicable in this form, if tested according to the category 2 standards for construction materials. This construction material can be applied in the "special category for MSWI bottom ash". Mine stone, LD slag, blast furnace foam slag, granulate blast furnace slag, and blast furnace slag sand are mostly applicable as category 1 construction materials. Some waste materials in category 2 can be applied under the conditions stipulated for category 1, if they are applied in road base layers which are usual in road construction (20cm).

12.10 The results of the new standard values (emissions) for the re-use of prefabricated construction materials

12.10.1 Prefabricated construction materials made of primary materials

The emissions from prefabricated construction materials made of primary raw materials are mostly lower than the new standard values for the leaching emissions. Cement concrete, asphalt cement, rough ceramic prefabricated construction materials, calcium-silicate bricks and blocks and sand cement stabilisation are applicable as category 1 construction materials. These prefabricated construction materials are applicable in both type A as well as in type B applications under the category 1 criteria. Type A application can be constantly wetted and is, for example, a road base. Type B application is only wetted through precipitation, and is a roof or a wall above-ground, for example (see 8.2.4.). Aerated concrete is only applicable under the category 1 criteria in type B applications (for example as part of an outside wall) and under category 2 criteria in type A applications (isolated).

12.10.2 Prefabricated construction materials made of primary materials with an addition of secondary materials

Cement concrete and asphalt cement with an addition of E fly ash (8% and 50% E fly ash respectively), are applicable under category 1 criteria in type A and B applications (see 8.2.4.).

Rough ceramic prefabricated construction materials, calcium-silicate bricks and blocks and aerated concrete with E fly ash (25%, 37%, and 57% respectively) are suitable for (a number of) the usual applications of these materials, since these prefabricated construction materials with E fly ash can be applied in type B applications under category 1 criteria.

Under category 2 criteria, they can be used in type A applications. Rough ceramic prefabricated construction materials with 40% E fly ash (lower leaching emission as the result of higher baking temperature) and calcium-silicate bricks and blocks with 9% E fly ash (lower percentage E fly ash) are also applicable in A applications under category 1 criteria.

Sand cement stabilisation with 73% E fly ash is not applicable under the Building Materials Decree. Porous masonry bricks are applicable in type B applications under category 1 criteria, and in type A applications under category 2 criteria. Bricks, aerated concrete and calcium-silicate bricks and blocks are usually used in layer construction (type B application).

Calcium-silicate bricks and blocks with lownox fly ash or ash lime is applicable under category 1 criteria. Calcium-silicate bricks and blocks with fluid bed E bottom ash is suitable for A applications under category 2 criteria, and for B applications under category 1 criteria.

Cement concrete and asphalt cement with MSWI bottom ash (8% MSWI bottom ash) are suitable for both types of applications as category 1 material.

Asphalt cement with 2% MSWI fly ash is applicable in both types of applications under category 1 criteria. Asphalt cement with 60% phosphor slag is applicable in both types of applications under category 1 criteria.

12.10.3 Prefabricated construction materials made of secondary materials

Lightly stabilised phosphor slag and phosphor slag are applicable in type A and B applications under category 1 criteria (see 8.2.4.).

Stabilised MSWI bottom ash is usually applicable in B applications under category 1 criteria and in A applications under category 2 criteria. A small part of the stabilised MSWI bottom ash is suitable for A and B applications under category 1 criteria.

A part of the copper slag is not applicable under the Building Materials Decree.

With the development of prefabricated construction materials in which secondary raw materials are processed, it is suggested to include the second life cycle of a construction material, to be known as construction recycling material. Preferably, the resulting aggregate must be able to be used as category 1 construction material. In any case, they must be examined/evaluated again before use.

PART 3

RE-USABILITY AND RE-USE

13. RE-USE

13.1 Introduction

For the estimation of the effect of the standard setting for construction materials (standard setting according to the oBB on the one hand and according to the Building Materials Decree on the other hand) on the re-use and on the functional application of construction materials, it is of importance that the method for the calculation of the standards for construction materials (Part 1) and the method of testing according to the allowed immissions is uniformly fixed (The Ministerial Regulation). At the publication of the Dutch version of this report the final text of the MR was not yet available. The examination method is therefore not counted in the calculations, but the examination procedure is reported in chapter 11.3. Furthermore, the quality of the construction materials must be well known (Part 2). In chapters 13.2-13.6, the emphasis is placed on the method by which data is worked out into conclusions, and how these are then presented. In chapters 13.7-13.9., a further interpretation follows, with the emphasis then being on the comparison between RIVM and Van Ruiten[62] [6]. In chapters 13.9.-13.13., an actualization is given for the situation in 1993, and the costs of dumping, analysis, isolation and quality-improvement are presented. Finally, in chapter 13.14., the possible market effects are quantified with the help of a number of scenarios.

13.2 The environmental hygienic quality of construction materials

In this report, the quality of the construction materials is described with the help of all the composition and leaching data which is made available to the RIVM. For each construction material individually, a tail probabitity of the leaching standard concerned is calculated for the most critical compound (Part 2). The same is also done for the composition standard[63]. Then, the tail probabilities are combined to an overall probability, assuming that the leaching and the (in)organic composition are not correlated (worst-case).

The division into categories, based on the tail probabilities, and the critical compounds are

[62] The report "Quantitative Inventory of the Possible Financial-Economical Aspects of the Adoption of the Construction Materials Act" drawn up by Van Ruiten

[63] The 'inorganic and organic composition' is that as is valid in the oBB. According to the June 1992 viewpoint notice, in the Building Materials Decree only the composition of the 'organic compounds' will still be tested.

reproduced in table 12.7.1.1.a-c, 12.7.1.2.a-b., 12.7.2.1.a-c., and 12.7.2.2.a-b.. These tail - probabilities are the best estimators for the environmental quality of the construction materials researched. If not enough data is available, then an RIVM expert opinion of the environmental quality is given where possible. For example, that the chance of pollution with an organic compound mentioned in the Building Materials Decree up to standard-exceeding concentrations is low if an industrial slag is formed at high temperatures and the available data of those compounds or of construction materials which are similar do not disagree. This expert opinion is stated, per construction material, in the conclusions (Part 2).

13.3 The environmental quality and the reliability

In statistical sense, the most probable situation (expected environmental quality) can be calculated based on the available data. The assumption here is a binomial distribution. In the experts-discussion with the industry (see Appendix 13), it is agreed that also the uncertainty in the estimation of the environmental quality (also known as the band width) will be made visible. For this reason, for each tail probability [P(U1), P(U2), $P(S_{inorg})$ and $P(S_{org})$], also the accompanying 95% confidence interval is calculated according to the procedure described in appendix 8.

The 95% confidence interval is limited by a left and a right limit [indicated with P(..,l) and P(..,r)][64]. The tail probabilities with the accompanying left and right limits are reproduced in the columns 6-17 of table a-d in appendix 15.

Although statistically not entirely correct, because the tail probability is not always completely complementary to the below-level chance, the mass of a construction material is split into a number of classes with the help of the 95% confidence intervals, for the leaching into: certainly cat. 1, unknown cat. 1 or 2, certainly cat. 2, unknown cat. 2 or dumping, and certainly dumping; for the composition in: certainly applicable, unknown, and non-applicable (certainly dumping).

[64] Also indicated with upper limit (P(...,l) and lower limit (P(..,r). In appendix 20, for example, for clay the P(U1)=0 (column 7). The left limit of the 95% confidence interval P(U1.1)=0 (column 6), and the right limit P(U1,r)=0.4 (column 8) etc.

Table 13.3.1. Division into classes.

		LEACHING				
		certainly cat. 1	uncertain cat. 1 or 2	certainly cat. 2	uncertain cat. 2 or dumping	certainly dumping
COMPOSITION	applicable	cat. 1	cat. 1 of cat. 2	cat. 2		
	unknown	cat. 1 or dumping	Apply in cat.1, cat. 2 or dumping			
	non-applicable	dumping				

The procedure of achieving this class-division is described in chapter 12.4. Then, the class of leaching and composition is combined (see table 13.3.1.). In table 13.3.2., an example of asphalt aggregate (bitumen) and the division of the mass between the various classes is given.

Table 13.3.2 Division of 1500 kton asphalt aggregate (bitumen) in classes on the basis of the new standards in Part 1. The percentile division is reproduced between brackets.

Asphalt aggregate in kton (%) (bitumen)		LEACHING					
		certainly cat. 1	uncertain cat. 1 or 2	certainly cat. 2	uncertain cat. 2 or dumping	certainly dumping	total
COMPOSITION	applicable	720 (48)	612 (41)	0	0	0	1332
	unknown	91 (6)	77 (5)	0	0	0	168
	non-applicable	0	0	0	0	0	0
	total	811	689	0	0	0	1500

If asphalt aggregate (bitumen) is evaluated on organic compounds, in Part 2 it is determined that the chance of the compound of a bitumen based asphalt aggregate with standard-exceeding concentrations is not present. The information in table 13.3.2. is taken from table a-b of appendix 16. In that appendix, this information for all the construction materials investigated is presented in the columns 10-15 for the new standard setting according to the Building Materials Decree (see Part 1) and the columns 4-9 for the old standard setting of the oBB. In appendix 16, the columns agree with the "division into classes" in table 13.3.1.

Note: With construction materials for which also organic compounds (and for the oBB also the inorganic compounds) are critical, the composition classes (unknown and non-applicable, see table 13.3.2.) are also filled in.

13.4 The parameters which influence the reliability

The expected environmental quality can vary within a certain band width. This band width is dependent on the statistical reliability which is chosen (95%, for example)[65]. The band width can be decreased in two ways:

a. by accepting a lower statistical reliability (80%, for example, instead of 95%),

b. by making the data set bigger, from which the conclusion is made for the quality of the construction materials.

The first is a policy choice. The second point was used to the maximum in this project in the gathering of the data. Also, based on the evaluation in Part 2, information about similar construction materials was combined into main groups, so that the number of observations on which a decision is based is increased.

Concerning the emission and composition data, for non-prefabricated construction materials no distinction is made between broken cement concrete and cement aggregate, between broken asphalt cement and asphalt aggregate, and between certified and non-certified E bottom ash, while for prefabricated construction materials no distinction is made for cement concrete with and without waste materials, and for asphalt cement with and without waste materials. This is because for these last two, all these prefabricated cosntruction materials remain well within the standards.

For the dumping costs, Figure 13.4.1. indicates how the uncertain costs decrease and partly convert themselves into certain costs as the data-set increases with an N series (size of the researched construction materials in the current data-set), 2N, 4N, 8N ..∞. With this, it is assumed that the data-set increases per construction material, but that the tail probability remains the same. If, for example, for N an excession is observed for five of the ten observations [5/10] (50%), then for 2N 10 out of 20 is assumed [10/20](50%). With ∞ the expected value is achieved.

In table 13.4.1., the expected environmental quality is showed for the example of asphalt aggregate (bitumen) from table 13.3.2. The "uncertain" classes have divided themselves over the "certain" classes according to the statistical expectation. The expected situation is

[65] The more one diverges from the statistical expected value, the chance of this value being the "real" value decreases. Within a confidence interval, therefore, not all values have an equal chance. Also, the confidence intervals are usually not symmetric around the expected value!

that situation which is the most likely, based on the available information. Further, it is noted that the band widths are not symmetrical, for although dumping of asphalt aggregate may not be excluded (table 13.3.3.), this is not expected based on the available data for asphalt aggregate (table 13.4.1.). For all the researched construction materials, this is worked out and reproduced in table 13.3.1.a-d (the right column).

Table 13.4.1. The expected applicability of 1500 kton of asphalt aggregate (bitumen).

Asphalt aggregate in kton (%) (bitumen)		LEACHING					
		certainly cat. 1	uncertain cat. 1 or 2	certainly cat. 2	uncertain cat. 2 or dumping	certainly dumping	total
COMPOSITION	applicable	1500 (100%)		0		0	1500
	unknown						
	non-applicable	0		0		0	0
	total	1500		0		0	1500

13.5 The mass balance of construction materials

To estimate the re-use and re-usability, it is necessary to make a mass balance of primary and secondary raw materials, this including the raw materials which are applied in composed products. This balance must be made for the current situation. In order to make the predictions for the chances of the various secondary raw materials on the various sub-markets possible, however, a description of the situation in the future (2000 or later) is also necessary. This means that for each raw material, a document would have to be composed describing the current market situation and developments for that raw material and/or construction material. The RIVM has made a start with the composition of these documents. An example is included in appendix 9. In 1994, the RIVM will begin with the composition of mass balances for construction materials and raw materials.

The current situation is described by the winning of primary raw materials, the production of secondary raw materials, import, the sales of raw materials and products in the construction industry and in export. The part of the secondary raw materials which cannot be sold, must be dumped and/or stored in expectation of the development of suitable processing methods. Reasons for raw materials being unsellable may be environmental, civil technical, or economical. To investigate the effect of the Building Materials Decree on the re-use, this report assumes selling without the stipulations of the Building Materials Decree (according to Van Ruiten [6]). It is possible that the supply of some waste materials is larger, and that also now already a part must be dumped. This dumping is not regarded as being an effect of the Building Materials Decree but as a difference between supply and demand.

Based on the potential usability on the market, which is determined in part by the environmental and civil technical demands, it is possible to estimate the re-usability of a waste material as a construction material. The market perception, however, determines the measure in which the re-usable construction materials are actually re-used or applied in a useful way.

A set of the most important waste materials which are re-used as construction materials, for the situation in 1990 as well as in 2000, is presented by Van Ruiten in his report [6] (appendix III, figure A). With the industry the agreement has been made (see appendix 13) that the effect of the standard setting on the re-usability and the (re-)use will be calculated with the help of this set of construction materials. This set has been completed in close consultation with the construction industries, and has also been accepted by DGM as a starting point. The set contains construction materials which are applied on or in the soil, as well as those applied in water way construction. The construction materials which belong to this set are reproduced in table 13.5.1.

Table 13.5.1. Amount of construction materials which are involved with the evaluation of the re-use (based on : Van Ruiten appendix, III, figure A and/or Branch Document Construction and Demolition Waste).

CONSTRUCTION MATERIAL (categorization according to Van Ruiten Appendix III figure A)	note RIVM	categorization according to appendix 1 oBB	mass in kton			
			1990		2000 (autonomous)	
			V.Ruiten *	V.Ruiten + adaptions acc.to Branche doc **	V.Ruiten *	V.Ruiten + adaptions acc. to Branche doc **
sand cement stab. + sieve sand		V1	100	100	300	300
cement, masonry and mix aggregate of concrete and masonry aggregate	cement aggregate	N1	250	1032	1000	1118
	masonry aggregate	N1	450	708	600	767
	mix aggregate (cert.)	N1		2506	3400	2714
E bottom ash	cert. and non-cert.	N	100	100	100	100
lightly stabilised E fly ash		V1	500	500	600	600
cement concrete +	with E fly ash (8%)		100	100	300	300
	with MSWI bottom ash (8%)	V1	0	0	100	100
	with jarosite end slag		0	0	100	100
asphalt cement +	asphalt aggregate recycling	V1	500	500	800	800
	with MSWI fly ash (2%)	V1	100	100	100	100
	with E fly ash (6%)	V1	100	100	100	100
	with phosphor slag (59%)	V1	100	100	200	200
crushed asphalt cement			100	100	0	0
Various blast furnace slag mixes (incl. 0.3 LD slag)	blast furnace slag mix	V1/N***	700	700	700	700
	cement concrete with granulated blast furnace slag	V1	1100	1100	1100	1100
LD slag (water way construction)		V1	100	100	100	100
phosphor slag (water way construction)		V1/N***	100	100	100	100
Total cat. 1.			3700	7246	8700	8299
masonry and mix aggregate	masonry aggregate	N2	1500	0	480	0
	mix aggregate non-cert.	N2		1100	3520	0
asphalt aggregate	bitumen	N2	1500	1500	2000	2400
sieve sand		N2	300	383	100	2500
E fly ash		N2	100	100	200	200
MSWI-bottom ash-stablization MSWI bottom ash	stabilised MSWI bottom ash	V2	0	0	0	0
	MSWI slag	N2	600	600	1500	1500
lightly stabilised phosphor slag		V2	400	400	400	400
Total cat. 2.			4400	4083	8200	6700
E fluid bed bottom ash		N	100	100	100	100
gassing bottom ash		N	0	0	100	100
aerated concrete + E fly ash		V	100	100	100	100
cleaned soil		N	400	400	1500	1500
chemistry gypsum	RO gypsum	N	200	200	300	300
	phosphor acid gypsum	N	0	0	0	0
Total waste material			100	100	200	200
TOTAL			8200	11429	17100	15199
Total not evaluated			1400	1400	2900	2900

* for the construction materials with an amount in the left of the column, no leaching data was available for the RIVM, and they are therefore not involved in the evaluation.

** Changes based on the branch document Construction and Demolition Waste. Arched data in the last and second-last column. The branch document does not expect non-certified aggregates anymore in 2000.

*** Concerns prefabricated construction materials (V) which are evaluated as non-prefabricated construction materials (N) due to the lack of leaching data (worst case).

The set describes the sale of Dutch construction materials on the Dutch market. The supply for some secondary raw materials will be greater while the sales can be smaller because the material is not sold on the Dutch market, or because there is not enough demand for the product, or because definite removal was chosen for.
Furthermore, in the RIVM report, it is assumed that the waste materials which are named in the Van Ruiten report also truly meet the valid civil technical requirements.
The testing of the construction materials according to the environmental demands is described in Part 2.

13.6 From re-usability to re-use

The re-use is influenced by the policies concerning the natrual raw materials and waste materials (dumping, etc.), the social acceptance of construction materials with waste materials, the development of the environmental quality of the secondary construction materials, the competition position between secondary raw materials, the financial suporting policy of the government, and the price difference between re-use and dumping.
The environmental quality of secondary raw materials and products thereof can improve through selective demolition, sorting, processing, etc. The acceptance can improve by certifying raw materials and products, price, information, and standard setting. The various primary and secondary raw materials compete with eachother on certain sub-markets, which reduces the possibility of improving the environmental quality of secondary raw materials against reasonable prices. The price of a product is partly determined by the analysis and evaluation costs. These costs can be reduced by a system of quality declarations and own declarations. Furthermore, for constructions which must be isolated, isolation brings extra costs which must compare to the dumping of the secondary construction material.
The perception of the market can be positively influenced through information about the environmental quality of waste materials. The RIVM research gives a first insight into the environmental quality of many secondary waste materials. This makes it easier for many users to determine whether a secondary raw material is suitable for a certain type of application and if there are any environmental risks attached to the product, which, if not present, will lead to an improvement in the acceptance of the secondary raw material. For the calculation of the re-usability, only the standard setting and the policy which directly

affects the applicability of the waste material is of importance, for example the measures to stimulate the re-use of MSWI bottom ash and tar-containing asphalt through the useful application of this material in a "special category".

Viewpoint notice

In the oBB, no distinction was made between the application heights; all the emission standards were standardized for non-prefabricated construction materials at h=70cm. In the June 1993 Viewpoint Notice, it was mentioned that this would be kept in mind in the Building Materials Decree. Some of the construction materials which are usually applied in layers of h=20-30 cm, then fit completely or for a large part into the category 1 construction materials, so that the usability and therefore the (re-)use is improved. A shift from dumping to category 2 application by way of application of construction materials in thin layers is marginal. These aspects of the Viewpoint Notice will be discussed seperately in chapter 13.9.

Furthermore, the minister has indicated that MSWI bottom ash and asphalt cement with tar do not need to be dumped anymore, but may be applied, within the limits of the Building Materials Decree in large-scale projects, and under certain conditions and specific isolation measures ("special category"). This will also be included in chapter 13.9.

13.7 A comparison of the 1992 RIVM report and the 1993 RIVM report

In the 1992 RIVM report, two conditions are made. For MSWI bottom ash it must still be researched whether the critical compounds which exceed the U2 standard for construction materials are correlated or not. If the compounds are not correlated, a much larger part will be non-applicable. In calculations, this indeed did appear to be the case, so that, based on the data-set in 1992, not approximately 50%, but 75% of the MSWI bottom ash would be non-applicable. During the discussion of the Viewpoint Notice with the Parliament, this information lead to the fact that the minister maintained the so-called "special category" for MSWI bottom ash.

Another condition was made with respect to the organic compounds (see Viewpoint Notice pages 12 and 13). At the time of the publishing of the 1992 RIVM report, there was still uncertainty concerning the quality of the data in the organic compounds data

base. This lead to an indicative judgment, namely, that, based on organic compounds, another 50kton would not be applicable. The organic compounds database was added to and checked thoroughly at the end of 1992, so that a judgment can be made now.
Finally, in the period up to June 1993, extra data was made available by the industries. All these changes can lead to other amounts of secondary construction material to be dumped. In table 13.7.1., the various changes are reproduced schematically.

In his report, Van Ruiten has predicted the re-use for a set of construction materials in the situation of the standard setting of the oBB being valid (appendix 1 or 2).
In table 13.7.1., with the variations A-I, The RIVM assumes the same data set and the accompanying masses as Van Ruiten. Besides the adapted standard setting, in variation I the accomodations concerning the "special category" for MSWI bottom ash is also included. In variation J for the construction recycling materials, instead of the amounts mentioned in the Van Ruiten report, the amounts in the Branch Document Construction and Demolition Waste [46] are used in the calculations.
I and J will be explained further in chapter 13.9.

Table 13.7.1. Changes in the amount of construction material to be dumped RIVM 1992/RIVM 1993 because of adjusted insights based on the sale of construction materials in 1990.

total to be dumped in kton in 1990	most important construction materials which must be partly dumped in kton			comments
A: 367	MSWI bottom ash E fly ash	300 58		standards accoring to the Viewpoint notice, condition MSWI bottom ash and organic compounds
B: 415	MSWI bottom ash E fly ash sieve sand	300 58	 51	as A, but keeping organic compounds slightly in mind.
C: 568	MSWI bottom ash E fly ash sieve sand	450 58	 51	as B, but now also keeping in mind that the compounds in MSWI bottom ash are not correlated.
D: 455	MSWI bottom ash E fly ash	372 83		as A, but based on more measurements and standards from Part 1.
E: 641	MSWI bottom ash E fly ash sieve sand	372 83	 186	As D, but now keeping organic compounds fully in mind.
F: 768	MSWI bottom ash E fly ash sieve sand	499 83	 186	as E, but now it is also kept in mind that the compounds in MSWI bottom ash are not correlated.
G: 992	MSWI bottom ash E fly ash sieve sand mix aggregate	499 83 225	 186	as F, but now also the construction recycling materials sub-divided into masonry, cement and mix aggregate.
H: 684	MSWI bottom ash E fly ash sieve sand mix aggregate	499 83 0	 102	As G, but now also keeping in mind the raising of the standard for mineral oil (500 mg/kg).
I: 102	sieve sand mix aggregate	 0	102	As H, but now keeping in mind the "special category", application in thin layers, and export: MSWI bottom ash 449 kton in "special category" E fly ash 83 kton is now fully used (export) see chapter 13.9. for further explanation.
J: 131	sieve sand mix aggregate	 0	131	As G, but now based on the construction recycling materials masses according to the "Branch Document" MSWI bottom ash 449 kton in "special category" E fly ash 83 kton is now fully used (export) see chapter 13.9. for further explanation.

Note: Up to and including the variation G, the evaluated mass is 6400 kton and the non-evaluated mass 3200 kton. In variation H and I, this is 8200 kton and 1400 kton respectively. For variation J, this is 11,429 kton and 1400 kton respectively. Up to and including variant H, the application height is standard 0.7 m for non-prefabricated construction materials; after that the application height is equal to that which is usual in road construction. The application height results especially in shifting from cat. 2 to cat. 1. The dumping of construction materials is barely influenced.

13.8 A comparison of the expected effects of the RIVM study with the results of the Van Ruiten financial economical research

The RIVM has compared the calculated re-usability of construction materials with the re-use as predicted by Van Ruiten. This for the situation in which the standard setting of the oBB would be valid and for the situation such as is now suggested in Part 1. For this comparison, the H situation in table 13.7.1. is chosen; this is with an application height of 70 cm and not a "special category". In view of the oBB, only the standard setting differs, and the RIVM describes the re-usability while Van Ruiten describes the re-use.

The RIVM predictions concerning the effects of the oBB for the construction materials and the predictions which are presented in the report "Quantitative Inventory of the Possible Financial Economical Aspects of the Adoption of the Building Materials Decree" [6] differ on several points, both for the oBB standard setting as well as for the adapted standards for construction materials[66] in Part 1 (1990:table 13.8.1. (appendix 1 oBB) and 2000: table 13.8.2. (appendix 2 oBB)). This has its origin in the fact that:

a. in the evaluation of the oBB by Van Ruiten, the market perception is also counted (expected market behaviour from which the actual re-use is predicted),
b. in the time-period in which Van Ruiten evaluated the market, there was not yet a unified and reliable set of data concerning the environmental quality of construction materials,
c. there was not yet insight into the long-term effects of the oBB if appendix 2 (oBB) would become valid,
d. there was no clear insight yet into the relationship between certification and a product with a certain environmental quality,
e. there were uncertainties about the financial suporting policy of the ministry,
f. there was a difference between the starting point of the authorities and the industries.

The estimation of market behaviour is subjective. The quality of the estimation is determined especially by the amount of and which sources/informants are consulted, as well as to what and how the problem statement was. The estimation of the re-use by Van Ruiten was therefore valid for the moment of the publication of the oBB. It will be apparent that it is not possible to make a translation of the re-usability to the re-use for the current situation without a certain market research[67], in which the changing conditions concerning points a-f are kept in mind.

[66] In the comparison, only those construction materials of which the RIVM had leaching and/or composition data are involved. The remaining construction materials are not included in the sums.

[67] This conclusion is made after several discussions with Van Ruiten

RIVM-Van Ruiten 1990

From table 13.8.1. (top part, oBB, app. 2) the following conclusions can be made. Tested according to appendix 2 oBB, according to the calculations of the RIVM, a substantial part of the N1/V1 construction materials which are mentioned in and therefore may be applied according to appendix 1 of the oBB, must be applied isolated (see column E with the line N1/V1: expected)[68] or must be dumped (see column G). The amount which must be dumped, is more than Van Ruiten expects, even if only appendix 1 (oBB) is kept in mind without even considering the environmental quality in appendix 2 (oBB) which the government desires (column K).

According to Van Ruiten, an oBB with only appendix 1 also leads to an extra market impulse of N1/V1 construction materials (column J=I-H).

For the application of those construction materials, only the type of construction material is of importance (appendix 1 oBB).

The environmental quality is considered to be sufficient.

For V2/N2 construction materials, the same is valid as far as testing according to appendix 1 oBB is possible (see line with N2/V2: expected). The rest will barely be used, according to Van Ruiten (column I with the line rest: expected).

For the adapted standard setting according to Part 1 (the bottom part of table 13.8.1.), it is valid that a large part of the N1/V1 construction materials which are mentioned in appendix 1 oBB now also meet the environmental demands (see column B, E, G, with line N1/V1: expected). For this reason, appendix 1 can be cancelled for these construction materials. A small part will have to either be applied isolated (column E) or is may be not applied (and will be dumped; see also chapter 13.14).

For the category N2/V2 construction materials, the same is valid. The largest part can be applied as category 1 or 2 construction material (column B and E). The part which would have to be dumped, is for a large part MSWI bottom ash (column G), which can be used in the "special category" (see also chapter 13.9). Also the MSWI bottom ash which is applicable as a category 2 construction material could be added to this.

In general it can be concluded that the re-usability is noticeably improved in view of the oBB. This will also benefit the re-use.

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[68] N1/V1 construction materials which appear in appendix 1 oBB may be applied unisolated according to the oBB.

RIVM-Van Ruiten 2000

For 2000, the RIVM (column B) estimates the applicability which would be valid for N1/V1 construction materials under the oBB lower than Van Ruiten (see column H with line N1/V1: expect in oBB (app. 2) of table 13.8.2.). A part is qualified by potentially sellable (column J) by Van Ruiten, but is, however, not sold.

For N2/V2 construction materials, which are evaluated according to appendix 2 oBB, the conclusions are the same, that is to say that they will not be applied (compare column G with K in line N1/V1: expected).

As the result of the adapted standard setting according to the Building Materials Decree (Part 1), the largest part of the N1/V1 construction materials will be freely (but recoverably) applicable (see column B). Also N2/V2 construction materials now fit for a large part in category 1 (column B with line N2/V2: expected, adapted standard setting according to Part 1). Category 2 and dumping consist mostly of MSWI bottom ash, which can be usefully applied under the conditions of the "special category" (column G). Through the clear choices with regards to points a-f, the re-usability is positively influenced.

Table 13.8.1. Comparison of the market effects in Kton between Van Ruiten, based on the oBB standard setting (appendix 1) and the RIVM, based on the oBB standard setting (appendix 2) and/or the new standard setting according to the Building Materials Decree (Part 1), assuming the realized sales in 1990.

The standards used for construction materials	Categorization according to the van Ruiten appendix III, fig. A. Type of construction material		mass RIVM leaching + composition 1990							van Ruiten 1990			
			total A	cat.1. B	uncertain cat. 1. or cat. 2. C	uncertain cat. 1. or dumping D	cat.2. E	uncertain cat. 1. or cat. 2. or dumping F	dumping G	realized sales in 1990 H	mass after testing acc. to apendix 1 oBB I	meet standards of appendix 1 oBB "market impuls" J	dumping K
oBB (Appendix 2)	N1/V1:	expected	3700	2140			768		792	3700	10450	6950	200
		95 % reliability	3700	1320	814	334	60	853	319				
	N2/V2:	expected	4400	298			680		3422	4400	2000	0	2400
		95 % reliability	4400	21	307	48	1	1907	2116				
	rest:	expected	100	28			72		0	100	0	0	100
		95 % reliability	100	15	28	0	48	9	0				
	Total:	expected	8200	2466			1520		4214	8200	12450	6950	2700
		95 % reliability	8200	1357	1149	383	108	2769	2435				
Adapted standard setting according to Part 1	N1/V1:	expected	3700	3226			474		0				
		95 % reliability	3700	2014	1000	222	20	444	0				
	N2/V2	expected	4400	3310			406		684				
		95 % reliability	4400	1263	1535	300	0	772	530				
	rest	expected	100	61			39		0	Consists of :			
		95 % reliability	100	47	27	0	20	6	0	MSWI bottom ash			
	Total	expected	8200	6597			919		684	E fly ash			
		95 % reliability	8200	3324	2562	522	40	1222	530	Sieve sand			

*see also table 13.7.1. (H).

Table 13.8.2. Comparison of the market effects in Kton between Van Ruiten, based on the oBB standard setting (appendix 1) and the RIVM, based on the oBB standard setting (appendix 2) and/or the new standard setting according to the Building Materials Decree (Part 1), assuming the realized sales in 2000

The standards used for construction materials	Categorization according to the van Ruiten appendix III, fig. A. Type of construction material		Sales RIVM leaching + composition 1990							van Ruiten 2000			
			total A	cat.1. B	uncertain cat. 1. or cat. 2. C	uncertain cat. 1 or dumping D	cat.2. E	uncertain cat. 1. or cat. 2. or dumping F	dumping G	expected mass in 2000 H	mass after testing acc. to apendix 2 oBB I	meet standards of appendix 2 oBB "negative market impuls" J	dumping K
oBB (Appendix 2)	N1/V1:	expected	8700	3520			1740		3440	8700	8300	1500	1900
		95 % reliability	8700	1847	1175	1111	120	2941	1506				
	N2/V2:	expected	8200	447			1160		6593	8200	1000	0	7200
		95 % reliability	8200	28	434	80	1	3560	4097				
	rest:	expected	200	128			72		0	200	0	0	200
		95 % reliability	200	44	99	0	48	9	0				
	Total:	expected	17100	4095			2972		10033	17100	9300	1500	9300
		95 % reliability	17100	1919	1708	1191	169	6510	5603				
Adapted standard setting according to Part 1	N1/V1	expected	8700	7808			892		0				
		95 % reliability	8700	4288	1994	981	20	1417	0				
	N2/V2	expected	8200	5683			1070		1447				
		95 % reliability	8200	2083	2560	546	0	1834	1177				
	rest	expected	200	161			39		0	Consists of:			
		95 % reliability	200	86	87	0	20	7	0	MSWI bottom ash			
	Total	expected	17100	13652			2001		1447	E fly ash			
		95 % reliability	17100	6457	4641	1527	40	3258	1177	Sieve sand			

Comments on the Van Ruiten report

The amounts which are stated by Van Ruiten sometimes do not agree with the latest RIVM figures. For asphalt aggregate, Van Ruiten does signal this, but it is not processed. Also the amount of construction and demolition waste, including the prognoses in the Van Ruiten report, do not appear to coincide with the implementation plan Construction and Demolition Waste [47]. The definition of the category "various blast furnace slag mixes" was also not clear at first[69]. Based on the information obtained about the making of the Van Ruiten report and the available knowledge about the amounts of the individual construction materials, several construction materials which are mentioned under "sales" in the Van Ruiten report, can be split up in the following way: "cement, masonry and mix aggregate", the group "various blast furnace slag mixes", and the group "chemistry gypsum" (see also table 13.5.1.). In view of the differences in environmental quality, applicability, and amount, it is desirable to include this further sub-dividing in the surveys of this report in order to get a better idea of the consequences of the Building Materials Decree.

A small part of the construction materials which are evaluated by Van Ruiten [6], could not be evaluated by the RIVM because of the lack of emission data (leaching tests). This means that the category of construction materials applicable under category 1 conditions, for 1990 and 2000, 1400 Kton and 2900 Kton respectively are not involved in the RIVM evaluation.

It is difficult to estimate as to how much it is possible to achieve in the future some of the applications which are evaluated by Van Ruiten, and in how much the available measurement data are representative for the application. It often concerns development research by interested producers of alternative construction materials (for example, jarosite end slag in cement concrete).

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[69] From a discussion with Mr. Van Ruiten on March 26, 1993, it appeared that the Van Ruiten report is limited to the waste materials which are released in The Netherlands. This means that the import of secondary raw materials is not included in the evaluation. In mixed blast furnace slag, 1100 Kton of granulated blast furnace slag is taken up which is processed into blast furnace cement by the CEMIJ for many years already. Blast furnace cement is an environmentally and civil technically accepted construction material. The remaining part in the category of mixed blast furnace slag (incl. LD slag) aims for the dual and triple mixes which are used as road base material in road construction.

13.9 State of affairs in 1993 and further developments

In the Viewpoint Notice it is announced that with the determining of the allowable emission from construction materials, the method of application in construction may be kept in mind (see also table 13.7.1. I and J). For non-prefabricated construction materials this is the application height, and for prefabricated construction materials this is the application thickness of the construction material, a correction for exhaustion, aging, and wetting by way of the calculated diffusion coefficient (see Part 1).

For the sake of the comparison with the Van Ruiten study, in the previous chapters, the calculations are continuously made with a 70cm application height and with the measured diffusion including flushing (and not with the calculated diffusion based on the diffusion coefficient). For a number of construction materials which are as a rule applied in layer thicknesses of h=20-30cm (road base layers), a part will shift in the direction of category 1 if this is kept in mind. This is to say "freely applicable but recoverable". Construction materials which will benefit from this are: mix aggregate (non-certified), E bottom ash, and blast furnace slag mix. In table 13.9.1., the application heights are discounted. Only several diffusion coefficients were available for the prefabricated construction materials, and these pD_e were greater than 10; it is therefore not possible to make a correction for exhaustion. Prefabricated construction materials which are placed in category 2 based on fast leaching compounds, will profit by this and will shift in the direction of category 1 construction materials.

In table 13.9.1. the prefabricated construction materials are evaluated on the measured diffusion; a $pD_e>10$ is assumed for the correction factors.

Furthermore, in the Viewpoint Notice, a "special category" for MSWI bottom ash is announced in which MSWI bottom ash is usefully applicable, if applied under specific isolation requirements. MSWI bottom ash, therefore, does not have to be dumped.

In an agreement between SEP-DGM-RIVM [48] it is determined that all E fly ash at the moment is processed in the cement and concrete blocks industry. These applications are all category 1 applications (see Part 2). At this time, there is no desire for non-prefabricated applications of E fly ash. This desire would arise only if the export would disappear completely, and in the category prefabricated construction materials no compensation or insufficient compensation would be found. If this situation would occur, the possibility exists for a system the same as that for MSWI bottom ash ("special category"). The dumping of E fly ash is not an issue at the moment. This is kept in mind in table 13.9.1. In the Van Ruiten report, the state of affairs is drawn up from the data and insights of 1990. In order to make the comparison between this study, previous studies, and the viewpoint notice as close as possible, in the previous figures (chapter 13.1-8), Van Ruitens quantitative sales figures are used as starting point. A full actualization of the market inventory also does not fit into this study. It is important that the shifts which can occur are mentioned, in order to make a better evaluation possible now. An important shift is made clear in the implementation plan Construction and Demolition Waste. From the Implementation Plan Construction and Demolition Waste [47], which is based numerically on the figures as reproduced in the Branch Document Construction and Demolition Waste [46], it appears that the production figures for construction and demolition waste presented by Van Ruiten were too low. The Van Ruiten figures for construction and demolition waste (see table 13.5.1.) are replaced by the most recent figures from the branch document (see table 13.5.1.) and are made representative for the situation in 1990 and 2000 respectively. This combination of Van Ruitens figures and the branch document were the basis for the calculations of which the results are presented in table 13.9.1. (1990) and in table 13.9.2. (2000). According to the branch document, in 2000 approximately 4000Kton will be used as gravel replacement in concrete. This involves a prefabricated application which is not described by Van Ruiten. Cement concrete with aggregates originating from construction waste is not expected to be hindered by the Building Materials Decree (category 1 application). It therefore does not lead to quantitative effects for the usability of this construction material. In the Implementation Plan, a plan is given to achieve a product with a certified improved quality by clean up, selective acceptance, and selective demolition. On a relatively short term basis, this will result in a lower dumping necessity, and a further shifting of the construction recycling materials in the direction of category 1 construction materials.

Policy-wise, a lower statistical reliability may also be acceptable (see chapter 13.4.). The lowest reliability percentage which is still scientifically maintained is 80%[70] A lower tail probability does not result in another expectation, but it does result in another division of certain and uncertain costs and amounts.

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[70] In most of the statistics books, for this one will still find tables with excession chances

Table 13.9.1. Expected sales in Kton of construction materials in 1990 assuming the "Van Ruiten/Branch Document" (for totals, see table 13.5.1.), the adapted standard setting according to Part 1, and the Viewpoint Notice promises.

Categorization according to Van Ruiten	Categorization into classes							
1990 expected sales in Kton Type of construction material	total evaluated use	cat.1.	uncertain cat. 1. or cat. 2.	uncertain cat. 1. or dumping	cat.2.	uncertain cat.1. or cat. 2. or dumping	Do not dump: "special category" or applicable in another way	dumping *
N1/V1: expected	7246	6482			764	0	0	0
95 % reliability	7246	3406	1709	856	20	1255	0	0
N2/V2 expected	4084	3020			351	0	582	131
95 % reliability	4084	1208	1448	249	0	632	470	77
rest expected	100	61			39	0	0	0
95 % reliability	100	47	27	0	20	6	0	0
Total expected	11429	9563			1154	0	582	131
95 % reliability	11429	4661	3184	1105	40	1892	470	77

Table 13.9.2. Expected sales in Kton of construction materials in 2000 assuming the "Van Ruiten/Branch Document" (for totals, see table 13.5.1.), the adapted standard setting according to Part 1, and the Viewpoint Notice promises.

Categorization according to Van Ruiten	Categorization into classes							
2000 expected sales in Kton Type of construction material	total evaluated use	cat.1.	uncertain cat. 1. or cat. 2.	uncertain cat. 1. or dumping	cat.2.	uncertain cat.1. or cat. 2. or dumping	Do not dump: "special category" or applicable in another way	dumping *
N1/V1: expected	8299	7505			794		0	0
95 % reliability	8299	4053	1907	971	20	1348	0	0
N2/V2 expected	6700	4346			190		1413	751
95 % reliability	6700	1912	1900	572	0	719	1157	440
rest expected	200	161			39		0	0
95 % reliability	200	86	87	0	20	7	0	0
Total expected	15199	12012			1023		1413	751
95 % reliability	15199	6051	3894	1543	40	2074	1157	440

* The allowed corrections for prefabricated construction materials are not discounted in this table (see text).

The figures on which tables 13.9.1-2 are based, and the splitting off per construction material is given in columns 1-10 in table a-d in appendix 17.

13.10 Dumping costs

In table 13.10.1., a survey is given of the average dumping rates in 1992 for several relevant waste materials. These amounts are taken from the RIVM database IVERA [49].

Table 13.10.1. Survey of dumping costs in guilders excluding VAT according to IVERA.

waste material	average	minimum	maximum
dredging sludge	79	11	147
construction and demolition waste	71	10	147
gypsum	60	60	60
waste materials MSWI's	84	62	120
slags	155		
polluted soil	71	25	112

In 1992, the average dump rate is f90 per ton (standard deviation 34)[71]. A rate of f125 per ton (average +sd)[72] is calculated. This rate is used in both the calculations for the situation in 1990 as well as 2000. For the sake of uniformity and comparability, neither a normal rise in dumping rates, nor rises as a result of the waste materials policy are kept in mind. It is expected that, as part of the waste materials policy, the dumping costs will rise to the level of the costs for the burning of waste materials. This rate will then be approximately f250 per ton.

Of the construction materials in the Van Ruiten set (table 13.5.1.), only sieve sand, E fly ash, and MSWI bottom ash would have to be dumped for a part according to the standard setting of Part 1 (appendix 17, column 7 and 8). E fly ash is now completely used, and MSWI bottom ash is usable in the "special category". The dumping costs actually only concern sieve sand (appendix 17, column 8). Sieve sand is now also dumped for a large part. In table 13.10.2. is schematically indicated which figures (see explanation chapter 13.3.) are involved in the calculation of the dumping costs. In table 13.10.3., a comparison is made between 1990 (dumping rate f125/ton), 2000(dumping rate f125/ton) and 2000 (dumping rate = burning costs = f250/ton). It must be mentioned that the RIVM has included only the evaluated construction materials in the calculation (table 13.5.1.). A distinction is also made between 'expected dumping costs', 'certain dumping costs', and 'possible dumping costs'.

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[71] In these rates, price rises or possible policy plans concerning the waste materials policy which could lead to a rise in the dumping rate are not discounted; this concerns technical costs as they are currently surveyable.

[72] This rate is also used by Van Ruiten in his report for both the situation in 1990 as well as in 2000

Table 13.10.2. Splitting into classes and the categories involved in the calculations.

		LEACHING				
		certainly category 1	uncertain category 1 or 2	certainly category 2	uncertain category 2	certainly dump
COMPOSITION	applicable	NO DUMPING COSTS			POSSIBLE DUMPING COSTS	CERTAIN DUMPING COSTS
	unknown	POSSIBLE DUMPING COSTS				CERTAIN DUMPING COSTS
	non-applicable	CERTAIN DUMPING COSTS				

Table 13.10.3. Dumping and dumping costs for the Van Ruiten set/Branch Document (see table 13.5.1.)

Adapted standard setting according to Part 1	mass in Kton excl. MSWI bottom ash (*) en E fly ash			dumping costs in Kf excl. MSWI bottom ash (*) and E fly ash		
	expected	certain	uncertain	expected	certain	uncertain
1990 dumping rate f125,- per ton	130	77	3000	16000	9600	375000
2000 dumping rate f125,- per ton	750	440	3600	94000	55000	450000
2000 dumping rate f250,- per ton	750	440	3600	188000	110000	900000

* MSWI bottom ash is applied in "special category". excl. VAT.

For 1990, the expected dumping costs will be approximately 16,000 kf[73]. With 95% reliability, the dumping costs lie between 9600 kf and 380000 kf[74] (band width). If a less reliable judgment is accepted, 80% reliability for example, then the band width is 12000 kf to 280000 kf. The expectation remains the same. If construction materials which are applicable as category 2 construction material nevertheless are not applied and must therefore be dumped, the expected dumping costs will rise to approximately 160000 kf[75]. But if the MSWI bottom ash which is applicable in category 2 (76 kton column 5 of table a in appendix 17) is processed in the "special category" instead of being dumped, then the rising of the expected dumping costs is 150000 kf. The isolation costs for MSWI bottom ash will then rise evenly with the extra amount of MSWI bottom ash which is applied in the "special category".

[73] The amounts in chapter 11.9.2. are presented in column 20 in table a-d in appendix 22.

[74] The upper limit of the band width is achieved by adding certain and uncertain: 9600 + 375000, which is 380000 rounded off.

[75] Expected cat. 2 (column 5) + expected dumping (column 8) with rate f125/ton. See appendix 22 table a.

For 2000, the expected dumping costs will rise to 94000 kf with a band width of 55,000 to 510,000 kf, or, with a dumping rate equal to the burning rate, to 188,000 kf with a band width of 110,000 to 1,000,000 kf.

13.11 Evaluation of construction materials

The evaluation costs of a construction material are composed from the sampling costs (PM), the sample preparation costs (f195), the costs for the conducting of the leaching test (f620), the analyzing of the percolates/extracts of the leaching proof on the compounds mentioned in the Building Materials Decree (f8,000).
The prices are valid per sample (see appendix 10). For the determination of the composition contents, the sample must be destroyed, dissolved, by way of aqua regina (f50) to determine the cations. The analysis of the anions and the organic compounds takes place by way of extraction. Finally, the compounds must still be analyzed to determine the composition. For inorganic compounds, this costs approximately f1150, and for organic compounds approximately f2300. A complete evaluation will cost approximately f13,000 per sample, excluding VAT, at the 1990 price level. Through knowledge of the construction material to be analyzed, a large cost-cutting can be achieved in the analysis of the compounds. In the experts-discussion (see appendix 13) with the industries, it is agreed that for the calculation of the evaluation costs, only those compounds which are mentioned as "most critical" or as "remaining critical compounds" in Part 2 will be involved in the calculation. Which of the compounds are critical and must in any case be examined, can be deduced per compound from appendix A, and are reproduced in table 12.7.1.1., 12.7.1.2., 12.7.2.1., 12.7.2.2.. Furthermore, it is possible to optimize the analysis of the leaching liquid. For example by combining several fractions (for example from 7 fractions to 3).
The actual evaluation costs will be around f1,750 (excl. VAT) per evaluation[76], assuming that only a few guide compounds are researched for composition and leaching.
A measurement of the composition of inorganic or organic compounds costs approximately f400 (excl. VAT) for both per evaluation.

[76] The following is calculated:

Leaching	= f700 + N compounds critical *3*f70.
inorganic composition	= 150 + N comounds critical * f70
organic composition	= 100 + N compounds critical *f275.
For leaching, N is >	= 1. For the composition, N is equal to the number of critical compounds.

Starting points for the calculation of the evaluation costs

Construction materials which clearly can be placed in one category, will not have to evaluated as often in actual practice. For non-prefabricated construction materials or parts thereof which can certainly be placed into a category, the number of evaluations in this calculation has been set at one evaluation per 20,000 tons (code H), and for prefabricated construction materials or parts thereof which can certainly be placed into a category, the number of evaluations has been set at one evaluation per 1,000 tons (code L). How this will happen exactly, is also still dependent on the evaluation protocol in the ministerial regulation. The evaluation costs are also dependent on the certainty which the producer and the buyer both desire or demand, and on the size of the samples which are produced or marketed respectively. Note: for the construction materials which are applied in the "special category", no evaluation costs have to be paid. The approach mentioned above can therefore give insight only into the size order of the costs.

Remaining construction materials

The construction materials which are mentioned in the Van Ruiten set cover the most important re-use of waste materials as construction materials. Aside from this, the Building Materials Decree is also applicable to natural raw materials and less critical forms of re-use. As a rule, these construction materials fit completely into the category 1 construction materials. Of the evaluated costs resulting under the Building Materials Decree, only the evaluation costs for these construction materials are of importance. Also these construction materials can be distinguished between prefabricated and non-prefabricated construction materials. In table 13.11.2., the estimates of the amounts and the evaluation costs are presented.

In table 13.11.1., for each combination of leaching (code U) and composition (code S), it is indicated which mass of the construction material is involved in the evaluation costs (see also chapter 13.3.). For example, for a prefabricated construction material which concerning leaching and composition fits 100% into category 1 (code UH/SH), one leaching test and one composition test is carried out per 5000 tons. The composition and the percolates are only analyzed for the 'critical compounds'[77].

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[77] The evaluation costs are worked out per construction material and presented in column 11-19 in table a-d in appendix 22.

For a construction material which concerning leaching fits partly into category 1 and partly between category 1 and 2, but concerning composition fits under "applicable" (code UL/SH), the available mass is split in the calculations into a category 1 part and that part of which, based on the uncertainty analyses, it is not yet known whether it fits into category 1 or 2. After that, the method described above is used once more, keeping in mind the accompanying amount per evaluation. All the evaluations which can be clearly placed into a category are indicated under "certain", and all the rest under "uncertain", in table 13.11.2. Placed in the column "expected" is the amount which would be achieved if it would be possible to place all the construction materials into a category beforehand.
The construction materials which do not fit into the Van Ruiten set, are evaluated with the code UH. The organic composition for these construction materials is usually of minor importance.

Table 13.11.1. Splitting into classes for the calculation of the evaluation costs.

		LEACHING				
		certainly cat. 1	uncertain cat. 1 or 2	certainly cat. 2	uncertain cat. 2	certainly dumping
COMPOSITION	applicable	UH/SH	UL/SH	UH/SH	UL/SH	UH/SH
	unknown	UH/SL	UL/SL	UH/SL	UL/SL	UH/SL
	non-applicable	UH/SH	UL/SH	UH/SH	UL/SH	UH/SH

LEGEND:	Code explanation:	non-prefabricated	prefabricated
	UH	one leaching per 20000 ton	one leaching per 5000 ton
	UL	one leaching per 5000 ton	one leaching per 1000 ton
	SH *	one composition test (organic) per 20000 ton	one composition test (organic) per 5000 ton
	SL *	one composition test (organic) per 5000 ton	one composition test (organic) per 1000

* For the inorganic composition, the same scheme is used in the oBB for the calculation of the costs (read inorganic instead of organic).
Note: construction materials which do not fit into the Van Ruitens set are calculated with the codes UH. The composition (organic) is mostly of minor importance for these construction materials.

Table 13.11.2. Evaluation costs (*) based on the Van Ruiten set/Branch Document (see table 13.5.1.) and the starting points which were chosen (see text).

year	mass to be evaluated in kton	evaluation costs in kf		
		expected	certainly	uncertain
1990, v.Ruiten sub-set/Branche doc.	11000	1250	600	2700
1990, remaining construction materials	97000	8500		
2000, v.Ruiten sub-set/Branche doc.	14000	1600	800	3150
1990, remaining construction materials	124000	14600		

* For construction material in the "special category", no evaluation costs have to be paid. For both 1990 as well as 2000, the 1990 price level is used. All costs are excl. VAT.

It is expected that the evaluation costs in 1990 will be approximately 1250 kf. With 95% reliability, the evaluation costs will be between 600 kf and 3300 kf[78] (band width). If a lower reliability is accepted (80% for example), then the band width is 750 kf to 2800 kf. In addition to this are the costs for the evaluation of the remaining construction materials, approximately 8500 kf.

The evaluation costs are between f0.15 and f0.40 per ton construction material. For 2000, the costs per evaluation are maintained at this level (1990 price level), only the amount of construction materials to be evaluated is greater. The evaluation costs would then be between 800 and 4000 kf. It is expected that the costs will be approximately 1600 kf. In addition to this are the costs for the evaluation of the remaining construction materials, approximately 14,600 kf.

The evaluation costs are not divided evenly between the various construction materials. For the situation in 1990, this is worked out in table 13.11.3. The evaluation costs per construction material for the situation in 2000 basically do not differ from those in 1990.

Note: for both the Building Materials Decree as well as for the acception of waste materials at dump sites, the analysis must take place with the same test methods for the same compounds. The analysis costs are therefore hardly influenced by application or dumping.

[78] The upper limit of the band width is achieved by adding certain and uncertain: 600 + 2700 rounded off is 3300.

Table 13.11.3. Evaluation costs per construction material for 1990.

construction material	evaluation costs band width * per ton f/ton	
cement aggregate	0,06	0,12
masonry aggregate	0,08	0,25
certified mix aggregate	0,07	0,16
E bottom ash	0,06	0,11
cement concrete with granulated blast furnace slag	0,22	0,40
cement concrete + E fly ash (8%)	0,22	0,40
asphalt cement with asphalt recycling	0,27	0,47
asphalt cement with MSWI fly ash (2%)	0,27	0,47
asphalt cement with E fly ash (6%)	0,27	0,47
asphalt cement with phosphor slag (59%)	0,27	0,47
blast furnace slag mix	0,22	0,96
LD slag	0,27	0,75
phosphor slag	0,22	1,11
non-certified mix aggregate	0,07	0,21
bitumen asphalt aggregate	0,07	0,16
sieve sand	0,06	0,19
E fly ash	0,01	0,14
MSWI slag	special category	
lightly stabilised phosphor slag	0,18	0,79
fluid bed bottom ash	0,06	0,11
average of the column weighed average	0,15 0.11	0,39 0,29

* Band width is amount 'certain' to amount 'certain + uncertain'. For details see column 11-19 in table a-d in appendix 17. Price level 1990 excl. VAT.

13.12 Costs of isolation measures

In the Building Materials Decree, isolation measures will be prescribed for category 2 construction materials and the useful application of construction materials in the "special category". The details of these measures will be described in the ministerial regulation. A first estimation is based on the report "Cost Structure Dump Sites"[50].

In this report, the dump costs are systematically reproduced and quantified. Assuming the method described and the costs, a calculation is made, in which all the costs which are specific for a dump site are left out such as preparation costs, property acquisition, industry costs, etc. Only the costs which concern isolation and the managing of the waste materials and the controlling of the emissions from waste materials. The characteristics of the construction which functioned as model for the calculation of the isolation costs are given in table 13.12.1.

Table 13.12.1. Characteristics of the waste material and the model construction.

Characteristic	value
mass, s.g. = 2 t/m^3	100000 ton
surface area	1 ha
length	500 m
width	average 20 m
height	5 m
construction life time	50 year
annuity	30 year
interest	5%

For category 2 construction materials, only the costs of a top closure (single liner), a checking system, and maintenance are taken into account, and for construction materials which are applied in the "special category", an under-closure (single liner) is also calculated. The under-closure in the "special category" could be replaced by a diffusion-slowing layer. This will lead to lower isolation costs. This is dependent on the isolation requirements in the ministerial regulation.

The investments are calculated with an annuity of 30 years and an interest of 5%. The calculations are reproduced in appendix 14. For category 2 construction materials, an amount of approximately f10/ton is calculated, and for construction materials in the "special category" and amount of approximately f32/ton. In table 13.12.2., the ranges which are included in the calculation of the isolation costs are reproduced (see also chapter 13.3. for explanation). In table 13.12.3., the isolation costs for category 2 construction materials[79] and the "special category"[80] construction materials are shown for the years 1990 and 2000.

Table 13.12.2 Division into classes.

<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="5">LEACHING</td></tr>
<tr><td>certainly cat. 1</td><td>uncertain cat. 1 or 2</td><td>certainly cat. 2</td><td>uncertain cat. 2 or dumping</td><td>certainly dump</td></tr>
<tr><td rowspan="3">COMPOSITION</td><td>applicable</td><td rowspan="2">no isolation</td><td colspan="3" rowspan="2">Construction isolation</td><td rowspan="2"></td></tr>
<tr><td>unknown</td></tr>
<tr><td>non-applicable</td><td colspan="5">Isolated DUMPING</td></tr>
</table>

Table 13.12.3 Isolation costs for category 2 construction materials and construction materials applied in the "special category" on the basis of the starting points mentioned in the text.

year and type of construction material	mass to be isolated in kton			isolation costs in kf		
	expected	certain	uncertain	expected	certain	uncertain
1990 category 2	1200	40	5100	12000	400	51000
2000 category 2	1000	40	6000	10000	400	60000
1990 'special category'	500	400	100	16000	14000	3600
2000 'special category'	1200	1100	290	40000	35000	9000

[79] The masses of category 2 construction materials which are to be isolated are presented in detail in table a-d in appendix 22:
- expected: column 5 of table a and c.
- certain: column 5 of table b and d.
- uncertain: column 3 + 6 of table b and d.

Note: the figures are rounded off.

[80] The masses of MSWI bottom ash in the "special category" to be isolated are presented in detail in table a-d in appendix 22:
- expected: column 7 of table a and c.
- certain: column 7 of table b and d.
- uncertain: column 4+6 of table b and d.

Note: the figures are rounded off.

13.13 The costs of quality improvement

Concerning the construction recycling materials, the RIVM expects that the greatest concentrations of polluting compounds will be found in the finer fractions. By selectively reducing the non-stone-like parts (these are the soft parts such as specimen, lime, gypsum, aerated concrete blocks, etc) and seperation of these parts, the quality of the remaining part is improved, but one is stuck with an unsellable fine fraction. This fraction could be cleaned into a sellable category 1 construction material. At the request of DGM-A, a discussion Notice was drawn up by Van der Zanden B.V. concerning the improvement of the quality of construction recycling materials, especially the finer fraction [51]. Van der Zanden concludes on pg. 28 that: *"with a complete implementation of the Processing Scheme for Construction Demolition Waste materials, an extra cost amount of approximately f10 per ton of construction demolition waste materials must be taken into account with processing costs; with an amount of 10 million tons this means 100 million guilders per year"*. This amount is a temporary estimate, according to Van der Zanden.

The processing costs mentioned above especially concern the cleansing of sieve sand (including breaker sand), which costs between 14 and 100 guilders per ton (in the calculation f75/ton[81] See chapter 13.14., scenario 5). Van der Zanden states (see cursive above) that for the processing of the entire stone-like fraction of construction and demolition waste approximately 100 million guilders (see chapter 13.14., scenario 6) is necessary in order to process all stone-like construction and demolition waste materials to a category 1 construction material. He considers further research necessary. For the calculation of the costs for quality improvement, these amounts are used (see chapter 13.14.).

The RIVM has not investigated as to what the representative values are for construction materials which do not belong to the group of construction recycling materials. Van Ruiten mentions several amounts in his report. Since the research for quality improvement is still fully underway, the tabled values (table 13.13.1.) must be seen as a first indication.

[81] For the amounts of sieve sand which are included in the calculations, see column 8 of table a and c in appendix 22.

Table 13.13.1 Indicative survey of the costs of quality improvement according to Van Ruiten and Van der Zanden.

Construction material	costs	Comments
sieve sand	15 - 100 (75) f/t	incl. deposit costs for slag
stone-like construction materials	100.000.000 f/10.000.000 t	involves all stone-like construction materials
old asphalt	30 f/t	
soil	none	cleansing, fits under another regulation
MSWI bottom ash	50 - 900 f/t	very dependent on the method
MSWI fly ash	40-100 f/t	glassing
blast furnace slag	-	no method available
LD slag	unknown	adaptation prod. process possible
phosphor slag	unknown	
E bottom ash	unknown	by way of another kettle design
E fly ash	10 f/t	through a critical purchase policy

It must be mentioned that the branch union VVAV still sees possibilities of processing the MSWI bottom ash into a category 2 construction material.

13.14 Conclusions and market effects

In table 13.14.1. (1990) and tables 13.14.2. and 13.14.3. (2000), a survey of the possible costs connected with the Building Materials Decree[82] is given. A number of costs are not calculated. These are the costs of possible industry closures and shifts in the market. The expected costs[83] are included in these scenarios; for the band widths refer to the chapters where the various posts are described. In the calculation, the Van Ruiten set/Branch Document (table 13.5.10) is used as starting point.

1. First, the standard scenario is calculated. In this, the starting point is that a construction material is applied in the category (categories) which belong (belongs) to the expected quality of the construction material. This quality is described in Part 2 and is deduced from the available data. If a construction material is applied in category 1

[82] It is noted that for both the Building Materials Decree as well as for the acceptance of waste materials at dump sites, the analysis must be done on the same parameters. The analysis costs are therefore barely influenced by application or dumping.

[83] Price level 1990, excl. VAT.

and/or 2 and/or would have to be partly dumped, then the costs are calculated per category, and based on the amount of construction material which would be applied in the category concerned.

2. Then a scenario is calculated in which the construction materials or parts of the construction material which cannot be directly sold as category 1 construction materials, is dumped. In such a case, the category 2 construction materials or parts thereof are not applied isolated, but are dumped. The part which fits into category 1, is applied (non-isolated). The netto market effect is then 132 million/year in 1990 and 118 million/year more in 2000 in comparison with scenario 1. With an increase in the dumping costs to the burning tariffs, the difference can add up to 245 million/year more in 2000.
3. Then, the scenario is calculated in which all the construction materials which cannot be singly placed into category 1 or 2 (therefore divided between category 1 and 2) are applied isolated. This also concerns the category 1 part. From Van Ruiten's set, these are the construction materials mix aggregate, E bottom ash, blast furnace slag mix, phosphor slag, and fluid bed bottom ash. The construction materials which fit completely into category 1, are applied (non-isolated). For 1990, this results in 34 mil/yr more, and for 2000, 27 mil/yr more in comparison to scenario 1[84]
4. The previous scenario is also calculated for the case in which all the construction materials which cannot be singly placed into one category (therefore divided between category 1 and 2, are dumped. This concerns both the category 1 as well as the category 2 part. From the Van Ruiten set, this concerns the construction materials mix aggregate, E bottom ash, blast furnace slag mix, phosphor slag and fluid bed bottom ash. Only construction materials which fit completely into category 1 are applied (non-isolated). For 1990, the netto market effect would be approximately 564 mil/yr more, and for 2000 approximately 454 mil/yr more in comparison to scenario 1. In 2000, the difference can increase to 919 mil/yr if dumping costs are equal to the burning tariffs.

[84] In the Branch Documnet Construction and Demolition Waste, it is expected for 2000 that all the construction recycling materials will be offered as certified products. Certified construction materials as a rule are of better quality (see Part 1). The result is that the isolation costs are lower.

5. Then, a scenario is calculated in which sieve sand which must be dumped, is processed so that it is sellable as a category 1 construction material. The other construction materials are used according to scenario 1. In such a case, the netto market effect in 1990 is cost neutral (in fact: -6 million/yr) and in 2000, -38 million cheaper. If the higher dumping tariff (f250/ton) is applicable, then a saving of 132 million/yr can be achieved.
6. Finally, a scenario is calculated when all stone-like construction and demolition waste is processed into construction materials which are usable as category 1 construction materials. The other construction materials are used according to scenario 1. This costs 77 million/yr more in comparison to the standard scenario in 1990, and approximately 1 million/yr more in 2000. If the dumping tariff is equal to the burning tariff, a saving of approximately 77 million/yr is possible in 2000.

The costs concerning the Building Materials Decree will be around 60 million/yr in 1990 and 160 million/yr in 2000. If the choice is made for processing and/or removal, this will lead to a shift in the costs. The example scenarios mentioned are reproduced in table 13.14.1. (1990), table 13.14.2. (2000) and table 13.14.3. (2000, high dumping tariff).
The waste materials policy is directed towards prevention and re-use, whereby the processing of waste materials is preferable to the dumping of waste materials.
By processing the waste materials to re-usable products, the costs can rise to 150-175 million/yr. The evaluation shows that through steering by way of tariffs, the processing of waste materials can be stimulated.

Table 13.14.1 Expected market effects in million guilders per year for various re-use scenarios (values: 1990) with a dumping tariff of f125/ton.

scenario	categories				evaluation costs		TOTAL
	certainly cat. 1	cat. 2	'Special category'	dumping	v.Ruiten set	others	
1. Building Materials Decree 1993	apply	isolation: Mf 12	isolation: Mf 16	dumping: Mf 16	Mf 1.5	Mf 8.5	Mf 54
2. cat. 2 also dumping	apply	dumping: cat. 2	isolation: Mf 16	dumping: Mf 16 plus Mf 144 cat. 2	Mf 1.5	Mf 8.5	Mf 186
3. apply certainly only cat. 1, the rest cat. 1 and 2 isolate	apply	isolation: Mf 46 incl. cat. 1 part	isolation: Mf 16	dumping: Mf 16	Mf 1.5	Mf 8.5	Mf 88
4. apply certainly only cat. 1, the rest cat. 1 and 2 dumping	apply	construction materials in cat. 1 <u>and</u> cat. 2 dumping	isolation: Mf 16	dumping: Mf 16 plus Mf 576 cat. 2	Mf 1.5	Mf 8.5	Mf 618
5. cat. 2 isolate, and process constructi-on materials to be dumped	cat. 1 apply and process sieve sand: Mf 10	isolation: Mf 12	isolation: Mf 16	see cat. 1	Mf 1.5	Mf 8.5	Mf 48
6. process all construction recycling materials	apply cat. 1, process all construction recycling materials Mf 100.	Mf 5 (concerns remaining construction materials)	isolation: Mf 16	see cat. 1	Mf 1.5	Mf 8.5	Mf 131

price level 1990, excl. VAT

Table 13.14.2 Expected market effects in million guilders per year for various re-use scenarios (values: 2000) with a dumping tariff of f125/ton.

scenario	categories				evaluation costs		TOTAL
	cat. 1	cat. 2	'Special category'	dumping	v.Ruiten set	others	
1. Building Materials Decree 1993	apply	isolation: Mf 10	isolation: Mf 40	dumping: Mf 94	Mf 1.6	Mf 15	Mf 161
2. cat. 2 also dumping	apply	dumping: cat. 2	isolation: Mf 40	dumping: Mf 94 plus Mf 128 cat. 2	Mf 1.6	Mf 15	Mf 279
3. apply certainly only cat. 1, the rest cat. 1 and 2 isolate	apply	isolation: Mf 37 incl. cat. 1 part	isolation: Mf 40	dumping: Mf 94	Mf 1.6	Mf 15	Mf 188
4. apply certainly only cat. 1, the rest cat. 1 and 2 dumping	apply	construction materials in cat. 1 and cat. 2 dumping	isolation: Mf 40	dumping: Mf 94 plus Mf 464 cat. 2	Mf 1.6	Mf 15	Mf 615
5. cat. 2 isolate, and process construction materials to be dumped	cat. 1 apply and process sieve sand: Mf 56	isolation: Mf 10	isolation: Mf 40	see cat. 1	Mf 1.6	Mf 15	Mf 123
6. process all construction recycling materials	apply cat. 1, process all construction recycling materials Mf 100.	Mf 5 (concerns remaining construction materials)	isolation: Mf 40	see cat. 1	Mf 1.6	Mf 15	Mf 162

price level 1990, excl. VAT.

Table 13.14.3. Expected market effects in million guilders per year for various re-use scenarios (values: 2000) with a waste materials policy in which the dumping tariffs increase to f250/ton.

scenario	categories				evaluation costs		TOTAL
	cat. 1	cat. 2	'Special category'	dumping	v.Ruiten set	others	
1. Building Materials Decree 1993	apply	isolation: Mf 10	isolation: Mf 40	dumping: Mf 188	Mf 1.6	Mf 15	Mf 255
2. cat. 2 also dumping	apply	dumping:	isolation: Mf 40	dumping: Mf 188 plus Mf 256 cat. 2	Mf 1.6	Mf 15	Mf 500
3. apply certainly only cat. 1, the rest cat. 1 and 2 isolate	apply	isolation: Mf 37 incl. cat. 1 part	isolation: Mf 40	dumping: Mf 188	Mf 1.6	Mf 15	Mf 282
4. apply certainly only cat. 1, the rest cat. 1 and 2 dumping	apply	construction materials in cat. 1 and cat. 2 dumping	isolation: Mf 40	dumping: Mf 188 plus Mf 929 cat. 2	Mf 1.6	Mf 15	Mf 1174
5. cat. 2 isolate, and process construction materials to be dumped	cat. 1 apply and process sieve sand: Mf 56	isolation: Mf 10	isolation: Mf 40	see cat. 1	Mf 1.6	Mf 15	Mf 123
6. process all construction recycling materials	apply cat. 1, process all construction recycling materials Mf 100.	Mf 5 (concerns remaining construction materials)	isolation: Mf 40	see cat. 1	Mf 1.6	Mf 15	Mf 162

price level 1990, excl. VAT

14. RECOMMENDATIONS

14.1 The ministerial guideline

In the ministerial guideline concerning the evaluation of construction materials, it is important to keep in mind the variations within a sample. The producer of a construction material may have determined that the average value of a construction material sample meets the requirements. If the sample is then divided into part samples which are individually tested according to the criteria of the Building Materials Decree, then it is possible that some of the part samples do not meet the requirements.

In the evaluation method, this would have to be taken into consideration. There are various possibilities for this, namely:

a. to allow the evaluation of the large sample to be valid also for all the part samples taken from it.

b. for smaller samples, to use rejection limits deduced from the standards, which take into consideration the unhomogeneous character of construction materials.

c. apply samples having a large spreading and which on average are close to the standard, only in large applications, as an entire sample.

A, b, and c aim at letting the rejection chance of a part sample in the order of size to be the same as that of the original sample. If this is done, then the use of waste materials as construction materials such as predicted in this report, will also be valid in actual practice. It is not investigated whether the possibilities suggested can also be realized legally and practically.

14.2 Research

The RIVM/RIZA recommends the following researches:

- The effect of "fresh" drilling surfaces and/or break surfaces of proctors and non-prefabricated construction materials respectively on the emission
- Up to now, little attention has been given to the second life cycle of a prefabricated construction material (second generation problem).
- Further research of the quantification of differences between leaching in the lab and the emission in actual practice.

- The maximum allowed emission by construction materials is defined by the government on the product level, based on the criteria of marginal burdening with the accompanying numerical elaboration. The goal of the standard setting is to give general standards and regulations which in most situations will not lead to a relatively high increase of the concentrations in the soil with respect to the target values for soil quality, in the groundwater with respect to the target values groundwater quality and in the surface water with respect to the limit value for surface water quality. This standard setting, especially the question of whether there is enough protection for soil and groundwater, is momentarily being studied by the RIVM. It is being investigated whether further research is desired by the RIZA as to whether there is sufficient protection of the surface water.
- Transportation by way of diffusion (without percolation) from granular construction materials.
- Research of the changes in the emission behaviour over time through aging of the construction material and the formation of 'new minerals'.
- Research of the passage of water through various types of (isolation) materials in various engineering constructions.
- Research of the effective infiltration.
- Research of the kappa.
- Research of the average wetting period of isolated applications in actual practice.
- Research as to whether the emission by diffusion is dependent on the measure of wetting of the construction material.
- Research of the effect of temperature change on the leaching emission. Investigate the temperature divisions of surface water during one year.
- Further research of the emission to the surface water as the result of streaming through a construction.
- Research of the quantification of initial emissions at the application of construction materials, including the accompanying L/S definition for the estimation of the initial leaching. The calculated emission gives the possibility of extrapolation to other periods. The initial emission as the result of flushing is not included. For the emission to the surface water, further research is desired as to the contribution of this emission in the total emission to the surface water.

- In order to be able to determine the effect of the ministerial regulation and standard setting on the re-use, both qualitative and quantitative monitoring of construction materials is desired. In agreement with DGM, time has been reserved for this activity in the MAP environment.

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APPENDICES

NB. The effects of the latest adjustments by VROM/DGM of:

1 the PAH-total-compostition standard of 75 mg/kg to 50 mg/kg for construction and demolition waste and products made of it are not incorporated in this appendix.

2 the raise of the sulphate immission from 62000 to 100000 mg/m^2 for category 1 non-prefabricated construction materials are not incorporated in this appendix.

Appendix 0 Appendix belonging to the Building Materials Decree.

Composition values for clean soil

Compounds	CAS-no.	composition values (25% lutum and 10% humus* content) (mg/kg dry material, unless stated otherwise)
INORGANIC COMPOUNDS		
1. Metals		
arsenic (As)	[7440-38-2]	29
barium (Ba)	[7440-39-3]	200
cadmium (Cd)	[7440-43-9]	0,8
chromium (Cr)	[7440-47-3]	100
cobalt (Co)	[7440-48-2]	20
copper (Cu)	[7440-50-8]	36
mercury (Hg)	[7439-97-6]	0,3
lead (Pb)	[7439-92-1]	85
molybdenum (Mo)	[7439-98-7]	10
nickel (Ni)	[7440-02-0]	35
tin (Sn)	[7440-31-5]	20
zinc (Zn)	[7440-66-5]	140
2. Other inorganic compounds		
bromide	not actual	20[1]
chloride	not actual	200[2]
cyanide-free	not actual	1
	not actual	
cyanide complex	not actual	5
fluoride	not actual	175 + 13 Lu
sulphides (total)	not actual	2

1 Contrary to the table no composition value applies to bromide, in the event of the use of clean soil in locations where there is direct contact with or direct contact is possible with brackish surface water or seawater with a natural chloride concentration of more than 5,000 mg/l.

2 Contrary to the table no composition value applies to chloride, in the event of the use of clean soil in locations where there is direct contact or direct contact is possible with brackish surface water or seawater with a natural chloride concentration of more than 5,000 mg/l.

Compounds	CAS-no.	composition values (25% lutum and 10% humus* content) (mg/kg dry material, unless stated otherwise)
ORGANIC COMPOUNDS		
3. Aromatic compounds		
benzene	[71-43-2]	0,05
ethyl benzene	[100-41-4]	0,05
toluene	[108-88-3]	0,05
xylenes (total)[3]	[95-47-6], [108-38-3], [106-42-3]	0,05
isopropyl benzene	[98-82-8]	a
styrene (Vinylbenzene)	[100-42-5]	0,1
phenol	[108-95-2]	0,05
o-cresol (o-Methyl phenol)	[95-48-7]	a
m-cresol (m-Methyl phenol)	[108-39-4]	a
o-dihydroxy benzene (Catechol)	[120-80-9]	a
1-hydroxy naphthalene (α-Naphthol)	[90-15-3]	a
5-methyl-2-isopropyl phenol (Thymol)	[89-83-8]	a
4. Polycyclic aromatic hydrocarbons (PAHs)		
PAHs total (total of 10)[4]	[91-20-3], [85-01-8], [120-12-7], [206-44-0], [56-55-3], [218-01-9], [207-08-9], [50-32-8], [191-24-2], [193-39-5]	1

3 Xylenes (total) is defined as the sum of o-xylene, m-xylene and p-xylene.

4 PAH (total of 10) is defined as the sum of anthracene, benzo(a)anthracene, benzofluoranthene, benzo(a)pyrene, chrysene, phenanthrene, fluoranthene, indeno(1,2,3-cd)pyrene, naphthalene and benzo(ghi)perylene.

Compounds	CAS-no.	composition values (25% lutum and 10% humus* content) (mg/kg dry material, unless stated otherwise)
5. Chlorinated hydrocarbons		
a. (volatile) hydrocarbons		
monochloropropenes (total)	[590-21-6], [557-98-2], [107-05-1]	0,01
dichloromethane	[75-09-2]	a
1,3-dichloropropene	[542-75-6]	a
trichloromethane	[67-66-3]	0,001
trichloro ethanes (total)	[79-01-6], [79-00-5]	0,001
trichloro ethene (Tri)	[79-01-6]	0,001
tetrachloromethane (Tetra)	[56-23-5]	0,001
tetrachloro ethanes (total)	[630-20-6], [79-34-5]	0,001
tetrachloro ethene (Per)	[127-18-4]	0,01
hexachloro ethane	[67-72-1]	0,01
bis(2-chloro isopropyl)-ether	[39638-32-9]	a
epichlorohydrine	[106-89-8]	a
b. chlorobenzenes		
monochlorobenzene	[108-90-7]	a
dichlorobenzenes (total)	[95-50-1], [541-73-1], 106-46-7]	0,01
trichlorobenzenes (total)	[87-61-6], [120-82-1], [108-70-3]	0,01
tetrachlorobenzenes (total)	[634-66-2], [634-90-2], [95-94-3]	0,01
pentachlorobenzene	[608-93-5]	0,0025
hexachlorobenzene	[188-74-1]	0,0025
c. chlorophenoles		
monochlorophenoles (total)	[95-57-8], [108-43-0], [106-48-9]	0,0025
dichlorophenoles (total)	[576-24-9], [120-83-2], [583-78-8], [87-65-0], [95-77-2], [591-35-5]	0,003
trichlorophenoles (total)	[15950-66-0], [933-78-8], [933-75-5], [95-95-4], [88-06-2], [609-19-18]	0,001
tetrachlorophenoles (total)	[4901-51-3], [58-90-2], [935-95-5]	0,001
pentachlorophenol	[87-86-5]	0,002

Compounds	CAS-no.	composition values (25% lutum and 10% humus* content) (mg/kg dry material, unless stated otherwise)
d. polychlorobiphenyles (PCBs)		
PCB 28	[7012-37-5]	0,001
PCB 52	[35693-99-3]	0,001
PCB 101	[37680-37-2]	0,004
PCB 138	[35065-28-2]	0,004
PCB 153	[35065-27-1]	0,004
PCB 180	[35065-29-3]	0,004
PCBs (total of 6)[5]	[7012-37-5], [35693-99-3], [37680-37-2], [35065-28-2], [35065-27-1], [35065-29-3]	0,02
PCB 118	[31508-00-6]	0,004
e. remaining chlorinated hydrocarbons		
chloro anilines (total)	[95-51-2], [108-42-9], [106-47-8]	a
dichloro anilines (total)	[608-27-5], [554-00-7], [95-82-9], [608-31-1], [95-76-1], [626-43-7]	a
EOCl (total)	not applicable	0,1
monochloronitrobenzenes (total)	[88-73-3], [121-73-3], [100-10-5]	0,01
dichloronitrobenzenes (total)	[3209-22-1], [611-06-3], [89-61-2], [99-54-7], [618-62-2], [601-88-7]	0,01
monochlorotoluene (total)	[95-49-8], [108-49-8], [106-43-4]	a

5 PCBs (total of 6) is defined as the sum of PCB 28, 52, 101, 138, 153 and 180.

Compounds	CAS-no.	composition values (25% lutum and 10% humus* content) (mg/kg dry material, unless stated otherwise)
6. PESTICIDES		
a. organochloro-pesticides		
aldrin	[390-00-2]	0,0025
chlorodane	[57-74-9]	0,01
DDT/DDE/DDD[6]	[72-54-9], [53-19-0],[784-02-6], [72-54-8], [3424-82-6], [50-29-3]	0,0025
dieldrin	[60-57-1]	0,0005
endrin	[72-20-8]	0,001
α-endosulphan	[115-29-7]	0,0025
α-HCH	[319-84-6]	0,0025
β-HCH	[319-85-7]	0,001
γ-HCH (lindane)	[58-89-9]	0,05 μg/kg
heptachlor	[76-44-8]	0,0025
heptachloro epoxide (total)	[280044-83-9], [1024-5703]	0,0025
hexachlorobutadiene	[87-68-3]	0,0025
b. organophosphor-pesticides		
azinphos-methyl	[86-50-0]	0,06 μg/kg
azinphos-ethyl	[2642-71-9]	0,01
cholinesterase restraints	not applicable	a
demeton (total)	[17040-19-6], [298-03-3], [126-75-0], [919-86-8]	a
diazinon	[333-41-5]	0,07 μg/kg
dichlorvos	[62-73-7]	a
dimetheoaat	[60-51-5]	a
disulphoton	[298-04-4]	0,01
phenitrothion	[122-14-5]	0,01
malathion	[121-75-5]	0,02 μg/kg
parathion(-ethyl)	[56-38-2]	0,04 μg/kg
parathion + parathion-methyl	[56-38-2], [298-00-0]	0,01
triazophos	[24017-47-8]	0,01
trichlorophon	[52-68-6]	a

6 DDT/DDD/DDE is defined as: the sum of DDT, DDD and DDE.

Compounds	CAS-no.	composition values (25% lutum and 10% humus* content) (mg/kg dry material, unless stated otherwise)
c. organotin pesticides		
TBTO	[56-35-9]*	0,0001
d. chlorophenoxy acetic acid herbicides		
2,4-dichlorophenoxy acetic acid	[94-75-7]	a
dichloroprop	[120-36-5]	a
mcpa	[94-74-6]	a
mecoprop	[93-65-2]**	a
2,4,5-trichlorophenoxy acetic acid	[93-76-5]	a
e. aromatic chloro amines		
linuron	[330-55-2]	a
monolinuron	[1746-81-2]	a
3,3-dichlorobenzidine	[91-94-1]	a
f. remaining pesticides		
atrazine	[1912-24-9]	0,05 µg/kg
4-chloro-3-methylphenol	[59-50-7]	a
chloridazon	[1698-60-8]	a
dibromo ethanes (total)	[557-91-5], [106-93-4]	a
dichloro ethanes (total)	[75-34-3], [107-06-2]	a
dichloro ethenes (total)	[75-35-4], [156-59-2], [156-60-5]	a
dichloropropanes (total)	[78-87-5], [142-28-9], [78-99-9], [594-20-7]	a
1,3-dichloro-2-propanol	[96-23-1]	a
methylbromide	[74-83-9]	a
acetamide	[79-07-2]	a
propanil	[709-98-8]	a
triphluralin	[1582-09-8]	0,01

Compounds	CAS-no.	composition values (25% lutum and 10% humus* content) (mg/kg dry material, unless stated otherwise)
7. Remaining organic compounds		
acrylonitrile	[107-13-1]	a
benzidine (total)	[92-87-5]**	a
biphenyl	[92-52-4]	a
cyclohexanone	[108-94-1]	0,1
dimethylamine	[124-40-3]*	a
diethylamine	[109-89-7]*	a
phthalates (total)	not applicable	0,1
oxidated PAHs (total)	not applicable	1
heptane	[142-82-5]	1
hydrazine	[302-01-2]	a
mineral oil[7]	not applicable	50
octane	[111-65-9]	1
pyridine	[110-86-1]	0,1
tetrahydrophuran	[109-99-9]	0,1
tetrahydrothiophene	[110-01-0]	0,1

*: the numbers are adjusted with respect to the Building Materials Decree.
** the numbers are adjusted with respect to the Building Materials Decree and the corresponding name is a collective name.

7 Mineral oils relates to the sum of all alkanes. If any form of mineral oil contamination is demonstrated in the soil, the concentration of aromatic and/or polycyclical aromatic hydrocarbons has to be determined alongside the mineral oil concentration.

Key to the abbreviations and symbols

a = detectability limit. The composition value of the substance in question is equal to the detectability limit.
Lu = the percentage of lutum in the soil to be assessed.

* To convert the composition value of standard soil into the composition value for the soil to be assessed the following formula applies to heavy metals:

$$Sw_b = Sw_{std} * \frac{A + (B * \%lutum) + (C * \%org.subst.)}{A + (B * 25) + (C * 10)}$$

in which:

Sw_b = the composition value of the soil to be assessed (mg/kg)
Sw_{std} = the composition value of the standard soil (25% lutum en 10% humus) (mg/kg) (see the table with the compostition values in appendices 1 and 2 respectively)
%lutum = measured percentage of lutum in the soil to be assessed
%org.subst. = measured percentage of organic substance in the soil to be assessed.
A, B en C = constants depending on the metal (see table 2)

If measuring problems occur with low concentrations of organic substance or lutum, percentages of 2% organic substance and lutum can be assumed.

* For converting the composition values of the standard soil into composition values for the soil to be assessed the following formula applies to organic substance:

$$Sw_b = Sw_{std} * \frac{\%org.subst.}{10}$$

in which:

Sw_b = the composition value of the soil to be assessed (mg/kg)
Sw_{std} = the composition value of the standard soil (10% humus) (mg/kg) (see the table with the composition values in appendices 1 and 2 respectively)
%org.subst. = measured percentage of organic substance in the soil to be assessed. For soil with a measured organic substance concentration of more than 30% or less than 2% concentrations of 30% and 2% are adhered to respectively.

Table 2: Constants of the metals depending on the substance

substance	A	B	C
arsenic (As)	15	0,4	0,4
barium (Ba)	30	5	0
cadmium (Cd)	0,4	0,007	0,021
chromium (Cr)	50	2	0
cobalt (Co)	2	0,28	0
copper (Cu)	15	0,6	0,6
mercury (Hg)	0,2	0,0034	0,0017
lead (Pb)	50	1	1
molybdenum[1] (Mo)	1	0	0
nickel (Ni)	10	1	0
tin[1] (Sn)	1	0	0
zinc (Zn)	50	3	1,5

[1] No correction will be handled for molybdenum and tin.

Appendix 0A Appendix belonging to the Building Materials Decree.

Composition and immission values for construction materials, not being clean soil

Substance	CAS-no.	immission-values (mg/m^2 per 100 year)	composition values for other construction materials than soil (mg/kg dry material)	composition values for soil assuming 25% lutum and 10% humus* (mg/kg dry material)
INORGANIC COMPOUNDS				
1. Metals				
antimony (Sb)	[7440-36-0]	39	-	-
arsenic (As)	[7440-38-2]	435	-	55
barium (Ba)	[7440-39-3]	6300	-	625
cadmium (Cd)	[7440-43-9]	12	-	12
chromium (Cr)	[7440-47-3]	1500	-	380
cobalt (Co)	[7440-48-2]	300	-	240
copper (Cu)	[7440-50-8]	540	-	190
mercury (Hg)	[7439-97-6]	4,5	-	10
lead (Pb)	[7439-92-1]	1275	-	530
molybdenum (Mo)	[7439-98-7]	150	-	200
nickel (Ni)	[7440-02-0]	525	-	210
selenium (Se)	[7782-49-2]	15	-	-
tin (Sn)	[7440-31-5]	300	-	-
vanadium (V)	[7440-62-2]	2400	-	-
zinc (Zn)	[7440-66-5]	2100	-	720

Substance	CAS-no.	immission-values (mg/m² per 100 year)	composition values for other construction materials than soil (mg/kg dry material)	composition values for soil assuming 25% lutum and 10% humus* (mg/kg dry material)
2. Other inorganic compounds				
bromide	not applicable	300[8]	-	-
chloride	not applicable	30000[9]	-	-
cyanide (free)	not applicable	15	-	20
cyanide (complex) (pH≥5)[10]	not applicable	75	-	50
cyanide (complex) (pH<5)[3]	not applicable	75	-	650
fluoride	not applicable	14000[11]	-	-
thiocyanates (total)	not applicable	-	-	20
sulphate	not applicable	45000[12]	-	-

8 Contrary to the table no immission value applies to bromide, in the event of the use of clean soil in locations where there is direct contact or direct is possible with brackish surface water or seawater with a natural chloride concentration of more than 5,000 mg/l.

9 The immission value for chloride given in the table is expressed in mg/m² per year. Contrary to the table the following immission values apply to chloride:
a. an immission value of 87000 mg/m² per year for the use on or in the soil of a non-prefabricated construction material that is applied as category 1 construction material.
b. an immission value of 174000 mg/m² per year for the use in surface water of a non-prefabricated construction material used as category 1 construction material and
c. no immission value for the use of a construction material in locations where there is direct contact or direct contact is possible with brackish surface water or seawater with a natural chloride concentration of more than 5000 mg/l.

10 Acidity: pH (0.01 M $CaCl_2$). For determining a pH higher than or equal to 5 and a pH lower than 5, the 90-percentile of the measured values applies.

11 Contrary to the immission value for fluoride given in the table, an immission value of 56000 mg/m² per 100 years applies for the use of a construction material in places where there is direct contact or direct contact is possible with brackish surface water or seawater with a natural chloride concentration of more than 5000 mg/l.

12 The immission value for sulphate given in the table is expressed in mg/m² per year. Contrary to the immission value given in the table, the following applies to sulphate:
a. an immission value of 100,000 mg/m² per year for the use on or in the soil of a non-prefabricated construction material that is applied as category 1 construction material.
b. an immission value of 124,000 mg/m² per year for the use in surface water of a non-prefabricated construction material used as category 1 construction material and
c. an immission value of 180,000 mg/m² per year for the use of a construction material in locations where there is direct contact or direct contact is possible with brackish surface water or seawater with a natural chloride concentration of more than 5000 mg/l.

Substance	CAS-no.	immissi-on-values (mg/m^2 per 100 year)	composition values for other construction materials than soil (mg/kg dry material)	composition values for soil assuming 25% lutum and 10% humus* (mg/kg dry material)
ORGANIC COMPOUNDS				
3. Aromatic compounds				
benzene	[71-43-2]	-	1,25	1
ethylbenzene	[100-41-4]	-	1,25	1,25
toluene	[108-88-3]	-	1,25	1,25
xylenes (total)[13]	[95-47-6], [108-38-3], [106-42-3]	-	1,25	1,25
styrene (Vinylbenzene)	[100-42-5]	-	-	100
phenol	[108-95-2]	-	1,25	1,25
cresols (total)[14]	[108-39-4], [95-48-7], [106-44-5]	-	-	5
o-dihydroxybenzene (Catechol)	[120-80-9]	-	-	20
m-dihydroxybenzene (Resorcinol)	[108-46-3]	-	-	10
p-dihydroxybenzene (Hydrochinon)	[123-31-9]	-	-	10

13 Xylenes (total) is defined as the sum of m-xylene, p-xylene and o-xylene.

14 Cresols (total) is defined as the sum of m-cresol, p-cresol and o-cresol.

Substance	CAS-no.	immission-values (mg/m² per 100 year)	composition values for other construction materials than soil (mg/kg dry material)	composition values for soil assuming 25% lutum and 10% humus* (mg/kg dry material)
4. Polycyclic aromatic hydrocarbons (PAHs)				
naphthalene	[91-20-3]	-	5[15]	5
phenanthrene	[85-01-8]	-	20[8]	20
anthracene	[120-12-7]	-	10[8]	10
fluoranthene	[206-44-0]	-	35[8]	35
chrysene	[56-55-3]	-	10[8]	10
benzo(a)anthracene	[218-01-9]	-	50[8]	40
benzo(a)pyrene	[207-08-9]	-	10[8]	10
benzo(k)fluoranthene	[50-32-8]	-	50[8]	40
indeno (1,2,3cd) pyrene	[191-42-2]	-	50[8]	40
benzo(ghi)perylene	[193-39-5]	-	50[8]	40
PAHs total (total of 10)[16]	[91-20-3], [85-01-8], [120-12-7], [206-44-0], [56-55-3], [218-01-9], [207-08-9], [50-32-8], [191-42-2], [193-39-5]	-	75[8]	40
5. Chlorinated hydrocarbons				
a. (volatile) chlorohydrocarbons				
monochloro ethene (Vinylchloride)	[75-01-4]	-	-	0,1
dichloromethane	[75-09-2]	-	-	4
1,2-dichloro ethane	[107-06-2]	-	-	4
trichloromethane	[67-66-3]	-	-	3
trichloro ethene (Tri)	[79-01-6]	-	-	4
tetrachloromethane (Tetra)	[56-23-5]	-	-	1
tetrachloro ethene (Per)	[127-18-4]	-	-	4
chloronaphthalene (total α,β)	[90-13-1], [91-58-7]	-	-	10

15 Contrary to the table the following applies to construction and demolition waste and products made from this including cement aggregate, mix aggregate, breaker sand and sieve sand:
a. no composition value for individual PAHs and
b. a composition value for total PAHs (10 PAHs) of 50 mg/kg.
This deviation from the table is **not** applicable to the asphalt aggregate referred to in footnote 19.

16 PAH (total of 10) is defined as: the sum of anthracene, benzo(a)anthracene, benzofluoranthene, benzo(a)pyrene, chrysene, phenanthrene, fluoranthene, indeno(1,2,3-cd)pyrene, naphthalene and benzo(ghi)perylene.

Substance	CAS-no.	immissi-on-values (mg/m² per 100 year)	composition values for other construction materials than soil (mg/kg dry material)	composition values for soil assuming 25% lutum and 10% humus* (mg/kg dry material)
b. chlorobenzenes				
chlorobenzenes (total)[17]	[108-90-7],[95-50-1], [541-73-1], [106-46-7], [87-61-6], [120-82-1], [108-70-3], [634-66-2], [634-90-2],[95-94-3], 608-93-5], [188-74-1]	-	-	5
c. chlorophenols				
chlorophenols (total)[18]	[95-57-8], [108-43-0], [106-48-9], [576-24-9], [120-83-2], [583-78-8], [87-65-0], [95-77-2], [591-35-5], [15950-66-0], [933-78-8], [933-75-5], [95-95-4], [88-06-2], [609-19-8], [4901-51-3], [935-95-5], [58-90-2], [87-86-5]	-	-	6
pentachlorophenol	[87-86-5]	-	-	5
d. polychloro-biphenyls (PCBs)				
PCBs (total of 7)[19]	[7012-37-5], [35693-99-3], [37680-37-2], [35065-28-2], [35065-27-1], [35-065-29-3], [31308-00-6]	-	0,5	0,5
e. remaining chlorinated hydrocarbons				
EOCl (total)	not applicable	-	3 mg Cl/kg	3 mg Cl/kg

17 Chlorobenzene (total) is defined as the sum of all isomers of all chlorobenzenes (mono, di, tri, tetra, penta, hexachlorobenzene).

18 Chlorophenol is defined as: the sum of all isomers of chlorophenols (mono, di, tri, tetra and pentachlorophenol).

19 PCBs (total of 7) is defined as: the sum of PCB 28, 52, 101, 118, 138, 153, 180.

Substance	CAS-no.	immissi-on-values (mg/m² per 100 year)	composition values for other construction materials than soil (mg/kg dry material)	composition values for soil assuming 25% lutum and 10% humus* (mg/kg dry material)
6. Pesticides				
a. organochloro pesticides				
DDT/DDE/DDD[20]	[72-54-9], [53-19-0], [784-02-6], [72-54-8], [3424-82-6], [50-29-3]	-	-	0,5
drins (total)[21]	[390-00-2], [60-57-1], [72-20-8]	-	-	0,5
HCH-compounds[22]	[319-84-6], [319-85-7], [58-89-9], [319-86-8]	-	-	0,5
organochloro compounds (total)[23]	not applicable	-	0,5	0,5
b. remaining pesticides				
atrazine	[1912-24-9]	-	-	0,5
carbaryl	[63-25-2]	-	-	0,5
carbofuran	[1563-66-2]	-	-	0,5
maneb	[1247-38-2]	-	-	0,5
non chlorine pesticides (total)[24]	not applicable	-	0,5	0,5

20 DDT, DDD, DDE is defined as: the sum of DDT, DDD and DDE.

21 Drins is defined as: the sum of aldrin, dieldrin and endrin.

22 HCH compounds are defined as: the sum of α-HCH, β-HCH, γ-HCH and Δ-HCH.

23 Organochloro pesticides (total) is defined as: the sum of all pesticides containing chlorine.

24 Non-chlorine-containing pesticides (total) is defined as: the sum of all pesticides with the exception of pesticides containing chlorine.

Substance	CAS-no.	immission-values (mg/m^2 per 100 year)	composition values for other construction materials than soil (mg/kg dry material)	composition values for soil assuming 25% lutum and 10% humus* (mg/kg dry material)
7. Remaining organic compounds				
cyclohexanone	[108-94-1]	-	-	270
phthalates (total)	not applicable	-	-	60
mineral oil[25]	not applicable	-	500[26]	500
pyridine	[110-86-1]	-	-	1
tetrahydrophuran	[109-99-9]	-	-	0,4
tetrahydrothiophene	[110-01-0]	-	-	90

For the key to the abbrevations and symbols:
See appendix 0.

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25 Mineral oils relates to the sum of all the alkanes. If any form of mineral oil contamination is demonstrated in the soil, the concentration of aromatic and/or polycyclical aromatic hydrocarbons has to be determined alongside the mineral oil concentration.

26 Contrary to the table, no composition value applies to mineral oil for the construction materials listed below:
- Asphalt or asphalt cement, including possible surface treatments, interim layers and top layers, being a construction material that comprises a binder on the basis of bitumen, stony materials, sand and filler, and which as such is used regularly in road and hydraulic engineering or for constructions for floors, leak-proof or otherwise;
- Stabilised asphalt aggregate being a construction material that comprises sand, cement and/or bitumen emulsion, water and at least 70% mm asphalt aggregate, which as such is regularly used in road building or hydraulic engineering and in which the content of asphalt cement in the asphalt aggregate is at least 40%.
- Asphalt aggregate being a construction material that as such is regularly used in road base foundations and which comprises at least 80% broken or cut asphalt or asphalt cement.
- Mineralised bitumen roofing materials which are regularly used in civil and utility building construction.

Appendix 1 Belonging to the Building Materials Decree soil and surface water protection, dated 26-6-1991

Construction materials placed into the categories N1 or V1[27]

Cement concrete	V1W
Asphalt cement	V1W
Calcium-silicate bricks and blocks	V1W
Rough ceramic products	V1W
Aerated concrete in outside walls	V1
Masonry and fill mortar	V1W
Bentonite sand isolation layers	N1
Sand cement stabilization	N1V1W
Sand cement stabilization with sieve sand*	V1
Deposition stones, including:	
Quartzite, Sand stone, Lime stone	N1V1W
Coagulation stone, including:	
Basalt, Granite, Porfier,	N1V1W
Flug sand, Lava stone	N1
Cement Aggregate*	N1W
Masonry and mix aggregate*	N1W
E bottom ash*	N1
Cement concrete with N1 materials, E fly ash, E fly ash aggregate, MSWI bottom ash and/or Jarosite end slag	V1
Asphalt cement with N1 materials, E fly ash, and/or E bottom ash	V1
Asphalt cement with asphalt aggregate	V1
Asphalt cement with phosphor slag	V1
Crushed asphalt cement	V1
Calcium-silicate bricks and blocks with N1 materials and/or E fly ash	V1
Blast furnace aerated slag	V1
Granulated blast furnace slag	V1
Blast furnace slag mix stabilization	V1
LD slag in streaming, salty surface water	V1
Phosphor slag in streaming, salty surface water	V1

Construction materials placed into the categories N1 or N2

Masonry and mix aggregate	N2
Asphalt aggregate	N2
Sieve sand	N2
E fly ash	N2
MSWI bottom ash*	N2
MSWI bottom ash stabilisation	V2
Phosphor slag stabilisation	V2

Construction materials placed into category G

Sediments: Sand, Clay, Gravel, Loam, De-silted sea sand S(oil)	W

* = tested according to current certification demands or demands currently being developed.
W = construction materials indicated with a W may be applied in stagnant waters (of which the flow rate is less than approximately 25 m^3/s)

[27] The construction materials mentioned next are specified in the report "Definitions, application areas and environmental aspects of construction materials (Publication series Soil Protection 1991/I).]

Appendix 2 Belonging to the Building Materials Decree (oBB) soil and surface water protection, dated 26-6-1991

Values for **granular** construction materials in constructions which do not become soil

type of construction material :	Granular construction materials		
type of requirement:	leaching [2]		composition [3]
level:	U1	U2	S1
unit:	mg/kg	mg/kg	mg/kg
1. Metals			
Cr (chrome)	1.0	10	1250
Co (cobalt)	0.2	2	250
Ni (nickel)	0.35	4	250
Cu (copper)	0.35	4	375
Zn (zinc)	1.4	14	1250
As (arsenic)	0.3	3	375
Mo (molybdenum)	0.05	0.5	125
Cd (cadmium)	0.01	0.1	10
Sb (antimony)	0.03	0.3	50
Se (selenium)	0.02	0.2	50
Sn (tin)	0.2	2	250
Ba (barium)	4	40	7500
Hg (mercury)	0.005	0.05	5
Pb (lead)	0.8	8	1250
V (vanadium)	0.7	7	1250
2. Inorganic compounds			
F (fluoride)	5	50	4500
CN (free)	0.01	0.1	25
CN (complex)	0.05	0.5	125
SO_4 (sulphate)	750	10000	25000
Br (bromide)	0.2	2	500
Cl (chloride)	600	5000	5000
3. Aromatic compounds			
Benzene	-	-	-
Ethylbenzene	-	-	-
Toluene	-	-	-
Xylenes	-	-	-
Phenols	-	-	-
Aromates (total)	-	-	-
4. PAHs			
Naphthalene	-	-	-
Phenanthrene	-	-	-
Anthracene	-	-	-
Fluoranthene	-	-	-
Chrysene	-	-	-
Benzo(a)anthracene	-	-	-
Benzo(a)pyrene	-	-	-
Benzo(k)fluoranthene	-	-	-
Indeno(1,2,3cd)pyrene	-	-	-
Benzo(ghi)perylene	-	-	-
PAHs total(10 PAHs)	-	-	-
5. Remaining organic compounds			
PCBs total	-	-	-
EOCl total	-	-	-
Organochlorine pesticides (tot.)	-	-	-
Non-chlorine free pesticides (tot.)	-	-	-
Mineral oil	-	-	-

Legend:

1) = Concerning the method of testing according to the values and the margins of maximum excession which apply, the Ministers give further rules conforming with article 22 of the conceptual Act.

2) = Leaching measured with the column test (NEN 7343). These values concern the cumulative leaching, indicated in mg/kg construction material at L/S=10. (This is the total amount of a component which is collected during the steps of the test. The amount is determined seperately in each step. In total, 10 ml of water is percolated and collected per gram of construction material. L/S=Liquid/Solid.

3) = Values for metals, fluoride, bromide, and sulphate based on aqua regina destruction (NEN 6465).

Appendix 2 Continue.

Values for **prefabricated** construction materials in constructions which do not become soil

type of construction material :	**Prefabricated construction materials**		
type of requirement:	leaching [2]		composition [3]
level:	U1	U2	S1
unit:	mg/m²	mg/m²	mg/kg
1. Metals			
Cr (chrome)	90	450	2500
Co (cobalt)	15	75	500
Ni (nickel)	30	150	500
Cu (copper)	30	150	750
Zn (zinc)	125	625	2500
As (arsenic)	25	125	750
Mo (molybdenum)	4	20	250
Cd (cadmium)	0.7	3.5	20
Sb (antimony)	2.5	13	100
Se (selenium)	1.8	9	100
Sn (tin)	20	100	500
Ba (barium)	350	1750	15000
Hg (mercury)	0.3	1.5	10
Pb (lead)	75	375	2500
V (vanadium)	60	300	2500
2. Inorganic compounds			
F (fluoride)	440	2200	9000
CN (free)	0.9	4.5	50
CN (complex)	4.5	23	250
SO_4 (sulphate)	15000	45000	40000
Br (bromide)	20	100	1000
Cl (chloride)	2250	11250	-
4. PAHs			
Naphthalene	-	-	1
Phenanthrene	-	-	5
Anthracene	-	-	5
Fluoranthene	-	-	5
Chrysene	-	-	1
Benzo(a)anthracene	-	-	50
Benzo(a)pyrene	-	-	5
Benzo(k)fluoranthene	-	-	50
Indeno(1,2,3cd)pyrene	-	-	50
Benzo(ghi)perylene	-	-	50
PAHs total(10 PAHs)	-	-	50

Legend:

1)= Concerning the method of testing according to the values and the margins of maximum excession which apply, the Ministers give further rules conforming with article 22 of the conceptual Act.

2)= Leaching measured with the diffusion test (NEN 7345).
These values concern the cumulative leaching (diffusion) after a diffusiontest in 64 days. (This is the total amount of a component which is collected during the steps of the test. The amount is converted to the amount per surface unit of the construction material in the test.)

3)= Values for metals, fluoride, bromide, and sulphate based on aqua regina destruction (NEN 6465).

Appendix 2A Belonging to the Building Materials Decree (oBB) soil and surface water protection, dated 26-6-1991

Values for construction materials in constructions which become soil

type of construction material :	**Soil**
type of requirement:	composition [2]
level:	target value [3]
unit:	mg/kg
1. Metals	
Cr (chrome)	50 + 2Lu
Co (cobalt)	10 + 0.17Lu
Ni (nickel)	10 + Lu
Cu (copper)	15 + 0.6(Lu + Hu)
Zn (zinc)	50 + 1.5(2Lu + Hu)
As (arsenic)	15 + 0.4(Lu +Hu)
Mo (molybdenum)	5
Cd (cadmium)	0.4 + 0.007(Lu + 3Hu)
Sb (antimony)	2 + 0.02(Lu + 0.01Hu)
Se (selenium)	2
Sn (tin)	20
Ba (barium)	300 + 3.9Lu
Hg (mercury)	0.2 + 0.0017(2Lu + Hu)
Pb (lead)	50 + Lu +Hu
V (vanadium)	50 + 1.8Hu
2. Inorganic compounds	
F (fluoride)	175 + 13Lu
CN (free)	1
CN (complex)	5
SO_4 (sulphate)	500
Br (bromide)	20
Cl (chloride)	200
3. Aromatic compounds	
Benzene	0.05
Ethylbenzene	0.05
Toluene	0.05
Xylenes	0.05
Phenols	0.05
Aromates (total)	-
4. PAHs	
Naphthalene	0.01
Phenanthrene	0.1
Anthracene	0.1
Fluoranthene	0.1
Chrysene	0.01
Benzo(a)anthracene	1
Benzo(a)pyrene	0.1
Benzo(k)fluoranthene	1
Indeno(1,2,3cd)pyrene	1
Benzo(ghi)perylene	1
PAHs total(10 PAHs)	1
5. Remaining organic compounds	
PCBs total	0.01
EOCl total	0.1
Organochlorine pesticides (tot.)	0.01
Non-chlorine free pesticides (tot.)	0.01
Mineral oil	50

Legend:

1)= Concerning the method of testing according to the values and the margins of maximum excession which apply, the Ministers give further rules conforming with article 22 of the conceptual Act.

2)= Values for metals, fluoride, bromide, and sulphate based on aqua regina destruction (NEN 6465).

3)= Lu=lutum content in %; Hu= humus content in %.

Appendix 3 Short description of the standardized leaching tests

The tests are described in detail in NENs currently published conceptually, and which will be published shortly in a final form.

3.1 Column test for granular materials according to NEN 7343

The matrix (S kg, maximum particle size 4 mm) to be investigated is leached upflow with demineralized water acidized to pH=4 (HNO_3) in a column (diameter 5 cm, length 30-60 cm) (see figure 3.1.).

The acidized demineralized water simulates rainwater. The percolation water which leaves

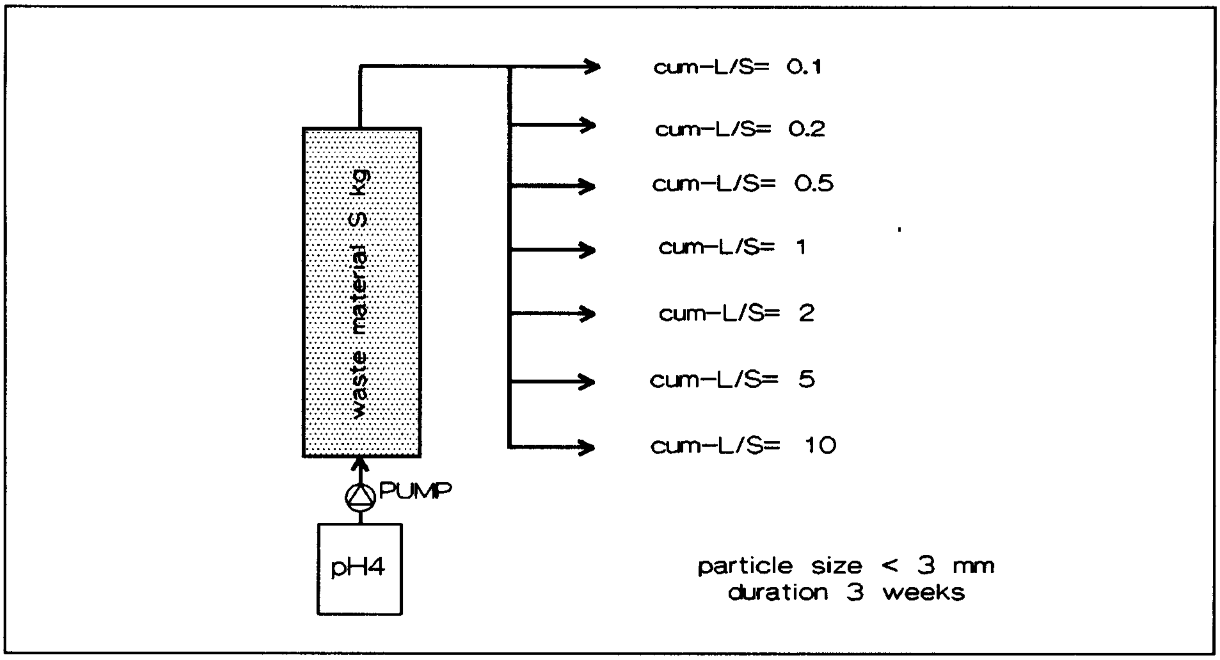

Figure 3.1 Column test

the column at a constant speed (approximately 0.5 L/S per day in L/kg), is filtered (0.45 µm) when leaving the column, and is gathered in fractions. The relationship L/S is a measure for the amount of percolation water (L liter) which has passed the column, filled with the S kg construction material, during a certain period of time, and is related to the leaching time in actual practice. After a cumulative L/S ratio of 0.1, 0.2, 0.5, 1, 2, 5, and 10 respectively is reached, a representative sample for analysis is taken from the fractions collected.

As soon as possible after the leaching, the pH and the conductivity is measured.

The percolate is then preserved and analysed. The column test is applicable for inorganic compounds. The cumulative emissions can be calculated with the following equation:

$$\textit{cum. emission columntest} = \sum_{i=1}^{n} conc.M_i * L_i/S \tag{3.1}$$

n = the number of the fraction
M_i = the material (Cd, for example)

The relationship between the L/S ratio and the actual time scale is reproduced in the following equation:

$$\textit{number of years} = \frac{L/S * h * Da}{P} \tag{3.2}$$

P = infiltration (m/year)
h = thickness of the layer (m)
Da = dry volume weight of the material to be investigated ($tons/m^3$)
L/S = Liquid-Solid ratio (l/kg)

3.2 Diffusion test for prefabricated construction materials according to NEN 7345

In a container, the material to be researched (minimum size of 40mm) is hung up or supported in such a way that water contact is assured on all sides. The container is then filled with demi water brought up to pH=4, of which the volume is 5 times that of the material. The fluid is refreshed at fixed times (0.25, 1, 2.25, 4, 9, 16, 36, and 64 days) and then analyzed.

From the analyses of the extracts, it can be deduced as to which mechanism determines the release of the individual components. The following leaching mechanisms can be distinguished: dissolving, flushing, and diffusion. Sometimes a combination of more than one mechanism occurs at the same time. For the prediction of the leaching behaviour on the long term, it is important to determine how much diffusion control there is.

If diffusion is the dominant mechanism, then from the test described here together with the availability test[28], a number of intrinsic parameters can be calculated with which the

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[28] The availability test according to NEN 7341 is made up of an extraction with a liquid/solid material relationship of 100 (l/kg) at a constant pH=4 (controlled). This test is modified in order to be able to measure better the availability of anions by, prior to leaching at pH=4, leaching the material at pH=7 (both a L/S=50, during 3 hours).

release of materials on the long term can be estimated. The calculated emission during 64 days is determined in the following way:

For each fraction where there is mention of a diffusion-controlled release, the effective diffusion coefficient (D_e) can be calculated with the following equation:

$$D_{e,i} = \frac{\pi * E_i^2(t)}{(E_{avail} * d_c) * (\sqrt{t_i} - \sqrt{t_{i-1}})^2} \qquad (3.3)$$

$D_{e.i.}$	=	effective diffusion coefficient of fraction i, in m^2/s;
$E_i(t)$	=	the emission in fraction i, in mg/m_3;
E_{avail}	=	the maximum content which is available for leaching, in mg/kg;
d_c	=	density of the construction material, in kg/m^3;
t_i	=	the contact time after fraction i, in s;
t_{i-1}	=	the contact time after fraction (i-1), in s.

With the help of the average D_e, the calculated emission during 64 days can be determined.

Appendix 4 Water balance of a construction

In the literature, the percolate production for an open application is predicted with the model below [52]:

$$P = N - R - E \tag{4.1}$$

P = percolate production (mm/yr).
N = 700 - 950 mm/yr; precipitation.
R = 0 - 75 mm/yr; run-off (not percolating rainwater; A = coeff*N; coeff. = 0.25-0.8, depending on the type of lining)
E = 200 - 450 mm/yr; evaporation

For The Netherlands, it can be calculated that the percolate production in an open construction will be between 250 and 350 mm/yr.

The average amount of precipitation in The Netherlands is approximately 700-950 mm/yr (N). The evaporation (E) of an uncovered construction is 200-450 mm/yr (covered >450 mm/yr) and the superficial drainage 0-75 mm/yr (R). The infiltration is estimated at 250-350 mm/yr.

Appendix 5 Data acquisition and processing

5.1 Data acquisition

For the comparison of construction materials with the standards, leaching and composition data was gathered.

The gathering of data took place by requesting reports or other information available from lab tests from the following parties involved:

* the National Institute of Public Health and the Environment in Bilthoven;
* the Directorate General for the Environment of the Ministry of Housing, Spatial Planning and the Environment in The Hague;
* various research institutes and advice bureaus;
* the industries

All the parties involved have given their cooperation in this gathering of information.

The construction materials for which data has been gathered, are those construction materials indicated in Appendix 1 of the oBB, in addition to various construction materials indicated in the Intron report 92002, at the request of CUR/CROW/NNI. The relevant construction materials are reproduced in appendix 16.

The relevant composition and leaching data gathered concerns the following lab tests:

* composition by way of aqua regina destruction (according to NEN 6465)
* leaching from granular construction materials by way of the column test (according to NEN 7343)
* leaching from prefabricated products by way of the diffusion test (according to NEN 7345).

The following data was also gathered for construction materials:

* composition by way of total-destruction. With conversion factors, the results of these lab tests are converted to composition by way of aqua regina destruction (see also chapter 10.2.1.) and included in the calculations made.
* leaching of granular construction materials by way of the cascade test. The results of this lab test are converted to column test results by extrapolating hand-made leaching graphs, and included in the calculations made (see also chapter 12.2.2.).

5.2 Selection of data

It was determined whether the given data met certain criteria for use in a comparison with the standard values. The following criteria were used:

General

* lab tests must be carried out according to the relevant NEN and NVN standards;
* there must be single measurements (no averages or ranges);
* the data must be supplied with the correct units or possibilities for conversion.

Composition with aqua regina and total-destruction

* the data must be supplied with the correct units (mg/kg).

Column test

* there must be a cumulative value in mg/kg, and/or
* 7 steps must have been carried out and stated in mg/l, including an L/S relationship in l/kg.

Cascade test

* 5 steps must have been carried out and stated in mg/l, including an L/S relationship in l/kg.

Diffusion test

* there must be a cumulative value in mg/m^2 after 64 days, and/or
* 8 steps must have been carried out and stated in mg/l, including the surface area of the test piece in m^2, the amount of liters of fluid used, and the times of the steps.

If data did not meet the requirements above, it was decided whether this could be solved by way of data from the report concerned. In several cases, this did not seem possible. But, because of the limited time available, no investigation was done of the researchers or publishers of the data.

5.3 Processing in the data base

The available and suitable data was entered into a data base. Per construction material, the following data was entered:

General

* the name of the construction material
* the origin of the construction material (country, place, factory)
* additions of secondary construction materials in percentages (for prefabricated construction materials)

Composition with aqua regina and total-destruction

* the measurement results in mg/kg

Column and cascade test

* the measurement results of the various steps in mg/l
* the cumulative lower and upper limit for the various steps in mg/kg (lower: with detection limit=0 and upper: detection limit=measurement result)
* the L/S relationship per step in l/kg

Diffusion test

* the measurement results of the various steps in mg/l
* the cumulative lower and upper limit for the various steps in mg/m^2 (lower: with detection limit=0 and upper: detection limit=measurement results).
* the time per step
* the surface area of the test piece in m^2
* the number of liters of water in l
* the diffusion coefficient

If lab tests are carried out in doubles, the measurement results are averaged and then entered. All the data is entered twice, after which the files are mathematically subtracted from eachother. There where the value was then smaller or greater than 0, the entering mistakes were corrected.

5.4 Calculations carried out

With the help of the data in the data base, calculations have been made per individual construction material of the following:

* the total number of tests entered (n) per parameter
* the average value for the parameter concerned
* the standard deviation of the average
* the minimum value of the parameter concerned
* the maximum value of the parameter concerned
* the categorization of the number of measurements into the various categories of the oBB standard values and the standard values determined by the RIVM (new standard values)
* the skewness of the division
* the kurtosis of the division

If more than 10 test results are available for a certain parameter, then the average, the standard deviation, the skewness and the kurtosis are calculated from the logarithms of the measurement values.
If the measurement results were below the detection limit, then the detection limit is used as measurement value.

5.5 Available information

The print-outs of the calculations are used for the evaluation per construction material in Part 2 of this report. The entire work method of gathering and processing data is described in the report "Data base data construction materials" [53]. The sources of the lab tests which were used are given in a separate literature file, which is included in the report "Literature file Data base Construction materials" [35].

Appendix 6 Comparison of aqua regina destruction with the total-destruction methods

Various construction materials from the Mammoth study are destroyed by the division Measuring Methods of the Lab for Waste Materials and Emission by way of an aqua regina destruction (NEN 6465). This destruction method is compared with the method for total contents used by ECN. These methods used by ECN were:

- neutron activation for As, Sb, and V
- destruction by a melt with $LiBO_4$ for Ba, Cr, and Ni
- bomb destruction with $HF/HNO_3/HClO_4$ for Cd, Cu and Zn
- bomb destruction with HF/H_2SO_4 for Se.

The construction materials used for this comparison are mentioned below.

Table 6.1. Construction materials which are used in the comparison.

Code	Type of construction material	Code	Type of construction material
AVSR, AVSA	MSWI bottom ash	MGOR, MGWR	Masonry aggregate
HSLY	Blast furnace slag	ZAKS	Sand
STSY	Steel slag	HSZA	Blast furnace slag sand
FFSV	Phosphor slag	MSBN, MSBB	Mine stone
AVVR, AVVA	MSWI fly ash	KLBN, KLBB	Clay
EVZ, EVB	E central fly ash	LAVA	Lavalite
BGOR, BGWR	Cement aggregate	VULS	Filling material (lime stone dust)
PCEM	Cement	KALK	Lime

In the tables following, the compositions (mg/kg) of the construction materials after aqua regina and total-destruction are given.

Appendix 6 Continue

Table 6.2. Comparison of the aqua regina destruction with the total-destruction methods

	As		Ba		Cd		Cr	
	Aqua regina	Total	Aqua regina	Total	Aqua regina	Total	Aqua regina	Total
Slags								
AVSR	6	19.4	891	1275	1.44	2	61	248
AVSA	6	20.3	845	1492	NA	7.8	66	296
HSLY	< 1	< 0.2	776	714	< 0.08	NA	140	135
STSY	1	1.1	353	354	< 0.08	0.1	1289	1290
FFSV	< 1	NA	151	163	0.19	0.2	34	40
Fly ashes								
AVVR	25	46	1680	1619	158	238	155	714
AVVA	25	47	719	1900	217	302	197	666
EVZ	36	56	748	1522	0.41	0.6	38	125
EVB	40	58	1968	1422	0.59	0.8	69	157
B&S waste								
BGOR	6	7.4	77	220	0.21	0.2	30	70
BGWR	4	6.6	81	242	0.13	0.1	42	95
MGOR	9	20.7	112	354	0.37	0.6	18	75
MGWR	9	12.6	65	290	0.27	0.3	28	66
Sand								
ZAKS	3	4.1	14	220	< 0.08	NA	< 11	17
HSZA	8	8.7	178	341	< 0.08	0.1	< 12	8
Natural products								
MSBN	21	45	30	396	0.75	0.9	< 12	115
MSBB	26	42	27	406	0.70	0.7	14	125
KLBB	9	18	71	309	0.17	0.3	27	118
KLBN	9	17	72	322	0.11	0.1	24	112
LAVA	< 1	1.9	328	1053	0.08	0.1	14	139
Lime-like								
VULS	< 1	6.5	61	156	0.17	0.2	14	41
KALK	4	1.4	33	30	0.10	0.1	< 11	4
PCEM	9	14.5	238	243	0.19	0.2	60	68

Appendix 6 Continue

Table 6.2 Continue

	Cu		Pb		Sb		Se	
	Aqua regina	Total	Aqua regina	Total	Aqua regina	Total	Aqua regina	Total
Slags								
AVSR	344	669	486	1086	14	27.8	< 2	0.5
AVSA	889	3212	783	1637	18	58.4	NA	0.3
HSLY	< 8	5	2	3	< 2	< 0.1	2	2.8
STSY	20	12	4	3	< 2	0.3	< 2	0.3
FFSV	< 8	4	< 2	2	< 2	0.2	< 2	1
Fly ashes								
AVVR	666	779	4111	6094	223	313	9	11.4
AVVA	570	647	3842	5936	258	361	NA	11.7
EVZ	95	187	30	90	6	9.2	20	20.4
EVB	61	159	31	92	8	11.2	NA	11.9
B&S waste								
BGOR	16	20	11	15	< 2	0.9	< 2	0.1
BGWR	18	21	12	13	< 2	0.7	NA	0.1
MGOR	8	24	36	137	< 2	1.7	NA	0.1
MGWR	32	23	88	317	< 2	1.1	< 2	0.1
Sand								
ZAKS	30	2	2	9	< 2	0.3	NA	< 0.1
HSZA	< 8	3	14	24	< 2	0.5	NA	NA
Natural products								
MSBN	54	60	31	52	< 2	2.2	NA	2
MSBB	43	66	35	47	< 2	1.8	< 2	1.3
KLBB	12	13	14	28	< 2	2.9	NA	1.4
KLBN	31	14	17	25	2	3.4	< 2	1.0
LAVA	49	58	< 2	9	< 2	< 0.1	< 2	0.1
Lime-like								
VULS	8	14	< 2	19	< 2	0.6	NA	0.1
KALK	< 8	4	13	2	< 2	0.4	NA	0.2
PCEM	20	32	5	5	3	4.8	< 2	0.4

Appendix 6 Continue

Table 6.2 Continue

	Ni		V		Zn	
	Aqua regina	Total	Aqua regina	Total	Aqua regina	Total
Slags						
AVSR	43	46	20	43	1212	1239
AVSA	60	86	30	52	1527	2125
HSLY	136	6.5	541	493	< 19	5
STSY	39	12.5	5345	5000	< 19	13
FFSV	< 8	3.5	24	25.5	< 19	11
Fly ashes						
AVVR	70	64	41	44.9	12757	14177
AVVA	101	114	34	31	13147	14864
EVZ	52	120	174	326	103	175
EVB	47	122	169	292	90	192
B&S waste						
BGOR	22	37	30	49	65	64
BGWR	39	47	41	63	51	58
MGOR	8	28	19	83	209	379
MGWR	10	29	27	61	215	256
Sand						
ZAKS	< 8	12	< 8	9.8	< 19	7
HSZA	9	11	< 8	< 5	35	41
Natural products						
MSBN	36	51	12	170	218	270
MSBB	55	59	NA	168	208	223
KLBB	16	34	31	131	27	45
KLBN	19	35	34	133	23	41
LAVA	40	88	141	311	31	98
Lime-like						
VULS	21	24	13	50	35	41
KALK	< 8	6.5	10	10.4	< 19	6
PCEM	28	32	77	88	108	120

Appendix 7 Categorization of construction materials into categories for conversion factors for the transformation of total-destruction to aqua regina destruction

The transformation factor is determined by the contents of a number of construction materials (primary and secondary) after destruction by way of aqua regina destruction, to be compared with those achieved after total-destruction (appendix 6). These construction materials are divided into 6 groups (see table 7.1) and a group unknown (7).

Tabel 7.1 Recoveries (%) for aqua regina destruction.

group	type of construction material	aqua regina/total*100%
1	slags and bottom-ashes	75 ± 16
2	fly-ashes	67 ± 15
3	construction (recycling) materials	61 ± 20
4	sand	68 ± 28
5	natural materials	53 ± 26
6	lime	82 ± 15
average		67 ± 9

For each group, the average transformation factor and the standard deviation are calculated from the aqua regina destruction compared to the total-destruction. The various construction materials are placed into a group (1-6) in table 7.2. Construction materials which cannot be placed into a certain group (group 7) are corrected with the average recovery.

Table 7.2 Recoveries per construction material, at the same time transformation factors for the conversion of total composition to the composition after aqua regina destruction.

group	recovery: aqua regina/total destruction in %	construction material	group	recovery: aqua regina/total destruction in %	construction material
SEDIMENTS					
5	52,8	Clay	7	67,5	* Quartzite
5	52,8	Loam	4	67,7	* Sand stone
4	67,7	Gravel	4	67,7	* Basalt
4	67,7	Natural sand	4	67,7	* Granite
4	67,7	* De-silted sea sand	7	67,5	* Porfier
		Quarry stone	4	67,7	* Flug sand
6	82	* Lime stone	5	52,8	Lava stone
PRODUCTS					
3	60,8	Cement concrete	7	67,5	Asphalt cement
		with cleaned soil			with asphalt aggregate (non-tar containing)
		with lava			with breaker sand
		with certified cement aggregate			with LD slag
		with certified mix aggregate			with phosphor slag
		with certified masonry aggregate			with Jarosite end slag
		with breaker sand			with MSWI fly ash
					with artificial aggregates
		with blast furnace slag			with E fly ash
		with LD slag			with E bottom ash
		with phosphor slag			with E fly ash
		with Jarosite end slag	3	60,8	mortar
		with copper slag			with E fly ash
		with MSWI bottom ash			with breaker sand

group	recovery: aqua regina/total destruction in %	construction material	group	recovery: aqua regina/total destruction in %	construction material
3	60,8	with artificial aggregates with E fly ash	7	67,5	Rough ceramic products
		with E fly ash			with E fly ash
		with E fly ash (in portland cement)	3	60,8	Concrete products
		with E bottom ash			with E fly ash
					with MSWI fly ash
					with MSWI bottom ash
			3	60,8	Brick
					with E fly ash
			3	60,8	Aerated concrete
					with E fly ash
STABILIZORS					
3	60,8	Sand bentonite	1	74,5	Hydraulic mix aggregate (mix aggregate with steel slag (ELO))
		with sieve sand	1	74,5	Lightly stabilised phosphor slag (phosphor slag with aggregated blast furnace slag sand)
3	60,8	Sand cement stabilization	1	74,5	Lightly stabilised steel slags (steel slag with granulated blast furnace slag or blast furnace slag sand)
		with sieve sand	1	74,5	stabilised MSWI bottom ash
		with cleaned soil			with RO gypsum
		with E fly ash			with E fly ash
		with E fly ash in portland cement			with E fly ash in portland cement
7	67,5	Crushed asphalt cement	1	74,5	with fluid bed fly ash
7	67,5	Asphalt aggregate			with breaker sand
		with asphalt aggregate (tar-containing)	2	66,9	Lightly stabilised E fly ash
		with breaker sand			with breaker sand
1	74,5	Blast furnace slag mix			
		with blast furnace slag			

group	recovery: aqua regina/total destruction in %	construction material	group	recovery: aqua regina/total destruction in %	construction material
		with granulated blast furnace slag			
		with blast furnace slag sand			
		with LD slag			
CONSTRUCTION AND DEMOLITION WASTE					
3	60,8	Cement aggregate	3	60,8	Mix aggregate
		* certified			* certified
		* not certified			* not certified
3	60,8	Masonry aggregate	3	60,8	Sieve sand
		* certified	3	60,8	Breaker sand
		* non certified	7	67,5	Construction and demolition waste unspecified
REMAINING MATERIAL					
7	67,5	Smoke gas desulphurizing gypsum	5	52,8	Mine stone
7	67,5	Phosphor acid gypsum			* Red (burnt)
					* Black (unburnt)
ASHES AND SIAGS					
2	66,9	E fly ash	2	66,9	MSWI fly ash
1	74,5	E bottom ash	1	74,5	Blast furnace slag
		* certified	1	74,5	Blast furnace aerated slag
		* non certified	1	74,5	Granulated blast furnace slag
2	66,9	fluid bed fly ash	1	74,5	Blast furnace slag sand
1	74,5	fluid bed bottom ash	1	74,5	Jarosite end slag
1	74,5	Gassing bottom ash	1	74,5	LD slag

Appendix 8 Statistical handling of the data[29]

1. Introduction

The normal distribution is a mathematical conception; an exact normal distribution is never found in reality. Many values have a distribution which differs from the normal distribution in relatively unimportant measure. Other values appear to come close to the normal distribution after a (logarithmic) transformation. In this study, it is calculated which part of the population (assuming a normal distribution) exceeds a certain standard value. This chance is called the tail probability P. When a value of which the distribution is not known is being investigated, the number of observations from a sample check which exceed a certain standard value can be counted. The sample check now follows a binomial distribution. This binomial distribution (dichotomy) is also used in this study to calculate the tail probability. In a binomial distribution, the measure of excession of the standard value is not taken into account, only whether an excession has taken place, no matter how small. Accepting the normal distribution, then this is the case, because a very large distribution has less chance to occur than a small distribution; the form of the distribution is known, that is, symmetrical around the average μ_x, and the width of the distribution is determined by the spreading σ_x.

The average, the spreading and the form of the distribution are all used in the calculation of the tail probability P. Because of the extra assumption of the acceptance of a normal distribution, a relatively smaller number of observations will be necessary to achieve an equal reliability in comparison with the equal reliability under the assumption of a binomial distribution. For large sample checks, the normal distribution is approached by way of the binomial distribution, the statistic approach is then of lesser importance. When assuming the normal distribution, however, it is important to be alert for the obvious distributions of the normal distribution because that is when incorrect results are achieved.

One-peaked distributions which are approximately symmetrical, but more pointed or more flatter than the normal distribution can often be approached sucessfully through a normal

[29] The making of a testing protocol took place under the close supervision of Mrs. M. van de Bol (ITI-TNO)

distribution. For crooked distributions, the approach is usually slower. Peaks in the same direction delay the approach the most. The possibility of indicating peaks or a distribution positively, is small for a small population ($n<11$) because in the testing of both, n is taken into account. With a small n, a peak must be a very large peak if it is to be seen as significant, while with a small population a peak has a large influence on the average and the standard deviation.

2. Testing of the distribution

If there is a sample check of n independent measurements χ_i of the random variable x, the hypothesis that the population frequency follows the normal distribution can be tested. Normally μ_x and the spreading σ_x must be estimated.

On the basis of a sample check, it is possible to determine definitely that a distribution is distributed normally. In the best case, it is possible to indicate that a distribution is not normal. In this report, the nature of the distribution is researched on the basis of the moment of the distribution, that is, the kurtosis and the skewness.

$$skewness = m_3/m_2^{3/2} \quad \text{inwhich} \quad m_r = \sum_{i=1}^{n} \frac{(x_i - \bar{x})^r}{n} \tag{7}$$

$$kurtosis = \frac{\sum_{i=1}^{n} |x_i - \bar{x}|}{\{n * \sum_{i=1}^{n} (x_i - \bar{x})^2\}^{1/2}} \tag{8}$$

These moments are compared with the expected moment of the normal distribution. For the skewness, the expectation with a normal distribution is zero, for the kurtosis 0.7979. The confidence interval of the expectation can be found in the tables.

3. Testing under acceptance of a normal distribution

The normal distribution is a chance distribution of a continuously stochatic value $\underline{x}$ which can take on an endless number of values from $-\infty$ to $+\infty$. The normal distribution is specified by an equation in which its mathematical average μ_x and its spreading σ_x occur $(N(\mu_x,\sigma_x))$.

The normally distributed value $\underline{x}$ can be converted in a standard normally distributed value by way of standardization.

$$\underline{T} = \frac{(\underline{x} - \mu_x)}{\sigma_x} \tag{9}$$

Each normal distribution becomes a standard normal distribution by standardization $((N(0,1))$. To calculate the chance of an excession of a standard value, the standard value must also be standardized with average 0 and spreading 1. The standard normal distribution is also a continuous chance distribution. If

$$\underline{T}_N = \frac{(N - \mu_x)}{\sigma_x} \tag{10}$$

in which N is the standard value. The chance which belongs to the interval $(-\infty, T_n)$ is called the left tail probability and the chance belonging to the interval $(T_n, +\infty)$ is called the right tail probability. The chances are even with the size of the surface area which is determined by the ordinate in T_n and the standard normal curve. The surface area and therefore the chance can be determined with the help of the tables containing the chances of the standard normally distributed value $\underline{T}$.

The calculation of the fraction of a measurement data population χ_o with a value greater than a standard value N is as follows. Consider a measurement data population of a construction material of which each element (measurement data) has a value of x and suppose that this value on the population is normally distributed by the average μ_x and spreading σ_x. One takes from this population a random sample check with size n.

With many actual practice problems, there is no hypothesis concerning the value of the parameters of the population distribution which is being studied. It is then necessary to estimate the values μ_x and σ_x as well as possible from a random chosen sample check by the average and the standard deviation.

$$s = \sqrt{\frac{1}{(n-1)}\sum_{i=1}^{n}(x_i - \bar{x})^2} \tag{11}$$

With the help of these values, first the value T can be calculated [54]:

$$T = -(\frac{\bar{x} - N}{s}) * \frac{\sqrt{n}}{(n-1)} \tag{12}$$

The tail probability then becomes

$$\begin{aligned} \hat{P} &= P\{\underline{T} < \frac{T\sqrt{n-2}}{\sqrt{1-T^2}}\} \quad for\ -1 < T < 1 \\ \hat{P} &= 0 \quad for\ T \leq -1 \\ \hat{P} &= 1 \quad for\ T \geq 1 \end{aligned} \tag{13}$$

The value $\underline{T}$ has a Student-t distribution with n-2 degrees of freedom. The fraction which exceeds the standard value is achieved from the tables for the Student-t distribution. For the fraction P, a confidence interval 100*(1-a)% can be calculated. In this study, a 95% reliability is used. P has a normal distribution. For the calculation of the confidence interval, the work method is as follows.

$$\begin{aligned} T_l &= k - \frac{N(0,1)_{1-0.5\alpha}}{\sqrt{2n}} * \sqrt{k^2+2} \\ T_r &= k + \frac{N(0,1)_{1-0.5\alpha}}{\sqrt{2n}} * \sqrt{k^2+2} \\ with\ k &= \frac{\bar{x} - N}{s} \wedge n > 2 \end{aligned} \tag{14}$$

the lower limit P_l and the upper limit P_r for T_l and T_r respectively can be found in the table of chance values for the standard normally distributed value $\underline{T}$. For a two-sided 95% confidence interval, N(0,1)0.975=1.96.

4. The influence of the peaks and testing

Before calculating the average, the spreading and the tail probabilities, testing the assumption that the sample check originates from a normal distribution is of importance. For a relatively small amount of observations, as is sometimes the case in this study, one could assume that a distribution is normal by definition. The normal pattern can be disturbed by outliers. These can be traced through an outlier test for an extreme outlier in a sample check originating from a normal distribution with an average μ_x and spreading σ_x unknown. This test is described by Barnett [55].

$$T = \max \left(\frac{x_n - \bar{x}}{s} , \frac{\bar{x} - x_1}{s} \right) \tag{15}$$

If it can be determined by $p<0.05$ that a peak is present, this is removed. Then the average, the standard deviation and the tail probabilities are calculated again as follows.

$$\bar{x}_c = \frac{n * \bar{x}_o - x_u}{n-1}$$

$$s_c = \sqrt{\frac{(n-1) * s_o^2 + n * \bar{x}_o^2 - x_u^2 - (n-1) * \bar{x}_c^2}{n-2}} \tag{16}$$

in which the subscripts c and o refer to corrected and uncorrected statistical values respectively. n is the number of observations which belongs with the uncorrected values, and x is the outlier. When there are several outliers, these can be removed sequentially.

5. Calculation of the tail probabilities in case the distribution is not known

In this study, an estimation is also given of the fraction P of the analysis results (composition or leaching) originating from a population whose analysis results have a certain χ_o characteristic (in this report an excession of a standard value; dichotomy).

The analysis results gathered by the RIVM (number n) are assumed by a random method (sample check) from a sample of analysis results of the composition or the leaching measured from construction materials. The fraction $\rho_o = \chi_{o/n}$ in which n is the number of observations and χ_o the number of observations which are above the standard value, now

appears to be the most likely estimation of the unknown value P. Instead of giving a value as an estimation for P, it is more informative to give an estimation interval for P (confidence interval) with a left limit p_l and a right limit p_r. For this interval it is valid that, with a chance at the most equal to the reliability coefficient α, this value does not contain P. Although statistically not entirely correct, there is therefore a $100(1-\alpha)\%$ chance that the interval contains P. The testing was done for excession and not for below-limit. The confidence interval is achieved by testing an hypothesis H_o. At the testing of the hypothesis H_o, the choice of α is based on the consequence of the wrongly rejection of H_o.
The choice of the confidence interval $1-\alpha$ is therefore dependent on the question of how important it is thought to be that the interval does contain the parameter. By increasing the size of the sample check, the estimation interval becomes smaller with a certain reliability coefficient. The reverse is also true: with a small spot-check size and a certain reliability coefficient, the interval becomes larger. In this report, the regular confidence interval of 95% is chosen.
For the calculation of the reliability limits of the fraction P, approach equations are available, as well as tables with exact values. Especially if P is close to 0 or 1 and/or if n is small, it is better to look up the reliability limits in a table containing the exact chances for $n > 1$. For samples up to and including $n = 10$, the exact values are looked up in tables [56]. Above $n = 10$, a difference is made between confidence intervals around $P < 0.1$ and $P > 0.9$, and those around P values between $0.1 < P < 0.9$.
The first ones are calculated with a Poisson approach:

$$\begin{gathered}
if\ \frac{x}{n}<0.1 \\
p_l = 0\ if\ x = 0 \\
p_l = \frac{\chi_l^2}{2*n} \wedge p_r = \frac{\chi_r^2}{2*n}\ if\ x > 0;\ \nu_l = 2*x \wedge \nu_r = 2*(x+1) \\
if\ \frac{x}{n}>0.9 \\
p_l = 1 - \frac{\chi_l^2}{2*n} \wedge p_r = 1 - \frac{\chi_r^2}{2*n}\ if\ x < n;\ \nu_l = 2*(n-x) \wedge \nu_r = 2*(n-x+1) \\
p_b = 1\ if\ x = n \\
\textit{of which } \nu \textit{ is the number of degrees of freedom}
\end{gathered} \tag{17}$$

and the last one (0.1 > P > 0.9) is calculated with the approach according to Molenaar:

$$\begin{gathered}
for\ n > 10\ en\ 0.1 \le \frac{x}{n} \le 0.9 \\
p_l = \frac{x - 1 + v - t * \sqrt{\dfrac{(x-w)*(n+1-x-w)}{n+11*w-4}}}{n+2*v-1} \\
p_r = \frac{x + v + t * \sqrt{\dfrac{(x+1-w)*(n-x-w)}{n+11*w-4}}}{n+2*v-1} \\
inwhich\ v = \frac{t^2+2}{3} \wedge w = \frac{7-t^2}{18} \\
inwhich\ t_{95\%} = 1.96
\end{gathered} \tag{18}$$

All the calculations are described in NEN 1047 [57]. The approaches are tested with exact values. This showed that in the critical areas (low n and a very small or very large P), less than 2% difference is seen in view of the exact values.

Appendix 9 Masonry and cement aggregate as gravel substitute in concrete

As a rough supplement material in concrete, gravel is the most used material in The Netherlands. The winnable gravel stocks in The Netherlands, however, are becoming smaller and smaller, and the government policy for the winning of river gravel is geared towards decreasing on the long term, partly due to the pressure of social resistance because of the extreme effects on the landscape. It is therefore to be expected that the cost price of river gravel will increase in the near future.

An intensive search for alternatives for gravel in concrete is underway, and many secondary raw materials are candidates.

The question is which one of these alternatives is the most likely candidate. How much of this material is there, and is the concrete market also large enough to take up that amount? These issues are dealt with in this article.

Amounts of concrete mortar

In The Netherlands, concrete is traditionally made up of gravel as rough supplementary material, sand as fine supplementary material, cement as bonding agent, and water as activator for the bonding agent. The application of concrete can be sub-distributed into two large groups, namely as concrete mortar, and as concrete blocks. The application area of concrete blocks is not handled in this article because the diversity of products results in many and sometimes very specific product requirements.

When this article speaks about concrete, concrete mortar is meant. The amount of concrete mortar (this is not-yet-hardened concrete) which is processed annually in The Netherlands is approximately 8 million m^3 [58].

This amount, distributed among several sectors, results in the following:

Table 1
Survey of the application of concrete mortar in The Netherlands in 1989 (in million m³) [58]

Sectors	Amounts
Housing construction	2.94
Utility construction	2.87
Agrarian sector	1.27
Road construction	0.33
Water construction	0.29
Concrete blocks	0.12*
Various	0.13
Total	**7.95**

* This is exclusively the amount of mortar which is delivered by the concrete mortar industry to the concrete blocks sector. The size of the market for the concrete blocks is much larger but is served by own production units.

Based on these amounts, it can be stated that 80% of the concrete mortar is applied in housing construction, utility construction, and the Road/waterway construction sector. The higher environment class which is often demanded in the agrarian sector, and the relatively small volume of the remaining sectors, have lead to the fact that these are not included in this article.

Concrete qualities

Depending on the type of application, concrete mortar will be stated in a strength class. The market for concrete mortar described before as it has been sketched and stated in strength classes, looks like this.

Table 2
Use of concrete mortar according to strength class in 1990 (in %) [58]

Class	%
B15	12
B25	79
B35	8
Others	1

90% of the total concrete mortar applications, therefore, is in the strength classes of B15 and B25.

secondary raw materials

A number of secondary raw materials are possibly candidates for the replacement of gravel as rough supplement material in concrete. One can think of:

- blast furnace slags
- steel slags
- MSWI slags
- masonry and cement aggregate
- artificially achieved aggregate materials from various secondary raw materials such as MSWI fly ash, powder coal fly ash, etc.

Each of these raw materials, of course, has its own specific physical and chemical characteristics, so that the one is more suitable than the other to replace gravel in concrete. It is not the intention here to make comparisons between these secondary raw materials based on their pros and cons. If one regards these materials from the viewpoint of the quantitative closing of the recycling circle, it is quickly apparent that in the previous list of secondary raw materials, only 1 product arises in "the construction", this being masonry and cement aggregate. From the viewpoint of "recycling and chain control", this raw material will be looked at.

Masonry and cement aggregate

In 1990 in The Netherlands, there was an amount of 12.2 million tons of construction and demolition waste [59] (excluding sieve sand). 95% of this amount of construction and demolition waste is stone-like material, and 75% if asphalt is excluded. Not everything is offered at the processing centres, which make use of construction and demolition waste aggregates, while another part which is offered is not usable for re-use. The aggregate available for re-use was 6.4 million tons in 1990 (excluding crushed asphalt).

The government has drawn up a policy in the Notice Concerning Prevention and Re-use of Waste Materials [60], in which it is stated that in the year 2000, 80% of the construction and demolition waste must be re-used.

In the prognosis of the amount of aggregates in table 3, it is accepted that these amounts must be minimally 80% of the stone-like material.

Table 3
Prognosis of the amounts of construction and demolition waste [59] and the possibility of making aggregate from this according to the 80% task statement (in million tons)

	1990	2000	2010
Construction and demolition waste	12.2	13.7	15.3
Stone-like material*	9.2	10.3	11.5
Aggregates	6.4**	8.2	9.2

* These amounts of stone-like material exclude asphalt, and are therefore 75% of the amount of construction and demolition waste.
** This amount is taken from the 1990 survey done by the Interest Group for Recycling and Demolition Waste (BRBS)

Scenario for 2000 and 2010

In order to be able to carry out any mathematical excercises, at the RIVM, several scenarios are worked out in a background document [61], on the basis of which the following calculations have been made.

Table 4
Prognosis of the expected use of concrete mortar in several sectors (in million m^3) [61]

Sectors	2000	2010
New housing construction	1.5	1.2
New utility construction	4.0	4.8
Road/waterway sector	1.0	1.1
Total	**6.5**	**7.1**

* The possibility that in the future, the concrete contribution can change in the sectors, is not taken into consideration.

According to Table 2, in the entire construction industry, approximately 79% of the concrete is applied in strength class B25, and approximately 12% in strength class B15.
In the table following, it is accepted that this distribution is equal in all the application sectors. This results in the following:

Table 5
Prognosis of the necessary amounts of concrete, according to sectors and strength classes (in m³ x 1,000)

Sectors	B15 2000	B25 2000	Total 2000	B15 2010	B25 2010	Total 2010
Housing construction	180	1,185	1,365	144	948	1,092
Utility construction	480	3,160	3,640	576	3,792	4,368
Road/waterway construction	120	790	910	130	870	1,000
Total	**780**	**5,135**	**5,915**	**850**	**5,610**	**6,460**

If in these amounts of concrete, 1,100 kg per m³ is assumed, then the following results:

Table 6
Prognosis of the necessary amount of gravel as rough supplement material in concrete, according to sectors and strength classes (in tons x 1,000)

Sectors	B15 2000	B25 2000	Total 2000	B15 2010	B25 2010	Total 2010
Housing construction	200	1,300	1,500	160	1,040	1,200
Utility construction	530	3,470	4,000	630	4,170	4,800
Road/waterway construction	130	870	1000	140	960	1,100
Total	**860**	**5,640**	**6,500**	**930**	**6,170**	**7,100**

Replacement of gravel by masonry and cement aggregate

In theory, it is possible to replace 100% of the concrete in the B15 strength class application area with, for example, masonry aggregate, cement aggregate, or a mix of these. Keeping in mind special construction parts or constructions whereby the application of gravel is desirable or necessary, a gravel replacement of 80 to 90% can be calculated without any risks.

From research done by Task Force 2 'Demolition aggregates' of the CUR Committee B38 'Application of alternative materials in concrete', it appeared that in the application area of the strength class B25, gravel can be replaced for 20% by masonry aggregate without a reduction in strength.

It is also possible to replace gravel 100% with masonry aggregate if in the calculation an extra construction height of 10% is used. Also, if the calculation values for concrete constructions, which are currently based on classic raw materials and a number of givens

and/or over-values which certainly are not always necessary, would be adapted, then percentages higher than the 20% gravel replacement mentioned before are very likely. As a first step, for B25 a gravel replacement of 40 to 60% is realizable over time.
In view of the fact that approximately 90% of the concrete market is found in the strength classes B15 and B25, the other application areas are not taken into consideration for pragmatic reasons.

Based on the data in table 6 and the expectation percentages mentioned before, the following amounts of aggregate could be sold on the concrete market.

Table 7
Prognosis for aggregates as gravel replacement in concrete (in tons x 1,000)

	Gravel		Replacement percentage	Aggregate	
	2000	2010		2000	2010
B15	860	930	85	730	790
B25	5,640	6,170	50	2,820	3,085
Total	**6,500**	**7,100**		**3,550**	**3,875**

Together with the "Sustainable construction" attitude according to the governments policy, it is necessary to give preference to the most high-grade application. This means that there must be a striving to let the application of aggregate as gravel replacement in concrete prevail above applications as stone road base material for the construction of roads. This, applied to the numbers from tables 3 and 7, results in the following:

Table 8
The most favorable distribution between aggregate as gravel replacement in concrete mortar and stone road base material in road construction (in million tons)

	1990	2000	2010
Available aggregate	6.4	8.2	9.2
Gravel replacement	-	3.6	3.9
Road construction	6.4	4.6	5.3

<u>Conclusions</u>

Based on the previous calculations and the applied priorities, the following appears:

- that gravel replacement in concrete mortar can be completely covered by the application of masonry and cement aggregates.
- that the remaining amount of aggregate is large enough to also be able to meet a large part of the current known demand for road base material for the construction of roads (see table 8)
- that the application of other secondary raw materials as gravel replacement in these sectors is not necessary or for a part not even desirable.
- that if this viewpoint gains ground on the market, less application possibilities in the construction for a part of the other secondary raw materials, named in this article, must be kept in mind.
- that if, according to expectation, only limited application possibilities remain for various secondary raw materials, it must be researched for how much of these secondary raw materials an application is available, or that final processing on a deposit is the last possibility.
- that if it should appear that final processing on a deposit is the only remaining possibility, sufficient capacity must be pre-available on time.

Appendix 10 Analysis costs for the inspection of construction materials

The table shows rates excluding VAT, taken from the rate statements from various labs (1 rate statement 1992, 2 statements taken from 1991 rates, and 1 statement taken from 1988 rates). For a clear survey, the rates are averaged. The highest and lowest rates are placed into a table to show that the labs differ substantially among eachother, despite their working according to the same standards. For large amounts of analyses and for urgent analyses there are other rates, with reduction and supplement respectively. These are not included in the table.

Table 10.1. Analysis rates for (an)organic compounds.

compound	average rate '92 /element	standard	comment
Cr, Co, Ni, Cu, As, Mo, Cd, Sb, Se, Sn, Ba, Pb, V	f 45	NEN 64xx	with GFAAS
Cr, Co, Ni, Cu, Zn, Mo, Cd, Sn, Ba, Pb, V	f 30	NEN 64xx	with Flame/ICP
As	f 100	own regulations	with standard addition
As-Sb-Se	f 50	no specification	with hydride technique
Hg	f 70	own regulations	with cold vapour AAS
Hg	f 40	NEN 6449/6445	none
Hg	f 40	NEN 6438	none
inorganic components			
Bromide	f 120	no specification	none
Chloride	f 60	NEN 6470	none
Cyanide total free	f 95	SM 413 H EPA 335.3	none
Cyanide total complex	f 90	NEN 6489 VPR C85.05	none
Fluoride total	f 80	NEN 6483	none

compound	average rate '92 /element	standard	comment
Sulphate	f 75	-	none
organic components			
BETX	f 180	VPR C85-10	GLC/FID
BETX	f 180	no specification	Purge and Trap
Phenols	f 80	NEN 6670	Fenol index
Phenols	f 300	no specification	EPA-series
Aromates (total)	f 260	VPR C85-10	none
PAHs (10 VROM)	f 275	VPR C85-11	none
PCBs total	f 380	no specification	incl. extraction
EOCl total	f 145	VPR C85-15	incl. extraction
Mineral oil	f 195	VPR C85-19	GC
Organochlorine pesticide	f 295	VPR C85-16	none
Chloride-free pesticide	f 525	VPR C85-17/18	none

methods	average rate '92	standard	comments
sampling	PM		PM
sample preparation	f 195	NEN 5751, own regulations	excl. dividing 2)
aqua regina destruction	f 50	NEN 6465	none
column test	f 620	NEN 7343	excl. analysis
diffusion test	f 525	NEN 7345	excl. analysis
availability test	f 280	NEN 7341	excl. analysis

1) including grinding and filtration
2) distribution cost f. 50,-

Appendix 11 Definitions of researched construction materials

Construction material	Definition	Additions
Asphalt aggregate	broken or milled asphalt concrete	tar
MSWI bottom ash	fixed residue created by burning - equalized rough waste or industrial waste materials which may be burnt together with domestic waste in MSWIs, fly ashes excepted.	tar
MSWI fly ash	burning residues created by burning domestic waste, equalized waste or industrial waste materials which may be burned together with domestic waste in MSWIs, and are carried with the smoke gasses due to their minute measurements	none
Cement aggregate	aggregate achieved through selective demolition and proper processing of concrete rubble and concrete blocks and construction and demolition waste processing centre.	none
Crushed asphalt cement	material existing of a mix of natural sand, asphalt aggregate, cement, and water.	breaker sand, asphalt aggregate and cement types.
Breaker sand	loose material existing of mineral particles, with a grain size being mostly between 63 µm and 2 mm, created by the breaking of natural materials.	none
Cement concrete	hardened or unhardened mixture of rough and fine supplement materials, cement, water and possibly help and/or fill materials.	natural sand, breaker sand, cleaned soil, gravel, stone, mine stone, lava, cement aggregate, mix aggregate, masonry aggregate, recycling breaker sand, LD slag, phosphor slag, jarosite slag, copper slag, E-bottom ash, MSWI slag, powder coal fly ash aggregates, expanded clay aggregates, silicafume, powder coal fly ash, and fluid bed fly ash.
Chrome slag	stone-like material which is released at the production of chrome	none
E-bottom ash	brown to black colored material existing of "heavy" ash particles which are formed during the burning process in powder coal fuelled power stations.	none
ELO slag	steel slags which are released at the preparation of non-alloyed carbon steel according to the electro-oven procedure	none
Flug sand	Fine granular material of volcanic origin, existing of porous grains of minute density.	none
Phosphor slag	slags released at the electro thermal destruction of phosphor from phosphate ore.	granulated blast furnace slag.
Phosphor acid gypsum	waste material product which is created at the release of phosphor acid, raw material for the manure industry, from phosphate ore.	none
Aerated concrete	artificial stone with a bonding based on calcium silicate hydrates, made from a mix of cement and/or lime and finely ground or fine-granular silicic acid containing materials and an addition of gas-forming products and water.	cement types, lime, natural sand, powder coal fly ash, gypsum, materials containing quartz, (natural) and gas-forming products.
Stabilised MSWI bottom ash	existing of a mix of MSWI sludge, a hydraulic stabilising agent, and water.	cement types, lime, natural sand, breaker sand, powder coal and fluid bed fly ash, and RO-gypsum.

Construction material	Definition	Additions
Stabilised powder coal fly ash	mixture of powder coal fly ash, a stabilising agent and water, possibly with a supplement material and/or help materials.	powder coal fly ash, natural sand, breaker sand, recycling breaker sand, gravel, stone, quarry stone, cement types, lime, and gypsum.
Granulated blast furnace slag	blast furnace slag achieved by granulating blast furnace slag	none
Cleaned soil	a product which is released at the thermal, chemical, or biological cleaning of polluted soil by soil cleaning projects.	none
Gravel	loose deposition stone made of stone grains of natural origin with grain size between 2 and 63 mm.	none
Quarry stone	material achieved by the breaking of stone-formations	none
Rough ceramic material	artificial stone, achieved by baking, largely existing of clay.	natural clay, natural sand, breaker sand, recycling breaker sand, powder coal fly ash, mining stone, coloring materials, chamotte, light weight supplement materials.
Blast furnace slag mix	made up of crushed slag, created during the preparation of rough iron in a blast furnace, mixed or not mixed with granulated blast furnace slag of at the most 25% crushed steel slag, created during the preparation of steel from rough iron.	none
Blast furnace slag sand	made up of granulated or crushed blast furnace slag, created during the preparation of rough iron in a blast furnace.	none
Blast furnace slag	made up of crushed blast furnace slag, created during the preparation of rough iron in a blast furnace.	none
Hydraulic mix aggregate	mix of mix aggregate and steel slag	none
Jarosite end slag	stone-like material which is created during the sludging of jarosite, a waste material which is released during the making of zinc.	none
Calcium-silicate bricks and blocks	material with a bonding based on calcium silicate hydrates, made of a mixture of extinguished lime and a quartz-containing material, achieved by hardening of closed forms under the influence of high-pressure steam.	fluid bed fly ash, powder coal fly ash, lightweight supplement materials and help materials.
Copper slag	slags created during the preparation of copper from copper ore.	none
Lava stone	broken porous stone of eruptive origin	none
LD slag	steel slags which are released during the preparation of steel according to the Linz-Donawitz method.	none
Loam	strongly connected, fine-granular soil type, existing of a mixture of loam, sand, and lutum.	none
Mix aggregate	mixture of cement and masonry aggregate whereby the contribution of cement aggregate is at least 45%.	none
Masonry aggregate	aggregate achieved by selective demolition and the adequate processing of masonry rubble in a construction and demolition waste processing centre.	none

Construction material	Definition	Additions
Mortar	hardened or unhardened mixture of fine supplement material, bonding agent(s) and water, with or without the addition of help materials.	cement types, lime, natural sand, breaker sand, recycling breaker sand, powder coal fly ash, silicafume, coloring materials, help materials, and polymeres.
Natural clay	strongly connected, fine-granular soil type which exists of a mixture of lutum, loam and sand.	none
Natural sand	loose deposition stone made of mineral particles with a grain size lying mostly between 63 µm and 2 mm, of which the composition and nature can vary greatly.	none
Powder coal fly ash	fine powder which mainly exists of round glass-like particles (mostly SiO_2 and Al_2O_3)	none
Red mine stone	created by on-site burning of (black) mine stone mountains	none
Smoke gas desulphurizing gypsum (RO-gypsum)	gypsum which is created at the desulphurizing of the smoke gasses of electricity stations according to the lime stone gypsum process.	none
Foam slag	with the help of water and steam, foamed blast furnace slag, created at the preparation of rough iron in a blast furnace.	none
Fluid bed bottom ash	rough-granular material mainly consisting of gypsum, lime, and calcium carbonate which stays behind in powder coal fuelled fluid bed burning installations.	none
Fluid bed fly ash	fine powder mainly made of round particle, carbon, gypsum, lime and calcium carbonate and which is seperated out of smoke gasses from powder coal fuelled fluid bed burning installations.	none
Sand bentonite	mix of granular material, bentonite, and water	none
Sand cement	mix of sand, cement, and water.	cement types, natural sand, gravel, powder coal fly ash
Sieve sand	fine-granular, mainly natural material, which is released when construction and demolition waste undergo a first round of sieving, before the material is lead into the breaker.	none
Black mine stone	stone which is released with the winning of coal.	none
Bitumenous stabilised mixture	mixtures consisting of fine and rough supplement material, fill material, help materials, petroleum, and asphalt aggregate.	natural sand, breaker sand, gravel, stone, quarry stone, LD, phosphor, and jarosite, MSWI bottom ash, and powder coal fly ash aggregates.
Recycling breaker sand	loose material consisting of stone-like particles with a grain size which lies mostly between 63 µm and 4 mm, created with the breaking of demolished and adequately processed concrete and/or masonry work rubble in a construction and demolition processing centre.	none

Appendix 12 Construction materials which are still in the development stage

Research of broken products containing jarosite end slag as gravel replacement

Broken asphalt cement containing jarosite end slag as gravel replacement, exceeds the S1 standard for construction materials for Cr[2/4], Cu[8/8], Mo(1/4[1/8]), Sb(4/4[8/8]), and zinc (Zn)(4/4[7/8]).

Broken cement concrete in which jarosite end slag is processed, exceeds the S1 standard for construction materials for Cr[6/8], Cu(4/4[12/12]), Sb[11/20], Mo[1/4] and Zn(4/4-[8/10]), and would be 100% (70-100%) non-applicable. This application is still in the experimental stage.

Cement concrete with jarosite end slag is not leached with the column test.

12.1 Cement concrete with jarosite end slag (50%)

General

diffusion test emission:	4	observations
aqua regina composition:	4	observations
transformed total-destruction composition:	0	observations

At the making of the first edition of this report (June, 1992), the deliverer had intentions to start production of that quality of jarosite end slag which is also used in these four samples of cement concrete with jarosite end slag. The remaining test samples of cement concrete with jarosite end slag are evaluated seperately.

oBB inorganic composition: In 100% of the samples, the copper content exceeds the S1 standard for construction materials.

oBB leaching: The cumulative emission of antimony is measured with a detection limit which is higher than the U1 standard for construction materials. For this product, then, it is not possible to give an evaluation of the antimony emission in view of the standard for construction materials. Based on the sample check and the measured materials, 100% (40-

100%) of cement concrete with jarosite end slag becomes V1 construction material.

New leaching standards: The detection limit of the measurement of antimony is lower than the new leaching standard for construction materials. Based on the sample check, 100% (40-100%) of cement concrete with jarosite end slag will be applicable as category 1 construction material in type A applications and in type B applications.

Conclusion: Cement concrete with this quality of jarosite end slag is a category 1 construction material, if applied as a prefabricated construction material.

12.2 Asphalt cement with jarosite end slag

General

diffusion test emission:	4	observations
aqua regina composition:	4	observations
transformed total-destruction composition:	0	observations

At the making of the first edition of this report (June, 1992), the deliverer had intentions to start producing that quality of jarosite end slag, which is also used in these four samples of asphalt cement with jarosite end slag. The remaining test samples of asphalt cement with jarosite end slag are evaluated seperately.

oBB inorganic composition: In 100% of the samples, large excessions of the copper and antimony contents are observed. In 25% of the samples, the zinc content also exceeds the S1 standard for construction materials.

oBB leaching: For all the samples, the detection limit of antimony is higher than the U1 standard for construction materials concerned. Based on the sample check, this material is classified 100% (40-100%) as a V1 construction material.

New leaching standards: The detection limit of the antimony measurement is lower than the new leaching standard for construction materials. No excessions of the V1 standard for construction materials is observed. This product, therefore, will be 100% (40-100%) applicable as category 1 construction material.

Conclusion: Asphalt cement with this quality of jarosite end slag is a category 1 construction material.

12.3 Rough Ceramic products with E fly ash

General

diffusion test emission:	7	observations
aqua regina composition:	0	observations
transformed total-destruction composition:	25	observations

In a comparison research, seven paving bricks with differing E fly ashes are investigated:

1*25% E fly ash acid
1*25% E fly ash neutral
2*25% E fly ash basis
1*25% E fly ash basis
1*40% E fly ash basis
1*40% E fly ash basis

oBB inorganic composition: No excessions of the S1 standard for construction materials are observed.

oBB leaching: Seven paving bricks with E fly ash are researched, of which one of the bricks exceeds the molybdenum U2 standard for construction materials. This paving brick from the test series is therefore not applicable under the oBB. This concerns a brick with 25% E fly ash. The other 3 bricks with 25% E fly ash exceed the U1 standard for construction materials. As a result of the higher baking temperature of the products with 40% E fly ash, the emission froms these products are lower than the emissions from paving bricks with 25% E fly ash.

New leaching standards: The molybdenum emissions from two bricks with 25% E fly ash still exceed the new category 1 standards for construction materials (see also the explanation under "oBB leaching"). In the usual applications (type B applications, a wall, for example), all the bricks in the test series meet the V1 criteria. In type A applications, two bricks from the test series are applicable in category 2, the rest in category 1.

Conclusion: From this indicative research it appears that the application of rough ceramic products with E fly ash depends on the baking temperature. From a test series appears that the rough ceramic products which are baked at a higher temperature, are applicable as category 1 construction materials.

12.4 Porous masonry bricks with addition

General

diffusion test emission:	3	observations
aqua regina composition:	0	observations
transformed total-destruction composition:	3	observations

In the Mammoth research, two porous masonry bricks with 28.5% E fly ash (neutral or alkalic) and one porous masonry brick with DSM fly ash are investigated. These porous masonry bricks are in general not applied outside.

oBB inorganic composition: No excessions of the S1 standard for construction materials are observed.

oBB leaching: The antimony emissions from the product with DSM fly ash and the vanadium emission from one brick with E fly ash exceed the U1 standard for construction materials. For three porous masonry bricks, the molybdenum and sulphate contents exceed the U2 standards for construction materials (100%).

New leaching standards: The emissions from the two porous masonry bricks with E fly ash (neutral or alkalic) exceed the sulphate category 2 standard for construction materials, and 50% also exceed the molybdenum category 2 standard for construction materials. The molybdenum emission from the brick with DSM fly ash esceeds the category 2 standard for construction materials concerned, and the antimony emission the category 1 standard for construction materials. The porous masonry bricks can, therefore, not be applied under the Building Materials Decree.

Conclusion: Porous masonry bricks cannot be applied under the Building Materials Decree Act. As a note, for construction technical reasons this brick is only applied inside. Inside applications fall outside of the influence sphere of the Building Materials Decree.

12.5 Calcium-silicate bricks and blocks with E fly ash (37%)

General

diffusion test emission:	2	observations
aqua regina composition:	0	observations
transformed total-destruction composition:	2	observations

The composition and the leaching emission is determined for calcium-silicate bricks and blocks with 37% E fly ash (both alkalic as well as neutral).

oBB inorganic composition: No excessions of the S1 standard for construction materials are observed.

oBB leaching: the molybdenum emission from calcium-silicate bricks and blocks with 37% E fly ash neutral exceed the U1 standard for construction materials concerned. With the addition of 37% E fly ash alkalic, excessions of the U1 standard for construction materials are noted for molybdenum, selenium, and vanadium. Based on these data, calcium-silicate bricks and blocks with 37% E fly ash is for 100% classified as a category 2 construction material.

New leaching standards: For calcium-silicate bricks and blocks with 37% E fly ash, molybdenum and vanadium are no longer critical elements. The emission of selenium, however, exceeds the category 1 standard concerned for construction materials of type A applications in 50% of the measurements. Based on these data, 50% can be used under category 2 criteria in type A applications. In the usual applications for calcium-silicate bricks and blocks (type B applications, for example in walls), 100% (16-100%) of calcium-silicate bricks and blocks with E fly ash is applicable under category 1 criteria.

Conclusion: Calcium-silicate bricks and blocks with 37% E fly ash is usable in its regular applications (type B) as a category 1 construction material.

12.6 Aerated concrete with E fly ash

General

diffusion test emission: 4 observations
aqua regina composition: 0 observations
transformed total-destruction composition: 7 observations

Data concerning the leaching emissions of aerated concrete with 57.3% E fly ash (both neutral and alkalic) are available.

oBB inorganic composition: No excessions of the S1 standard for construction materials are observed.

oBB leaching: Concerning molybdenum and sulphate, 100% of the samples exceed the U1 standard for construction materials. The emission of sulphate from aerated concrete with E fly ash neutral also exceeds the U2 standard. This results in approximately 50% (1-99%) being unusable under the oBB.

New leaching standards: The sulphate emission exceeds the category 1 standard for construction materials of type A applications in 100% of the samples, and the molybdenum emission in 50% of the samples. Under category 2 criteria, this product is 100% (16-100%) suitable for A applications. In view of the new standards, aerated concrete with E fly ash becomes applicable under category 1 criteria in type B applications.

Conclusion: Aerated concrete with 57.3% is a category 1 construction material in the regular application (type B).

12.7 Calcium-silicate bricks and blocks with fluid bed bottom ash

General

diffusion test emission: 1 observation

oBB leaching: With 1 measurement of calcium-silicate bricks and blocks with 29% fluid bed ash, the sulphate emission is higher than the U2 standard for construction materials. This results in approximately 100% (0-100%) of calcium-silicate bricks and blocks with fluid bed ash being unusable under the oBB.

New leaching standards: Also with respect to the new leaching standards for sulphate, 100% (0-100%) of calcium-silicate bricks and blocks with 29% fluid bed ash is not applicable under the Building Materials Decree, because the sulphate emission exceeds the category 2 standard.

Conclusion: Calcium-silicate bricks and blocks with fluid bed ash is not applicable under the Building Materials Decree. The product was an experiment.

Appendix 13 Minutes of the meeting between the industries-VROM-V&W-RIVM/RIZA

Minutes of the meeting between "the industries-VNG-DGM-RIVM", concerning the RIVM report "Environmental quality of primary and secondary construction materials in relation to re-use and soil protection", dated Dec. 7, 1992, held at the RIVM.

Present:
dr.Th.G.Aalbers (RIVM), ir.R.T.Eikelboom (VROM/DGM), prof.dr.ir.C.H.F.Hendriks (Intron)(after ca.15.30), ir.M.van Kampen (P&H, instead of ir.C.W.J.Hooykaas), drs.K.W.Keuzenkamp (VROM/DGM), ing.P.Leenders (VNG), ing.M.D.J.Oltheten (NVTB), ing.J.Peels (Intron), ing.M.van der Poel (SEP), mw.drs.G.A.Rood (RIVM; minutes), mr.drs.M.Uittenbosch (KNB), P.G.M.de Wilde (RIVM).

Absent:
J.van den Berg (Vliegasunie), dr.ir.Born (VVAV), drs.P.D.Rademaker (RCK).

Observers:
A.J.J.M. Feiter (Budelco), ing.J.van den Bremen (Hoechst), ing.W.Kat (Hoogovens), J.N.J.Kos (Argex), ing.P.van Diggele (SKH), ir.H.Roos (VBW-asfalt)

Incoming documents: see incoming mail.

Announcements:
- v.d. Poel (SEP) is not on the mailing list, but would like to receive a final report. Aalbers will see to it.
- The RIVM has had contact with 7 businesses/organizations (Budelco, VBW, SKH, Argex, Hoogovens, Hoechst, Pelt & Hooykaas) concerning the RIVM evaluation of the quality of the raw materials and products which are produced by them. Agreements have been made with these industries concerning the wording of the evaluation in the RIVM report.

- Environment Council BOUW wg 6 awaits the results of this meeting (adaptation in the report) and will take care of the policy questions.
- The RIVM has indicated that the selling of the first version of the report will be stopped as soon as the adapted version is ready.

indicative list from NVTB (document 1, see appendix):

1. when little data was available, "transformed" cascade test results were included in the evaluation as much as possible. This is always explicitly indicated in the text. According to research by v.d. Sloot, the results of the cascade test agree reasonably with the results of the column test. A manual "extrapolation" to L/S=10 is justifiable, however.

   Suggestion by Leenders: For MSWI bottom ash, many column test and cascade test results are known at the VVAV. A comparison of these results gives more information concerning the data extrapolation. Aalbers agrees to do this.

2. there is agreement on the fact that not much data is known. Oltheten believes that in the RIVM report, it is not clearly indicated that this does not concern a representative sample check. According to Aalbers, this is indicated, expecially in chapter 12.3-4, and a whole appendix is devoted to this (appendix 8). The measurement values which are included in the report are given by the industry as analysis results which describe the environmental quality of the product. In order to make a judgment concerning "the quality" of "the construction material", however, more data is needed, certainly if this product varies in environmental quality. Oltheten will make a text proposal for the summary, in which it is indicated that the results of the construction materials which were researched are not representative for "the quality of the construction materials".

Aalbers announces that, at the request of the Fly Ash Union, in the final report it will be indicated which products are special sample products. The information which Aalbers requested in August and which was promised by the brick industry will be given by Uittenbosch, and then processed by the RIVM in a report. The RIVM will also request and process information from prof. dr. S. B. Kroonen-berg.

Oltheten asks what will be done to get more certainty. Aalbers announces that on the short term, the newly arrived data will be processed in the final report. On the long term, the RIVM plans to continue gathering data about construction materi-als, and to publicize an update of the quality of construction materials once every 2 or 3 years. Keuzenkamp announces that the industries from their side would also be able to provide the RIVM with information from the certification. At the moment, VROM is not planning to develop projects such as the Mammoth project. Oltheten asks as to when data can be delivered for the final report. Keuzenkamp announces that the RIVM report must go the RMC together with the AmvB. The AmvB will go to the RMC at the end of the first quarter. In conjunction, Aalbers announces that the data must therefore be ready before mid February.

3. See "Policy notice "Environment Quality Goals for Soil and Water" (Milbowa), dated 05-02-1992, and "Aiming for Values". These reports were starting points.

4+5. Keuzenkamp announces that it is a DGM starting point to assume one standard soil, so that no soil research is necessary before a construction material can be applied.
The RIVM will provide insight into the spreading of the density of the Dutch soils.

6. The illustration has regrettably been left out in this report. The choice was 1:1. In many cases this is a more favorable approach for construction materials than when the model of a point-burdening is followed.

7. E_g is a correction factor for lab-actual practice relations and is not an allowable immission. In view of this, an E_g for V materials is also not relevant. For lab-actual practice relations, a correction is made for V materials by way of factors which have influence on the diffusion comparison (model calculations and equations). E_g is a first filling in of the correction factor. For N materials, the modelling research in cooperation with the LUW will give more information concerning the lab-actual practice relationship.

The RIVM assumes a dynamic balance, that is to say, the input of the materials by deposition is equal to the draining to lower layers. If secondary raw materials are applied on the soil, this dynamic balance will be disturbed. According to Hendriks, this could have consequences on the effective burdening of the soil, and therefore on the starting point of "marginal soil burdening". The behaviour of heavy metals in the soil underneath an application is part of the LUW research mentioned earlier. The possible consequences to the standard setting will be discussed with DGM in due time. RIVM will investigate whether E_g can already be adjusted on the basis of the first results of this research.

Uittenbosch will send information on leaching from clay soils to the RIVM, which can be processed in the report. Discussion will be carried on when all the results of the modelling research are known.

Oltheten asks whether it is not better to include the equation in the MR. Keuzenkamp answers that the equation in the AmvB offers more legislation validity.

The industry indicates that the inclusion of the equation into the MR is preferable to its inclusion in the AmvB.

8. Aalbers announces that the test methods will not be calibrated for compounds in the water streaming through.

9. The KNMI has given two different values for the average time in which it rains in The Netherlands. The RIVM will discuss this point with the KNMI. Uittenbosch will send more information to the RIVM concerning the actual practice moisture

action in bricks. Little is known, however, about the relationship between the moisture content in the bricks and the transportation (by way of diffusion, among others) of compounds to the surface of the bricks and from there on to the soil. According to Hendriks, this process proceeds differently for each V construction material.

10. Density is not relevant for V materials. In the resulting equation, density is excluded.

11. The research here will be presented as option for the research program "Task-stating plan SOSUV 2".
The question of the financial risks will be discussed in an NVTB-DGM talk.

Remaining questions and comments

Leenders has his doubts concerning chapter 11 "Re-use" and requests more information about the band widths. Aalbers says that the numbers of Van Ruiten were the starting point, he will discuss the numbers and their origin (including band widths) with Van Ruiten. Then the method in which the band widths can be presented in the RIVM report will be determined.

Van Kampen announces that the calculation of the standard deviation in the κ, results in much spreading in the standard value with smaller values. He suggests to use $\kappa=0.3$ for all compounds. This will be further discussed in a meeting between Van Kampen and RIVM.

Leenders and Oltheten ask whether the spreadings (confidence limits) in the standard values U1 and U2 can be indicated in an appendix. Keuzenkamp says that the industry, in view of the conformity declarations, are able to indicate the uncertainty in the quality of their products. This point is further discussed in a meeting between DGM and the NVTB.

Incoming mail:

1. An indicative list of subjects to be discussed with the RIVM and VROM DGM Soil concerning the report "Environmental quality of primary and secondary construction materials in relation to re-use and soil protection, RIVM nr. 771402005", dated December 3, 1992.
2. A letter to the Secretary of the project group Building Materials Decree, from RCK, number PR/AM/92-204, dated July 29, 1992.
3. A letter with an appendix from the Ceramic House, for Mr. Oltheten, from KNB, number KB 92.1702, dated October 1, 1992.
4. A letter for Mr. Oltheten (NVTB) from SKH, dated 4-11-1992.
5. A letter for NVTB, from VVAV, dated 11-09-1992.
6. A letter for the clerk of the Fixed Committee for Environment Control of the General Assembly of the States General, from SEP, number DR 92-1021, dated 16-09-1992.
7. A fax for Mr. Aalbers (RIVM), from VNG (dated November 1992, composed by Municipal Works Rotterdam), dated 2-12-1992.
8. A notice from Mr. Van Kampen (P&H), concerning chapter 8.1.2. Extrapolation factor.

The documents 1 up to and including 6 were received by fax by the RIVM on 3-12-1992. Document 8 was distributed during the meeting.

A report of the meeting "Industries-DGM-RIVM" concerning the adaptation of "Part 1, Standard setting" of the RIVM report "Environmental quality of primary and secondary construction materials in relation to re-use and soil protection" dated March 12, 1992, at the RIVM.

Present:

dr.Th.G.Aalbers (RIVM), J.W.van den Berg (Vliegasunie), dr.ir.J.P.G.Born (VVAV), ing.J.van den Bremen (Hoechst), ing.R.J.Busink (Hoogovens), ing.P.van Diggele (SKH), ir.R.T.Eikelboom (VROM/DGM-B), ir.M.van Kampen (P&H), J.N.J.Kos (Argex), ir.L.C.de Leur (VBW-asfalt, ipv ir.H.Roos), drs.K.W.Keuzenkamp (VROM/DGM-B), ing.M.D.J.Ol-theten (NVTB), Jhr.dr.J.J.Quarles van Ufford (VROM-DGM-A), drs.P.D.Rademaker (RCK), mw.drs.G.A.Rood (RIVM; meeting report), dr.ir.J.Schreurs (Intron, substitute for prof.dr.ir.C.H.F.Hendriks), mr.drs.M.Uittenbosch (KNB), ir.S.F.van der Weide (VROM/-DGM-A), P.G.M.de Wilde (RIVM).

Absent:

A.J.J.M.Feiter (Budelco), Folkertsma (Unie van Waterschappen), mw.drs.J.de Jongh (RINH), ing.N.M.M.Koeleman (Prov. ZH) ing.P.Leenders (VNG), ing.J.Peels (Intron), ing.M.van der Poel (SEP).

1. Announcements

- Keuzenkamp announces that today "Part 1 the standard setting" will be discussed, so that possible adaptations in the standard setting can still be processed before the evaluation of construction materials in view of the standards takes place.
- Aalbers announces that Cr and Co have been exchanged on pg. 36.
- The discussion takes place on the basis of the actions which concern the standard setting from the previous meeting minutes (dated 7-12-1992).

2. Discussion of the main points of part 1, minutes of the previous meeting (dated 7-12-1992):

4+5. The RIVM has given insight into the spreading of the density of the Dutch soils on pag. 14. Mr. De Leur, Mr. Uittenbosch and Mr. Van Diggele indicate that the density mentioned for sand soil and for clay soil are too low. The density which Ground Mechanisms uses, is acceptable for everyone as a practical solution. The RIVM will ask these figures from Ground Mechanisms.

6. The pictures are included on pages 15-18. The pictures are clear, except that the notes concerning N and V material respectively are missing. In the final report, this will be indicated with the figures.

7. Uittenbosch has sent information concerning the leaching from clay soils to the RIVM. The data will be used in the second part of the RIVM report (for the evaluation of construction materials).
In the report, a note will be included, stated that the E_g is a an equation term based on the current knowledge. From modelling research, more information will become availabe for N materials concerning the physical-chemical compounds in the description of the lab-actual practice relationship. As long as in the RIVM report the restrictions in the E_g are indicated, based on the current knowledge, then the calculation method for N materials is acceptable for everyone.

Why is there no E_g for V materials? See also the previous meeting minutes. A different calculation method is used. For V materials, there is not test method for the diffusion-determined emission from soil, and there is no data for E_g. For V materials, a correction is made for lab-actual practice reliationship by way of physical parameters. In the report, it will be stated that further research of lab-actual practice relationships is necessary and that this research is possible in various ways.

8. The RIVM has asked about the difference between the values given by the KNMI, and this has been indicated in the report. Uittenbosch has sent the RIVM a theoretical model about the actual practice moisture action in bricks. The difference between the Uittenbosch model and the RIVM model is that in Uittenbosch's model, release by way of diffusion occurs only with complete water soakage. The RIVM approach keeps in mind the wetting period. Both models have the disadvantage of not being validated through scientific research. The RIVM will send a summary of the KNB notice to Uittenbosch for a commentary. Uittenbosch will send the results of the TCKI research to the RIVM. On Monday, March 15, further discussion about this will take place between Uittenbosch, Rademaker, and Aalbers.

Further note 2: The discussion between Van Kampen and RIVM concerning the κ has taken place. As a result of this discussion, the κ is adapted. Van Kampen suspects that the κ of V is dominated by the many measurements of powder coal fly ash. In the report it will be indicated that it is more correct to relate the κ to the amount of construction material applied in The Netherlands, but that too little data is available for this at the moment. There is an agreement for an average κ value.
Further note 3: Spreadings are reproduced in the report.

3. Notes

1. For V materials, the smaller h will be lowered to 10 cm for bricks (in a one-stone wall). Civil-technically, 20 cm is a functional layer thickness for non-prefabricated construction materials (see the DWW Handbook for Hardenings). This will be sent to the RIVM by Van Diggele. The RIVM will give an advice, keeping in mind this information. In the report, the text concerning thin layers (p. 32) will be adapted.
2. Based on a question concerning the simplification that the entire water amount streams to the soil (p. 41), in the report will be added that the drainage of water with compounds through sewage, etc., is not kept in mind.
3. With table 8.1.4.: The RIVM will ask for more information about groundwater,

and will research as to why the concentrations are higher in the groundwater than the aim values indicated in Milbowa.

4. The RIVM will check the copper concentration in surface water in table 4.1.
5. In the introduction of the final report, a sketch will be given of how the report came into being, with a note that, at the publishing of the final report, the previous report is cancelled.
6. Keuzenkamp asks if there are any items in the RIVM report which are missing, and which, based on the current state of technology, can still be added (to). Oltheten announces that the representatives of the industry find that the RIVM report is an adequate reproduction of the current state of science. The industry does still see many holes in the translation of the lab to actual practice; research is still necessary.

<u>4. Question round</u>

Oltheten: Please tune the E/I equations for V and N materials in to each other.

Van Diggele: With road base above groundwater, a percolation of 300 mm/yr does not take place, and a seperate class would be desirable for this. He asks whether it is possible to also distinguish between A and B applications for N materials? Van Diggele will send data concerning F (CROW) to the RIVM. Keuzenkamp announces that further talks with the RIVM are necessary about this.

Rademaker: Does the RIVM accept the AMvB advice concerning the calculated E? Research to actual practice samples should take place as to the course of the pD_e.

Van De Berg: Integral cooperation between research institute, government, and industry would be able to fill up any gaps in the knowledge concerning the actual practice.

Report of the meeting "Industry-DGM-RIVM", concerning part 2 (quality of construction materials) and part 3 (re-usability and re-use) of the RIVM report "Environmental quality of primary and secondary construction materials in relation to re-use and soil protection" and the RIZA report dated may 12th 1993, at the RIVM.

Present

dr.Th.G.Aalbers (RIVM), J.W.van den Berg (Vliegasunie), dr.ir.J.P.G.Born (VVAV), ing.J.van den Bremen (Hoechst), ing.R.J.Busink (Hoogovens), ing.P.van Diggele (SKH), ir.R.T.Eikelboom (VROM/DGM-B), ir.M.van Kampen (P&H), J.N.J.Kos (Argex), ir.L.C.de Leur (VBW-asfalt, instead of ir.H.Roos), drs.K.W.Keuzenkamp (VROM/DGM-B), ing.M.D.J.Oltheten (NVTB), Jhr.dr.J.J.Quarles van Ufford (VROM-DGM-A), drs.P.D.Rademaker (RCK), mw.drs.G.A.Rood (RIVM; report), dr.ir.J.Schreurs (Intron, instead of prof.dr.ir.C.H.F.Hendriks), mr.drs.M.Uittenbosch (KNB), ir.S.F.van der Weide (VROM/DGM-A), P.G.M.de Wilde (RIVM).

Absent

A.J.J.M.Feiter (Budelco), Folkertsma (Unie van Waterschappen), mw.drs.J.de Jongh (RINH), ing.N.M.M.Koeleman (Prov. ZH) ing.P.Leenders (VNG), ing.J.Peels (Intron), ing.M.van der Poel (SEP).

1. Announcements:

- In view of questions concerning the status of this meeting, Keuzenkamp announces that this is an experts meeting in preparation for the policy meeting in the task force Building Materials Decree of the Environment Council Construction and the taks force Building Materials Decree of the DGM-Unie-IPO-VNG meeting. This meeting makes it possible for DGM (as initiator) to make a judgment about the reaction of third parties (industry and other government levels) to the RIVM report, and from this to make conclusions for the policy meeting on the one hand, and to formulate requests for the adaptation of the report to the RIVM (initiator) on the other hand.

2. Discussion part 2:

*9.1. the word "quality criteria" causes confusion and will be replaced by the RIVM with another term.

*9.2. Born asks whether there is information already concerning the promised comparison of the results of the column tests and the extrapolated cascade tests for MSWI bottom ash. Aalbers replies that for the cascade tests of MSWI bottom ash, a mix sample of the second up to and including the fifth fraction is measured, so that a manual extrapolation is not possible. At the moment, it is being researched whether a comparison is possible for other construction materials.
In table 9.2.1., the spreadings will be reproduced.

*9.3. It is noted that a normal distribution cannot be used when there is little data available. Aalbers replies that the normal distribution is only used to determine flukes. For the evaluation, the binomial distribution is used. After discussion, it is decided that the method which the RIVM has used is acceptable, but that the confidence intervals which follow from the statistic must be taken along into part 3.

*9.4. It is agreed that the evaluation of the sample check will take place based on construction materials of which more than one measurement is present in the data base (for n=1, no evaluation).

*9.5. & 9.6.

a. Bromide

Van Kampen notes that bromide is probably critical for construction materials which are cooled with seawater, and also for sea sand. The RIVM will carry out the same calculations for bromide as done for chloride and several variants, including the increase by way of policy. Based on these calculations, DGM will make a policy choice for the standardization of bromide.

Van Kampen will ask Blast Furnaces if they will take back in writing the letter concerning the air cooling of LD slag.

b. Appendix

In part 2, no experimental construction materials will be described, these descriptions will be included in the appendix. With agreement, the following construction materials will go to the appendix of the report: rough ceramic products with E fly ash, porous masonry stone with addition, calcium-silicate bricks and blocks with 37% E fly ash, aerated concrete with E fly ash, jarosite end slag, and proudcts with jarosite end slag. Aalbers will contact Budelco concerning jarosite end slag.

c. Clay

According to Uittenbosch, the Milbowa value for fluoride is too low; 27 of the 60 measurements of mixed clay from Dutch ground winnings with addition materials are higher than the Milbowa value for fluoride. Uittenbosch will deliver data on short term.

d. Aerated concrete

Rademaker will deliver new data on short term about the leaching emission of sulphate from aerated concrete.

e. Asphalt cement and asphalt aggregates

The comments concerning text will be processed by the RIVM.

f. Blast furnace slag mix

During the meeting, Van Diggele takes back the results of a German diffusion test of blast furnace slag mix which were given to the RIVM by him, because he considers them untrustworthy.

- For the evaluation of blast furnace slag mix as granular material, the conclusion will be adapted based on the conceptual quality document of the SKH.
- The question whether a distinction must be made between type A and B applications for granular materials would have to be discussed in Environment Council Construction.

g. Tables 9.2-10.1.-10.2.

The differences between the mailed tables and the tables which were distributed during the meeting, are the result of typing errors and the distinction now made between certified and non-certified materials.

3. RIZA report

During the meeting, the document "Progress RIZA report dated May 11, 1992, P. Vermij" is distributed and explained by Vermij. At the end of May, a new version will be ready, in which the desire for more argumentation is met with. According to Leenders, the re-use consequences for typical materials of the sediment bed of the surface water must be charted. Oltheten announces that a bilateral meeting will take place about the RIZA indicated way, and that the discussion will be continued after the new version.

4. Part 1 (RIVM report)

- In view of his question during the previous meeting, Van de Bremen asks for an explanatory text in the report as to why the 90% interval is used in table 8.1.3. The RIVM will include an explanation in the report. The RIVM will investigate whether the formulation can be quoted from the Milbowa policy viewpoint.
- The extrapolation factor with type B applications is increased by bringing the wetting time under the √ sign. This is also valid for the extrapolation factor with isolated applications.
- Leenders asks the RIVM to include a list of the research which is still necessary.

5. Part 3 (RIVM report) (from 2:00 p.m.)

General

- The construction materials which are still in a test stadium and are referred to the appendix, will not be included in part 3 in the re-use (agenda points 2, 9.5., & 9.6.b.). The confidence intervals will be processed in part 3 (agenda point 2, 9.3.). The results for the re-use will be indicated for construction materials with $n>1$ (agenda point 2, 9.4.)
- The method which Van Ruiten has used in his report for re-use and re-usability is acceptable. The amounts which are mentioned in the Van Ruiten report will be starting points. Concerning the translation of the re-usability and re-use, The RIVM will consult Van Ruiten. During the meeting, some questions still arise about table A-Appendix 3 from the Van Ruiten report.
- Approximately one week before June 3rd, the RIVM will mail an adapted conceptual part 3.

11.2.

- §11.2. will become an appendix. According to Van Weelden, a maximum of 50% of the gravel can be replaced by masonry aggregate. Aalbers will inquire about this.

11.3.

- The RIVM will adapt the numbering of the tables and the the referrals.
- p. 196 (text) "decreased applicability" disagrees with "shifting from category 2 to 1".
- The RIVM will suggest a monitoring research of construction and waste materials in order to evaluate the AmvB in the future.

11.5.

- Keuzenkamp announces that the ministerial regulation will not contain an obligatory sample evaluation. The Explanation Note will probably give the authorities involved the room for the evaluation. The sample evaluation will be the most extreme demand of the authorities involved.
- The RIVM will investigate how the analysis costs will be reproduced.
- In view of Leenders' question, the RIVM will add a paragraph concerning polluted soil.

6. Question round

- In view of a question from Van Kampen concerning the isolation with V materials, Vermij announces that the test with dredging specimen where the percolation is reduced to less than 2 mm/yr, it appears that the leaching emissions are on the same level as the emissions determined by diffusion.

Report of the meeting "Industry-DGM-RIVM/RIZA", about part 1B (standards for the application of construction materials in the wet construction) of the RIVM/RIZA report "Environmental quality of primary and secondary construction materials in relation to re-use and soil protection" june 24th 1993, at the VROM-DGM.

Present

Dr. Th. Aalbers (RIVM), ir. R.T. Eikelboom (VROM/DGM), ir. F. Folkertsma (UvW), prof.dr.ir. Ch. Hendriks (Intron), ir. M. van Kampen (P&H), R. van der Klooster (V&W/-RWS, chairman), ing. G. Laan (RWS/DWW), ing. M.D.J. Oltheten (NVTB), ing. R.J. Saft (RIZA, report), ing. P. Vermij (RIZA)

Observers

mr. T. van Gemert (V&W/RWS), ir. B. de Jong (V&W/RWS), ing. N.M.M. Koeleman (IPO), ing. P. Leenders (VNG)

The chairman opens the meeting with the announcement that Mr. Leenders has excused himself, but his comments will be voiced in writing.

Vermij gives a short explanation of the most important changes in comparison with the previous concept.

The leaching during the application of a construction is approached by maintaining a fixed L/S term of 0.1. In this way, the equations become more manageable, and less variables have to be taken into account. Aside from this, a factor for the application tempo is introduced, and the correction for the specific surface area of the material is removed. Both measures have lead to an increased allowable emission.

In §9.3., which is still editorially being adapted, two standards are calculated. The first concerns the flow rate minimally necessary for the application of primary materials, the second indicates the flow rate at which the route in the direction of the surface water becomes standard-setting. The room between these two calculated flow rates is so small, that it does not appear useful to base complicated, and practically hard to carry out legislation on this. In general, it can be stated that only the route to the sediment bed of the surface water has to be calculated through.

As far as this is necessary, for sensitive, virtually stagnant surface waters, more specific demands can be stated in provincial environment laws in applications of construction materials (for example in natural or water winning areas).

Then, a round is made of the participants so that a first reaction to the RIZA report can be gauged. Notations concerning text changes are, preferably in writing, passed on outside of the meeting.

Laan considers the report a usable start for the development of legislation. He does ask attention for the changed interaction between surface water and pore water with ship movements or high wave action. His estimation, however, is that the importance of this aspect is probably minimal.

Folkertsma finds that the report reads well, and sees, in view of §9.3., a special importance for the smaller waters, which are mostly controlled by smaller water departments. In this context, if general rules comes in the place of a permit requirement, he also sees possibilities in specific function attachment to surface waters coupled to demands to be more closely defined in the provincial environment legislation.

Hendriks concludes that a strong progress has been made in comparison to the previous concept. He can survey and judge the consequences of one and another only at the appearance of a new part 2. Aside from this, he also has several comments concerning the contents. He suggests an extra volume term in view of the problems in waters with a 0 flow rate (zero). He considers the L/S term of 0.1 very arbitrary and of great influence, but under the circumstances an acceptable given. The value for the infiltration flow rate (600 mm/yr) should be better argumented.
Concerning the paragraph "Results and conclusions", he predicts problems if the suppliers/buyers wish to use a construction material having a quality declaration, but the water quality controllers hinder this on grounds of an influence on the limit value of 20% or more.

Oltheten agrees with Hendriks. He also signals that the report must be seen as a preparation for a policy, and that final decisions (can) be made in another context. At the same time, he is interested in the translation into actual practice, for example concerning maintainance, releasing of quality declarations, etc.

Finally, Van Kampen indicates that the equations can be simplified, since the L/S term has become a "fixed" factor with a very small deviation. He has also made calculations concerning the influence of the infiltration flow rate from which he concludes that by the chosen value of 600 mm/yr, deviations of the emission values at 300 mm/yr will occur only for chloride and sulphate. This can lead to restrictions for the use of construction materials. He argues for a shading of the effects of the chloride and sulphate burdening, in connection with the already notable influence of the seapage of surface water with high chloride and sulphate contents.

Finally, he signals that a number of the fictitious limit values are very low.

The conclusion concerning the excessions of chloride and sulphate were also made by Aalbers based on his calculations. This is valid only for non-prefabricated materials, however; for prefabricated materials the problems do not occur. The calculations are carried out inclusive of the increased immission values for chloride and sulphate which DGM has determined on grounds of policy.

In a reaction on the comments made, Vermij suggests that the determining of the limit values mentioned, took place in the usual manner, namely based on a calculated MTR level which is compared and/or corrected for background concentrations. Only the final determining in a policy notice must still take place. A discussion of these values is of less significance, however, now that it appears that the route to the (water) bottom is the determining factor in all cases.

The value for the infiltration flow rate has great variations, but the maintaining of a fixed value has great practical benefits. Then, in each situation, a geohydrological research does not have to take place. The high value of 600 mm/yr is chosen because this value appears especially at the banks, where the work is carried out.

According to Oltheten, a policy choice is nevertheless made to protect the banks. He prefers lowering the infiltration flow rate to 300 mm/yr (the above-mentioned hinderances with regards to chloride and sulphate would then disappear), but only if this can be well argued.

Vermij agrees to look at the possibilities for an adaptation of the infiltration flow rate value. If one and another is not possible, he prefers one set of equations for both the soil as well as the sediment bed of the surface water, because these values are almost equal.

A discussion develops concerning an agreement made about the construction materials which the RIVM has calculated. According to Aalbers, the "Van Ruiten set", also used for the viewpoint notice, would be used for this. In this set, steel and phosphor slag are regarded as prefabricated material.

According to Oltheten, the set, however, does not apply well to wet applications, and the acceptation criteria agreed upon was whether more than one measurement is known. The Van Ruiten report would be used to make a seperation between re-usability and the actual re-use.

This contradiction will be discussed in the next MBB meeting.

At the end of the meeting, several important aspects are still brought up. Hendriks emphasizes that increases in the aim values are no longer of importance if the route to the sediment bed of the surface water is seen as being determining. Oltheten suggests the introduction of a type of addition term for the leaching of primary materials with low flow rates, so that secondary materials are not discriminated against if the quality of such materials is not less than that of primary materials. With very low flow rates, this term then has the function of minimal allowable emission.

The chairman then thanks those present for their input, and closes the meeting.

Appendix 14 Calculation of the isolation costs in guilders, based on the report "Cost structure of dump sites"

post	description	costs	capital	construction costs "special category"	capital	category 2
property acquisition				zero		zero
ground winning				zero		zero
installation costs under *	a. drainage control(f15/m HDPE, 100mm, 1000m/ha)	15000				not applicable
	b. sand/bentonite(f40/m², 50cm)	400000				not applicable
	c. or HDPE foil (f15/m², 2mm)					
	d. sand (f22/m³, 50cm)	110000				not applicable
	total/ha	525000 f/ha	525000	interest: 1014480		zero
						not applicable
	f. pipe drainage control (f50/m;HDPE, 200 mmx1) 2xlength	25				not applicable
	g. inspection pit drainage control (f5000;1/100mx1) 2xlength	25				not applicable
	h. pump pits drainage control (f36000;1/750 mx0.5) 1xlength	12				not applicable
	i. spray pieces drainage control (f500;1/10mx0.5) 1xlength	12				not applicable
	j. sampling cylinders (f8000;1/50 mx0.25) 1xlength	40				not applicable
	total/m construction	114 f/m	57000	interest: 110160		zero
operating costs				nihil		zero
finishing costs above	k. sand bentonite (f25/m²;30cm)	250000			250000	
	l. or HDPE-foil (f15/m²;2mm)	-			-	
	m. drain sand (f20/m³,40cm)	80000			-	not applicable
	total/ha	330000 f/ha	330000	interest: 637920	250000 f/ha	483120
After-care costs	n. maintenance minimal facilities installation costs drainage (per year)	1 %/y		28500		zero
	o. spraying drainage control upper (f3/m, 1000m/ha.1/3 year	1000 f/ha.y		50000		50000
	p. spraying drainage control lower (f3/m, 1000m/ha.1/3 year	1000 f/ha.y		50000		zero
	q. replacement minimal facilities (per m)	0,5 f/m.y		12500		12500
	r. sampling drainage control (f1000/10m, 1/jaarx0.5)per m 1xlength	25 f/m.y		625000		zero
	s. sampling vertical pipes (3xf1000/50m, 1/jaarx0.25) per m 1xlength	15 f/m.y		375000		375000
risk insurance	t	3 f/t		300000	1 f/t	100000
TOTAL				3203560		1020620
TOTAL/ton				**32**	f/t	**10 f/t**
mass, sg=2 ton/m³	100000 t					
surface area h=5m	1 ha					
length	500 m					
width	20 m					
construction life-term	50 y					
annuity	30 y					
interest	5 %					
zero	no cost post in useful construction material application as part of construction					
not applicable	not applicable for category 2 construction materials					

*a - i could be replaced by a diffusion slowing down layer.

Appendix 15 Confidence intervals and combined evaluation for construction materials based on the evaluated and adapted standard settings

Table a. confidence intervals and combined evaluation for non-prefabricated construction materials based on the adapted standard setting of Part 1 (h=70cm).

Table b. confidence intervals and combined evaluation for prefabricated construction materials based on the adapted standard setting of part 1.

Table c. confidence intervals and combined evaluation for non-prefabricated construction materials based on the standard setting of the oBB.

Table d. confidence intervals and combined evaluation for prefabricated construction materials based on the oBB.

column 1. Name of the construction material.

column 2. Note concerning the construction material.

column 3. Sequence number in appendix A-C.

column 4. Category distribution according to the oBB.

column 5. Chapter in which the construction material is discussed in Part 2.

column 6. Lower limit of the 95% confidence interval of the tail probability P4 belonging to the U1 standard for the leaching of construction materials based on the binomial distribution.

column 8. Upper limit of the 95% confidence interval of the tail probability P belonging to the U1 standard for the leaching of construction materials based on the binomial distribution.

column 9. Lower limit of the 95% confidence interval of the tail probability P belonging to the U2 standard for the leaching of construction materials based on the binomial distribution.

column 10. Tail probability P belonging to the U2 standard for the leaching of construction materials based on the binomial distribution.

column 11. Upper limit of the 95% confidence interval of the tail probability P belonging to the U2 standard for the leaching of the leaching of construction material based on the binomial distribution.

column 12. Lower limit of the 95% confidence interval of the tail probability P belonging to the S standard for the inorganic composition of construction materials based on the binomial distribution in the oBB.

column 13. Tail probability P belonging to the S standard for the inorganic composition of construction materials based on the binomial distribution in the oBB.

column 14. Upper limit of the 95% confidence interval of the tail probability P belonging to the S standard for the inorganic composition of construction materials based on the binomial distribution in the oBB.

column 15. Lower limit of the 95% confidence interval of the tail probability P belonging to the S standard for the organic composition of construction materials based on the binomial distribution in the oBB or the adapted standard setting according to Part 1.

column 16. Tail probability P belonging to the S standard for the organic composition of construction materials based on the binomial distribution in the oBB or adapted standard setting according to Part 1.

column 17. Upper limit of the 95% confidence interval of the tail probability P belonging to the S standard for the organic composition of construction materials based on the binomial distribution in the oBB or the adapted standard setting according to Part 1.

column 18. Expected procentual amount of construction material which on the basis of leaching and (in)organic composition fits into category N1 according to the oBB and/or is a category 1 construction material according to the standard setting of part 1.

column 19. Expected procentual amount of construction material which on the basis of leaching and (in)organic composition fits into the N2 category according to the oBB and/or is a category 2 construction material according to the standard setting of part 1.

column 20. Expected procentual amount of construction material which on the basis of leaching and (in)organic composition is not applicable according to the oBB and/or according to the standard setting of part 1.

ERR. No data available.

Table a: Confidence interval and combined evaluation for N O N - P R E F A B R I C A T E D construction materials
based on the A D A P T E D standard setting of Part 1 (h=70cm)

confidence intervals of P in %

BINOMIAL DISTRIBUTION

1	2	3	4	5		leaching 6	7		9	10	11	inorganic composition 12	13	14	organic composition 15	16	17	combination in % of leaching & composition: constr.mat 18	constr.mat 19	landfilling 20
construction material	remark	no.	cat. oBB	chapter		P(U1,l)	P(U1)	P(U1,r)	P(U2,l)	P(U2)	P(U2,r)	P(S,l)	P(S)	P(S,r)	P(S,l)	P(S)	P(S,r)	U1	U2	
clay		0	G	12.7.3.	1	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	84.1	100	0	0
loam		1	G	12.7.3.	2	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.4	100	0	0
gravel		2	G	12.7.3.	3	0.0	0.0	84.1	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	84.1	100	0	0
natural sand		3	G	12.7.3.	4	0.0	0.0	52.2	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	52.2	100	0	0
natural sand	de-silted	4	G	12.7.3.	5	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.4	100	0	0
limestone		5	N1	12.7.3.	6	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.4	100	0	0
quartzite		6	N1			ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
sand stone		7	N1			ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
basalt		8	N1	12.7.3.	7	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.4	100	0	0
granite		9	N1			ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
porfier		10	N1			ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
flug sand		11	N1	12.7.3.	8	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.4	100	0	0
lava stone		12	N1	12.7.3.	9	0.0	0.0	70.8	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	84.1	100	0	0
asphalt aggregate	bitumen	32	N2	12.7.3.	10	0.0	0.0	45.9	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	11.2	100	0	0
asphalt aggregate	recycling	33	N2	12.7.3.	10	0.0	0.0	45.9	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	11.2	100	0	0
asphalt aggregate	tar	33	N	12.7.3.	10	0.0	0.0	45.9	0.0	0.0	0.0	0.0	0.0	0.4	59.0	100.0	100.0	0	0	100
cement aggregate		42	N1	12.7.3.	11	0.0	0.0	30.8	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	33.5	100	0	0
masonry aggregate		43	N1	12.7.3.	12	0.0	0.0	60.2	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	70.8	100	0	0
masonry aggregate	certified	43	N2	12.7.3.	12	0.0	0.0	60.2	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	70.8	100	0	0
mixed aggregate		44	N2	12.7.3.	13	3.2	25.0	65.1	0.0	0.0	37.0	0.0	0.0	0.4	0.0	0.0	21.7	75	25	0
mixed aggregate	certified	44	N1	12.7.3.	13	1.2	14.3	42.8	0.0	0.0	26.4	0.0	0.0	0.4	0.0	0.0	21.7	86	14	0
sieve sand		45	N2	12.7.3.	14	0.0	0.0	37.0	0.0	0.0	0.0	0.0	0.0	0.4	21.5	35.7	52.0	64	0	36
recycling breaker sand		46	N	12.7.3.	15	21.2	44.4	69.5	0.0	0.0	20.5	0.0	0.0	0.4	6.6	17.6	34.5	46	37	18
recycling breaker sand	certified			12.7.3.	15	21.2	44.4	69.5	0.0	0.0	20.5	0.0	0.0	0.4	6.6	17.6	34.5	46	37	18
constr. and demol. waste	undefined	47	N	12.7.3.	16	5.3	40.0	85.3	0.0	0.0	52.2	0.0	0.0	0.4	12.1	35.7	65.2	39	26	36
smoke desulph. gypsum		48	N	12.7.3.	18	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
phosphor acid gypsum		49	N	12.7.3.	19	15.9	100.0	100.0	15.9	100.0	100.0	0.0	0.0	0.4	0.0	0.0	0.4	0	0	100
mine stone	others	50	N	12.7.3.	20	0.0	0.0	23.1	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	14.8	100	0	0
mine stone	certified	51	N	12.7.3.	20	0.0	0.0	23.1	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	14.8	100	0	0
mine stone	NL	51	N	12.7.3.	20	15.9	100.0	100.0	0.0	0.0	84.1	0.0	0.0	0.4	0.0	0.0	14.8	0	100	0
mine stone	washed	51	N	12.7.3.	20	0.0	0.0	23.1	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	14.8	100	0	0
with E fly ash		52	N2	12.7.3.	21	35.9	83.3	99.6	35.9	83.3	99.6	0.0	0.0	0.4	0.0	0.0	84.1	17	0	83
E bottom ash		53	N	12.7.3.	22	6.6	15.9	30.0	0.0	0.0	8.4	0.0	0.0	0.4	0.0	0.0	52.2	84	16	0
E bottom ash	certified	53	N1	12.7.3.	22	15.7	45.5	77.5	0.0	0.0	33.5	0.0	0.0	0.4	0.0	0.0	52.2	55	45	0
fluid bed fly ash		54	N	12.7.3.	23	35.9	83.3	99.6	35.9	83.3	99.6	0.0	0.0	0.4	0.0	0.0	84.1	17	0	83
fluid bed bottom ash		55	N	12.7.3.	24	6.6	15.9	30.0	0.0	0.0	8.4	0.0	0.0	0.4	0.0	0.0	52.2	84	16	0
coal gassing bottom ash		56	N	12.7.3.	25	0.0	0.0	60.2	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.4	100	0	0
coal gassing fly ash		58	N	12.7.3.	26	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.4	100	0	0
MSWI bottom ash		59	N2	12.7.3.	27	87.7	95.8	99.1	72.4	83.1	91.0	0.0	0.0	0.4	0.0	0.0	21.7	4	13	83
MSWI fly ash		60	N	12.7.3.	28	75.4	100.0	100.0	75.4	100.0	100.0	0.0	0.0	0.4	0.0	0.0	30.8	0	0	100
blast furnace slag		61	N	12.7.3.	29	4.3	33.3	77.7	0.0	0.0	45.9	0.0	0.0	0.4	0.0	0.0	60.2	67	33	0
blast furnace mixed slag			N	12.7.3.	17	9.9	42.9	81.6	0.0	0.0	41.0	0.0	0.0	0.4	0.0	0.0	0.4	57	43	0
hydr. mixed aggregate				12.7.3.	17	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
blast furnace foam slag		62	N1	12.7.3.	30	0.0	0.0	84.1	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	84.1	100	0	0
granulated blast furnace slag		63	N1	12.7.3.	31	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	84.1	100	0	0
blast furnace slag sand		64	N	12.7.3.	32	0.0	0.0	84.1	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.4	100	0	0
jarosite end slag		65	N	12.7.3.	33	99.6	100.0	100.0	99.6	100.0	100.0	0.0	0.0	0.4	0.0	0.0	0.4	0	0	100
LD slag		66	N	12.7.3.	34	42.1	85.7	99.6	29.1	71.4	96.3	0.0	0.0	0.4	0.0	0.0	84.1	14	14	71
phosphor slag		67	N	12.7.3.	35	99.6	100.0	100.0	0.0	0.0	0.4	0.0	0.0	0.4	0.0	0.0	84.1	0	100	0
ELO slag		68	N	12.7.3.	36	39.8	100.0	100.0	19.4	75.0	99.4	0.0	0.0	0.4	0.0	0.0	84.1	0	25	75
copper slag		69	N			ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
chromium slag		70	N			ERR	ERR	ERR	ERR	ERR	ERR	0.0	0.0	0.4	ERR	ERR	ERR	ERR	ERR	ERR
fly ash aggregate		71	N	12.7.3.	37	47.8	100.0	100.0	0.0	0.0	52.2	0.0	0.0	0.4	0.0	0.0	0.4	0	100	0

Table b: Confidence interval and combined evaluation for P R E F A B R I C A T E D construction materials
based on the A D A P T E D standard setting of Part 1

confidence intervals of P in %

BINOMINAL DISTRIBUTION

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
					leaching						inorganic composition			organic composition			combination in % of leaching & composition		
																	constr.mat	constr.mat	landfilling
construction material	remark	no.	cat. oBB	chapter	P(U1,l)	P(U1)	P(U1,r)	P(U2,l)	P(U2)	P(U2,r)	P(S,l)	P(S)	P(S,r)	P(S,l)	P(S)	P(S,r)	U1	U2	
lime stone		5	V1	12.8.2. 1	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
basalt		8	V1	12.8.2. 2	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
cement concrete		13	V1	12.8.2. 3	0.0	0.0	19.4	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.4	100	0	0
cement concrete +	with E fly ash (8%)	14		12.8.2. 4	0.0	0.0	19.4	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.4	100	0	0
	with MSWI bottom ash (8%)		V1	12.8.2. 4	0.0	0.0	19.4	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.4	100	0	0
	with jarosite end slag		V1		ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
	with ardealite			12.8.2. 4	0.0	0.0	19.4	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.4	100	0	0
	with lytag			12.8.2. 4	0.0	0.0	19.4	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.4	100	0	0
asphalt cement	recycling	15	V1	12.8.2. 5	0.0	0.0	20.5	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	16.0	100	0	0
	others			12.8.2. 5	0.0	0.0	20.5	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	16.0	100	0	0
asphalt cement +	with MSWI fly ash (2%)	16	V1	12.8.2. 6	0.0	0.0	20.5	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	16.0	100	0	0
	with E fly ash (6%)		V1	12.8.2. 6	0.0	0.0	20.5	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	16.0	100	0	0
	with E MSWI fly ash		V1	12.8.2. 6	0.0	0.0	20.5	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	16.0	100	0	0
	with phosphor slag (59%)		V1	12.8.2. 6	0.0	0.0	20.5	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	16.0	100	0	0
	with MSWI bottom ash			12.8.2. 6	0.0	0.0	20.5	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	16.0	100	0	0
	with jarosite end slag				ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
	with tar			12.8.2. 5	0.0	0.0	20.5	0.0	0.0	0.0	0.0	0.0	0.4	59.0	100.0	100.0	0	0	100
mortar				12.8.2. 7	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
mortar	with E fly ash	18	V1	12.8.2. 8	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
rough ceramic products		19	V1	12.8.2. 9	0.0	0.0	30.8	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.4	100	0	0
rough ceramic products	with E fly ash (25-40%)	20			ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
porous masonry bricks	with E fly ash (29%)				ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
Ca-silicate bricks and blocks		23	V1	12.8.2. 10	0.0	0.0	52.2	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.4	100	0	0
Ca-silicate bricks and blocks +	with E fly ash (9%)	24	V1	12.8.2. 11	0.0	0.0	52.2	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.4	100	0	0
	with E fly ash (37%)			12.8.2. 11	0.0	0.0	52.2	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.4	100	0	0
	with lownox fly ash (9%)			12.8.2. 11	0.0	0.0	52.2	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.4	100	0	0
	with fluid bed ash (29%)			12.8.2. 11	99.6	100.0	100.0	99.6	100.0	100.0	0.0	0.0	0.4	0.0	0.0	0.4	0	0	100
	with ash lime (8%)			12.8.2. 11	0.0	0.0	52.2	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.4	100	0	0
aerated concrete		25	V1	12.8.2. 12	71.6	100.0	100.0	0.0	0.0	28.4	0.0	0.0	0.4	0.0	0.0	0.4	0	100	0
aerated concrete +	with E fly ash	26			ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
sand cement stabilization		29	V1	12.8.2. 13	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.4	100	0	0
sand cement stabilization +	with E fly ash (73%)	30		12.8.2. 14	99.6	100.0	100.0	99.6	100.0	100.0	0.0	0.0	0.4	0.0	0.0	0.4	0	0	100
blast furnace slag mix		34	V1/N**	12.8.2. 15	9.9	42.9	81.6	0.0	0.0	41.0	0.0	0.0	0.4	0.0	0.0	0.4	57	43	0
hydraulic mix aggregate		35		12.8.2. 16	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
lightly stabilised phosphor slag		36	V2	12.8.2. 17	0.0	0.0	84.1	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.4	100	0	0
lightly stabilised steel slag		37		12.8.2. 18	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
stabilised MSWI bottom ash		38	V2	12.8.2. 19	54.1	100.0	100.0	0.0	0.0	45.9	0.0	0.0	0.4	0.0	0.0	0.4	0	100	0
lightly stabilised E fly ash		40		12.8.2. 20	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
blast furnace slag		61		12.8.2. 21	0.8	33.3	90.6	0.0	0.0	70.8	0.0	0.0	0.4	0.0	0.0	60.2	67	33	0
LD slag		66	V1	12.8.2. 22	0.0	0.0	45.9	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	84.1	100	0	0
phosphor slag		67	V1/N**	12.8.2. 23	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	84.1	100	0	0
copper slag		69		12.8.2. 24	53.8	91.7	99.8	14.3	41.7	73.0	0.0	0.0	0.4	0.0	0.0	0.4	8	50	42
hydr. stabilised E fly ash aggr.		73		12.8.2. 25	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
sand cement stabilization +	with sieve sand				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100	0	0
aerated concrete	with E fly ash				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100	0	0
cleaned soil					0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100	0	0
crushed asphalt cement					0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100	0	0

Table c: Confidence interval and combined evaluation for N O N - P R E F A B R I C A T E D construction materials based on the standard setting of the conceptional Administrative Order for Construction Materials

confidence intervals of P in %

BINOMIAL DISTRIBUTION

					leaching						inorganic composition			organic composition			combination in % of leaching & composition constr.mat	constr.mat	landfilling
1 construction material	2 remark	3 no.	4 cat. oBB	5 chapter	6 P(U1,l)	7 P(U1)	8 P(U1,r)	9 P(U2,l)	10 P(U2)	11 P(U2,r)	12 P(S,l)	13 P(S)	14 P(S,r)	15 P(S,l)	16 P(S)	17 P(S,r)	18 U1	19 U2	20
clay		0	G	12.7.3. 1	0.000	0.000	0.369	0.000	0.000	0.000	0.000	0.000	16.043	0.000	0.000	84.127	100	0	0
loam		1	G	12.7.3. 2	0.000	0.000	0.369	0.000	0.000	0.000	0.000	0.000	84.127	0.000	0.000	0.369	100	0	0
gravel		2	G	12.7.3. 3	1.259	50.000	98.741	0.000	0.000	84.127	0.000	0.000	70.760	0.000	0.000	84.127	50	50	0
natural sand		3	G	12.7.3. 4	0.505	20.000	71.631	0.000	0.000	52.199	0.000	0.000	5.677	0.505	20.000	71.631	80	20	0
natural sand	de-silted	4	G	12.7.3. 5	0.000	0.000	0.369	0.000	0.000	0.000	0.000	0.000	0.369	0.000	0.000	0.369	100	0	0
limestone		5	N1	12.7.3. 6	0.000	0.000	0.369	0.000	0.000	0.000	0.000	0.000	84.127	0.000	0.000	0.369	100	0	0
quartzite		6	N1		ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
sand stone		7	N1		ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
basalt		8	N1	12.7.3. 7	0.000	0.000	0.369	0.000	0.000	0.000	0.000	0.000	0.369	0.000	0.000	0.369	100	0	0
granite		9	N1		ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
porfier		10	N1		ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
flug sand		11	N1	12.7.3. 8	0.000	0.000	0.369	0.000	0.000	0.000	0.000	0.000	84.127	0.000	0.000	0.369	100	0	0
lava stone		12	N1	12.7.3. 9	0.841	33.333	90.566	0.000	0.000	70.760	0.000	0.000	41.044	0.000	0.000	84.127	67	33	0
asphalt aggregate	bitumen	32	N2	12.7.3. 10	22.284	66.667	95.671	0.000	0.000	45.946	0.000	0.000	21.706	33.481	51.515	69.276	33	67	0
asphalt aggregate	recycling	33	N2	12.7.3. 10	22.284	66.667	95.671	0.000	0.000	45.946	0.000	0.000	21.706	33.481	51.515	69.276	33	67	0
asphalt aggregate	tar	33	N	12.7.3. 10	22.284	66.667	95.671	0.000	0.000	45.946	0.000	0.000	21.706	58.956	100.000	100.000	33	67	0
cement aggregate		42	N1	12.7.3. 11	53.750	91.667	99.792	0.000	0.000	30.750	0.000	0.000	24.600	9.783	36.364	69.889	8	92	0
masonry aggregate		43	N1	12.7.3. 12	39.761	100.000	100.000	0.000	0.000	60.239	0.000	0.000	15.375	9.434	66.667	99.159	0	100	0
masonry aggregate	certified	43	N2	12.7.3. 12	39.761	100.000	100.000	0.000	0.000	60.239	0.000	0.000	15.375	9.434	66.667	99.159	0	100	0
mixed aggregate		44	N2	12.7.3. 13	44.292	80.000	97.481	0.000	0.000	30.844	0.000	0.000	12.724	47.255	87.500	99.684	20	80	0
mixed aggregate	certified	44	N1	12.7.3. 13	7.672	28.571	58.327	0.000	0.000	26.357	0.000	0.000	12.724	34.798	64.286	87.922	71	29	0
sieve sand		45	N2	12.7.3. 14	15.944	36.842	61.793	0.000	0.000	19.421	0.000	0.000	28.385	92.351	97.015	99.187	63	37	0
recycling breaker sand		46	N	12.7.3. 15	25.723	50.000	74.277	0.000	0.000	20.500	0.000	0.000	10.250	68.414	90.000	98.976	50	50	0
recycling breaker sand	certified			12.7.3. 15	25.723	50.000	74.277	0.000	0.000	20.500	0.000	0.000	10.250	68.414	90.000	98.976	50	50	0
constr. and demol. waste	undefined	47	N	12.7.3. 16	14.663	60.000	94.726	5.274	40.000	85.337	0.000	0.000	14.760	28.415	57.143	82.959	40	20	40
smoke desulph. gypsum		48	N	12.7.3. 18	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
phosphor acid gypsum		49	N	12.7.3. 19	15.873	100.000	100.000	15.873	100.000	100.000	99.631	100.000	100.000	0.000	0.000	0.369	0	0	100
mine stone	others	50	N	12.7.3. 20	0.000	0.000	23.063	0.000	0.000	0.000	0.000	0.000	12.300	1.043	8.696	31.304	100	0	0
mine stone	certified	51	N	12.7.3. 20	0.000	0.000	23.063	0.000	0.000	0.000	0.000	0.000	12.300	1.043	8.696	31.304	100	0	0
mine stone	NL	51	N	12.7.3. 20	15.873	100.000	100.000	0.000	0.000	84.127	0.000	0.000	12.300	1.043	8.696	31.304	0	100	0
mine stone	washed	51	N	12.7.3. 20	0.000	0.000	23.063	0.000	0.000	0.000	0.000	0.000	12.300	1.043	8.696	31.304	100	0	0
with E fly ash		52	N2	12.7.3. 21	35.868	83.333	99.579	35.868	83.333	99.579	0.000	0.000	5.857	0.000	0.000	84.127	17	0	83
E bottom ash		53	N	12.7.3. 22	56.338	72.093	84.738	0.000	0.000	8.581	0.000	0.000	4.671	0.000	0.000	52.199	28	72	0
E bottom ash	certified	53	N1	12.7.3. 22	34.414	66.667	91.045	0.000	0.000	30.750	0.000	0.000	4.671	0.000	0.000	52.199	33	67	0
fluid bed fly ash		54	N	12.7.3. 23	35.868	83.333	99.579	35.868	83.333	99.579	0.000	0.000	5.857	0.000	0.000	84.127	17	0	83
fluid bed bottom ash		55	N	12.7.3. 24	56.338	72.093	84.738	0.000	0.000	8.581	0.000	0.000	4.671	0.000	0.000	52.199	28	72	0
coal gassing bottom ash		56	N	12.7.3. 25	0.000	0.000	70.760	0.000	0.000	0.000	0.000	0.000	52.199	0.000	0.000	0.369	100	0	0
coal gassing fly ash		58	N	12.7.3. 26	99.963	100.000	100.000	0.000	0.000	0.037	0.000	0.000	70.760	0.000	0.000	0.369	0	100	0
MSWI bottom ash		59	N2	12.7.3. 27	94.803	100.000	100.000	87.676	95.775	99.127	94.942	98.266	99.642	3.342	17.647	43.407	0	4	96
MSWI fly ash		60	N	12.7.3. 28	75.400	100.000	100.000	75.400	100.000	100.000	93.063	98.750	99.969	0.000	0.000	30.750	0	0	100
blast furnace slag		61	N	12.7.3. 29	4.329	33.333	77.716	0.000	0.000	45.946	0.000	0.000	41.044	0.000	0.000	60.239	67	33	0
blast furnace mixed slag			N	12.7.3. 17	24.510	62.500	91.482	0.000	0.000	37.008	0.000	0.000	33.726	0.000	0.000	0.369	38	63	0
hydr. mixed aggregate				12.7.3. 17	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
blast furnace foam slag		62	N1	12.7.3. 30	1.259	50.000	98.741	0.000	0.000	84.127	0.000	0.000	52.199	0.000	0.000	84.127	50	50	0
granulated blast furnace slag		63	N1	12.7.3. 31	0.000	0.000	0.369	0.000	0.000	0.000	0.000	0.000	84.127	0.000	0.000	84.127	100	0	0
blast furnace slag sand		64	N	12.7.3. 32	0.000	0.000	84.127	0.000	0.000	0.000	0.000	0.000	60.239	0.000	0.000	0.369	100	0	0
jarosite end slag		65	N	12.7.3. 33	99.631	100.000	100.000	99.631	100.000	100.000	73.643	100.000	100.000	0.000	0.000	0.369	0	0	100
LD slag		66	N	12.7.3. 34	42.135	85.714	99.639	42.135	85.714	99.639	73.643	100.000	100.000	0.000	0.000	84.127	14	0	86
phosphor slag		67	N	12.7.3. 35	99.631	100.000	100.000	0.000	0.000	0.369	29.240	100.000	100.000	0.000	0.000	84.127	0	100	0
ELO slag		68	N	12.7.3. 36	39.761	100.000	100.000	19.405	75.000	99.369	73.643	100.000	100.000	0.000	0.000	84.127	0	25	75
copper slag		69	N		ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
chromium slag		70	N		ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
fly ash aggregate		71	N	12.7.3. 37	47.801	100.000	100.000	5.274	40.000	85.337	0.000	0.000	30.844	0.000	0.000	0.369	0	60	40

Table d: Confidence interval and combined evaluation for P R E F A B R I C A T E D construction materials based on the standard setting of the conceptional Administrative Order for Construction Materials

confidence intervals of P in %

BINOMINAL DISTRIBUTION

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
					leaching						inorganic composition			organic composition			combination in % of leaching & composition		
																	constr.mat	constr.mat	landfilling
construction material	remark	no.	cat. oBB	chapter	P(U1,l)	P(U1)	P(U1,r)	P(U2,l)	P(U2)	P(U2,r)	P(S,l)	P(S)	P(S,r)	P(S,l)	P(S)	P(S,r)	U1	U2	
lime stone		5	V1	12.8.2. 1	ERR	ERR	ERR	ERR	ERR	ERR	0.000	0.000	60.239	0.000	0.000	0.369	ERR	ERR	ERR
basalt		8	V1	12.8.2. 2	ERR	ERR	ERR	ERR	ERR	ERR	0.000	0.000	0.369	0.000	0.000	0.369	ERR	ERR	ERR
cement concrete		13	V1	12.8.2. 3	0.000	0.000	17.571	0.000	0.000	0.000	0.000	0.000	30.750	0.000	0.000	70.760	100	0	0
cement concrete +	with E fly ash (8	14		12.8.2. 4	0.000	0.000	17.571	0.000	0.000	0.000	0.000	0.000	30.750	0.000	0.000	70.760	100	0	0
	with MSWI bottom ash (8%)		V1	12.8.2. 4	0.000	0.000	17.571	0.000	0.000	0.000	0.000	0.000	30.750	0.000	0.000	70.760	100	0	0
	with jarosite end slag		V1		ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
	with ardealite			12.8.2. 4	0.000	0.000	17.571	0.000	0.000	0.000	0.000	0.000	30.750	0.000	0.000	70.760	100	0	0
	with lytag			12.8.2. 4	0.000	0.000	17.571	0.000	0.000	0.000	0.000	0.000	30.750	0.000	0.000	70.760	100	0	0
asphalt cement	recycling	15	V1	12.8.2. 5	0.000	0.000	28.385	0.000	0.000	0.000	0.000	0.000	21.706	9.269	27.778	53.562	100	0	0
	others			12.8.2. 5	0.000	0.000	28.385	0.000	0.000	0.000	0.000	0.000	21.706	5.274	40.000	85.337	100	0	0
asphalt cement +	with MSWI fly as	16	V1	12.8.2. 6	29.240	100.000	100.000	0.000	0.000	70.760	0.000	0.000	21.706	9.269	27.778	53.562	0	100	0
	with E fly ash (6%)		V1	12.8.2. 6	0.000	0.000	28.385	0.000	0.000	0.000	0.000	0.000	21.706	9.269	27.778	53.562	100	0	0
	with E MSWI fly ash		V1	12.8.2. 6	0.000	0.000	28.385	0.000	0.000	0.000	0.000	0.000	21.706	9.269	27.778	53.562	100	0	0
	with phosphor slag (59%)		V1	12.8.2. 6	0.000	0.000	28.385	0.000	0.000	0.000	15.873	100.000	100.000	9.269	27.778	53.562	100	0	0
	with MSWI bottom ash			12.8.2. 6	0.000	0.000	28.385	0.000	0.000	0.000	0.000	0.000	21.706	9.269	27.778	53.562	100	0	0
	with jarosite end slag				ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
	with tar			12.8.2. 5	0.000	0.000	28.385	0.000	0.000	0.000	0.000	0.000	21.706	58.956	100.000	100.000	100	0	0
mortar				12.8.2. 7	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
mortar	with E fly ash	18	V1	12.8.2. 8	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
rough ceramic products		19	V1	12.8.2. 9	5.274	40.000	85.337	0.000	0.000	52.199	0.000	0.000	37.008	0.000	0.000	0.369	60	40	0
rough ceramic products	with E fly ash (25	20			ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
porous masonry bricks +	with E fly ash (29%)				ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
Ca-silicate bricks and blocks		23	V1	12.8.2. 10	0.000	0.000	52.199	0.000	0.000	0.000	0.000	0.000	45.946	0.000	0.000	0.369	100	0	0
Ca-silicate bricks and blocks +	with E fly ash (9	24	V1	12.8.2. 11	0.000	0.000	52.199	0.000	0.000	0.000	0.000	0.000	45.946	0.000	0.000	0.369	100	0	0
	with E fly ash (37%)			12.8.2. 11	0.000	0.000	52.199	0.000	0.000	0.000	0.000	0.000	45.946	0.000	0.000	0.369	100	0	0
	with lownox fly ash (9%)			12.8.2. 11	0.000	0.000	52.199	0.000	0.000	0.000	0.000	0.000	45.946	0.000	0.000	0.369	100	0	0
	with fluid bed ash (29%)			12.8.2. 11	99.631	100.000	100.000	99.631	100.000	100.000	0.000	0.000	45.946	0.000	0.000	0.369	0	0	100
	with ash lime (8%)			12.8.2. 11	0.000	0.000	52.199	0.000	0.000	0.000	0.000	0.000	45.946	0.000	0.000	0.369	100	0	0
aerated concrete		25	V1	12.8.2. 12	71.615	100.000	100.000	57.308	92.308	99.808	0.000	0.000	52.199	0.000	0.000	0.369	0	8	92
aerated concrete +	with E fly ash	26			ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
sand cement stabilization		29	V1	12.8.2. 13	0.000	0.000	0.369	0.000	0.000	0.000	0.000	0.000	0.369	0.000	0.000	0.369	100	0	0
sand cement stabilization +	with E fly ash (7	30		12.8.2. 14	99.631	100.000	100.000	99.631	100.000	100.000	0.000	0.000	0.369	0.000	0.000	0.369	0	0	100
blast furnace slag mix		34	V1/N*	12.8.2. 15	ERR	ERR	ERR	ERR	ERR	ERR	0.000	0.000	33.726	0.000	0.000	0.369	ERR	ERR	ERR
hydraulic mix aggregate		35		12.8.2. 16	ERR	ERR	ERR	ERR	ERR	ERR	0.000	0.000	70.760	0.000	0.000	0.369	ERR	ERR	ERR
lightly stabilised phosphor slag		36	V2	12.8.2. 17	15.873	100.000	100.000	0.000	0.000	84.127	15.873	100.000	100.000	0.000	0.000	0.369	0	100	0
lightly stabilised steel slag		37		12.8.2. 18	ERR	ERR	ERR	ERR	ERR	ERR	0.000	0.000	0.369	0.000	0.000	0.369	ERR	ERR	ERR
stabilised MSWI bottom ash		38	V2	12.8.2. 19	62.992	100.000	100.000	34.904	75.000	96.817	22.284	66.667	95.671	0.000	0.000	0.369	0	25	75
lightly stabilised E fly ash		40		12.8.2. 20	ERR	ERR	ERR	ERR	ERR	ERR	0.000	0.000	52.199	0.000	0.000	0.369	ERR	ERR	ERR
blast furnace slag		61		12.8.2. 21	9.434	66.667	99.159	0.000	0.000	70.760	0.000	0.000	33.726	0.000	0.000	60.239	33	67	0
LD slag		66	V1	12.8.2. 22	22.284	66.667	95.671	0.000	0.000	45.946	28.415	57.143	82.959	0.000	0.000	84.127	33	67	0
phosphor slag		67	V1/N*	12.8.2. 23	99.631	100.000	100.000	0.000	0.000	0.369	29.240	100.000	100.000	0.000	0.000	84.127	0	100	0
copper slag		69		12.8.2. 24	53.750	91.667	99.792	14.272	41.667	72.971	ERR	ERR	ERR	ERR	ERR	ERR	8	50	42
hydr. stabilised E fly ash aggr.		73		12.8.2. 25	ERR	ERR	ERR	ERR	ERR	ERR	1.259	50.000	98.741	0.000	0.000	0.369	ERR	ERR	ERR
sand cement stabilization +	with sieve sand				0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	100	0	0
aerated concrete	with E fly ash				0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	100	0	0
cleaned soil					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	100	0	0
crushed asphalt cement					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	100	0	0

* Prefabricated construction material evaluated as non-prefabricated construction material.

Appendix 16 Splitting of construction materials into classes based on leaching and (in)organic composition and taking uncertainties into account

Table a. Splitting of non-prefabricated construction materials (in percentages) into classes based on the standard setting of the oBB and/or according to the standard setting of Part 1 (Building Materials Decree).

Table b. Splitting of prefabricated construction materials (in percentages) into classes based on the standard setting of the oBB and/or according to the standard setting in Part 1 (Building Materials Decree).

column 1. Name of the construction material.

column 2. Comments concerning the construction material.

column 3. Category distribution according to the conceptual Building Materials Decree.

For the other columns, see the surveys below. See also Chapter 13.3.

Survey 1. oBB.

<table>
<tr><th colspan="2" rowspan="2">NUMBERS IN PERCENTAGES</th><th colspan="5">LEACHING</th></tr>
<tr><th>certainly cat. 1</th><th>uncertain cat. 1 of 2</th><th>certainly cat. 2</th><th>uncertain cat. 2 or dumping</th><th>certainly dumping</th></tr>
<tr><td rowspan="3">COMPOSITION</td><td>applicable</td><td>cat. 1
column 4</td><td>cat. 1 of cat. 2
column 5</td><td>cat. 2
column 7</td><td></td><td rowspan="2"></td></tr>
<tr><td>unknown</td><td>cat. 1 or dumping
column 6</td><td colspan="3">apply in cat.1, cat. 2 or dumping
column 8</td></tr>
<tr><td>not applicable</td><td colspan="5">dumping
column 9</td></tr>
</table>

Survey 2. Standard setting according to Part 1 (Building Materials Decree).

<table>
<tr><th colspan="2" rowspan="2">NUMBERS IN PERCENTAGES</th><th colspan="5">LEACHING</th></tr>
<tr><th>certainly cat. 1</th><th>uncertain cat. 1 of 2</th><th>certainly cat. 2</th><th>uncertain cat. 2 or dumping</th><th>certainly dumping</th></tr>
<tr><td rowspan="3">COMPOSITION</td><td>applicable</td><td>cat. 1
column 10</td><td>cat. 1 of cat. 2
column 11</td><td>cat. 2
column 13</td><td></td><td rowspan="2"></td></tr>
<tr><td>unknown</td><td>cat. 1 or dumping
column 12</td><td colspan="3">apply in cat.1, cat. 2 or dumping
column 14</td></tr>
<tr><td>not applicable</td><td colspan="5">dumping
column 15</td></tr>
</table>

ERR. No data available.

Table a: Splitting of N O N - P R E F A B R I C A T E D construction materials (in percentages) into classes on the standard setting of the oBB and/or according to the standard setting of Part 1 (Administrative Order for Construction Materials) and taking uncertainties into account

			combination standard setting oBB leaching and composition organic/(inorganic oBB) in %						combination adapted standard setting leaching and composition organic (BB) in %					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
construction material	remark	cat. oBB	certainly cat.1	uncertain cat.1 or 2	uncertain cat.1 or dumping	certainly cat. 2	uncertain cat.2 or dumping	certainly dumping	certainly cat.1	uncertain cat.1 or 2	uncertain cat.1 or dumping	certainly cat. 2	uncertain cat.2 or dumping	certainly dumping
clay		G	16	0	84	0	0	0	16	0	84	0	0	0
loam		G	99	0	0	0	0	0	99	0	0	0	0	0
gravel		G	0	8	1	0	90	0	3	13	13	0	71	0
natural sand		G	8	12	20	0	60	1	23	25	25	0	27	0
natural sand	de-silted	G	99	0	0	0	0	0	99	0	0	0	0	0
limestone		N1	99	0	0	0	0	0	99	0	0	0	0	0
quartzite		N1	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
sand stone		N1	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
basalt		N1	99	0	0	0	0	0	99	0	0	0	0	0
granite		N1	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
porfier		N1	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
flug sand		N1	99	0	0	0	0	0	99	0	0	0	0	0
lava stone		N1	1	8	8	0	83	0	5	11	25	0	60	0
asphalt aggregate	bitumen	N2	1	18	2	0	46	33	48	41	6	0	5	0
asphalt aggregate	recycling	N2	1	18	2	0	46	33	48	41	6	0	5	0
asphalt aggregate	tar	N	0	0	2	0	39	59	0	0	22	0	19	59
cement aggregate		N1	0	14	0	7	69	10	46	20	23	0	10	0
masonry aggregate		N1	0	0	0	0	90	9	12	18	28	0	43	0
masonry aggregate	certified	N2	0	0	0	0	90	9	12	18	28	0	43	0
mixed aggregate		N2	0	0	1	0	51	47	27	32	8	0	33	0
mixed aggregate	certified	N1	5	5	22	0	33	35	45	20	12	0	22	0
sieve sand		N2	0	0	3	0	4	92	30	18	19	0	11	21
recycling breaker sand		N	0	0	8	0	23	68	20	32	8	0	33	7
recycling breaker sand	certified		0	0	8	0	23	68	20	32	8	0	33	7
constr. and demol. waste	undefined	N	1	8	3	0	56	32	5	18	8	0	57	12
smoke desulph. gypsum		N	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
phosphor acid gypsum		N	0	0	0	0	0	100	0	42	0	0	42	16
mine stone	others	N	53	16	23	0	7	1	66	20	11	0	3	0
mine stone	certified	N	53	16	23	0	7	1	66	20	11	0	3	0
mine stone	NL	N	0	34	0	0	65	1	0	43	0	0	57	0
mine stone	washed	N	53	16	23	0	7	1	66	20	11	0	3	0
with E fly ash		N2	0	5	0	0	59	36	0	5	0	0	59	36
E bottom ash		N	7	14	8	23	48	0	33	11	37	0	19	0
E bottom ash	certified	N1	4	27	5	2	62	0	11	24	12	0	53	0
fluid bed fly ash		N	0	5	0	0	59	36	0	5	0	0	59	36
fluid bed bottom ash		N	7	14	8	23	48	0	33	11	37	0	19	0
coal gassing bottom ash		N	29	70	0	0	0	0	40	60	0	0	0	0
coal gassing fly ash		N	0	0	0	100	0	0	99	0	0	0	0	0
MSWI bottom ash		N2	0	0	0	0	1	99	1	8	0	0	19	72
MSWI fly ash		N	0	0	0	0	2	98	0	9	0	0	16	75
blast furnace slag		N	9	19	13	0	59	0	9	19	13	0	59	0
blast furnace mixed slag		N	8	59	0	0	33	0	18	52	0	0	30	0
hydr. mixed aggregate			ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
blast furnace foam slag		N1	0	8	1	0	90	0	3	13	13	0	71	0
granulated blast furnace slag		N1	16	0	84	0	0	0	16	0	84	0	0	0
blast furnace slag sand		N	16	84	0	0	0	0	16	84	0	0	0	0
jarosite end slag		N	0	0	0	0	0	100	0	0	0	0	0	100
LD slag		N	0	0	0	0	15	85	0	5	0	0	65	29
phosphor slag		N	0	0	0	0	71	29	0	0	0	16	84	0
ELO slag		N	0	0	0	0	21	79	0	5	0	0	75	19
copper slag		N	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
chromium slag		N	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
fly ash aggregate		N	0	37	0	0	57	5	0	50	0	0	50	0

Table b: Splitting of PREFABRICATED construction materials (in percentages) into classes on the standard setting of the oBB and/or according to the standard setting of Part 1 (Administrative Order for Construction Materials) and taking uncertainties into account

			combination standard setting oBB leaching and composition organic/(inorganic oBB) in %						combination adapted standard setting leaching and composition organic (BB) in %					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
			certainly	uncertain	uncertain	certainly	uncertain	certainly	certainly	uncertain	uncertain	certainly	uncertain	certainly
construction material	remark	cat. oBB	cat.1	cat.1 or 2	cat.1 or dumping	cat. 2	cat.2 or dumping	dumping	cat.1	cat.1 or 2	cat.1 or dumping	cat. 2	cat.2 or dumping	dumping
lime stone		V1	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
basalt		V1	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
cement concrete		V1	24	5	58	0	12	0	80	19	0	0	0	0
cement concrete +	with E fly ash (8%)		24	5	58	0	12	0	80	19	0	0	0	0
	with MSWI bottom ash (8%)	V1	24	5	58	0	12	0	80	19	0	0	0	0
	with jarosite end slag	V1	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
	with ardealite		24	5	58	0	12	0	80	19	0	0	0	0
	with lytag		24	5	58	0	12	0	80	19	0	0	0	0
asphalt cement	recycling	V1	33	13	32	0	13	9	67	17	13	0	3	0
	others		11	4	57	0	23	5	67	17	13	0	3	0
asphalt cement +	with MSWI fly ash (2%)	V1	0	23	0	0	68	9	67	17	13	0	3	0
	with E fly ash (6%)	V1	33	13	32	0	13	9	67	17	13	0	3	0
	with E MSWI fly ash	V1	33	13	32	0	13	9	67	17	13	0	3	0
	with phosphor slag (59%)	V1	0	0	60	0	24	16	67	17	13	0	3	0
	with MSWI bottom ash		33	13	32	0	13	9	67	17	13	0	3	0
	with jarosite end slag		ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
	with tar		0	0	29	0	12	59	0	0	33	0	8	59
mortar			ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
mortar	with E fly ash	V1	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
rough ceramic products		V1	15	51	0	0	34	0	69	31	0	0	0	0
rough ceramic products	with E fly ash (25-40%)		ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
porous masonry bricks +	with E fly ash (29%)		ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
Ca-silicate bricks and blocks		V1	48	52	0	0	0	0	48	52	0	0	0	0
Ca-silicate bricks and blocks +	with E fly ash (9%)	V1	48	52	0	0	0	0	48	52	0	0	0	0
	with E fly ash (37%)		48	52	0	0	0	0	48	52	0	0	0	0
	with lownox fly ash (9%)		48	52	0	0	0	0	48	52	0	0	0	0
	with fluid bed ash (29%)		0	0	0	0	0	100	0	0	0	0	0	100
	with ash lime (8%)		48	52	0	0	0	0	48	52	0	0	0	0
aerated concrete		V1	0	17	0	0	26	57	0	28	0	43	29	0
aerated concrete +	with E fly ash		ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
sand cement stabilization		V1	99	0	0	0	0	0	99	0	0	0	0	0
sand cement stabilization +	with E fly ash (73%)		0	0	0	0	0	100	0	0	0	0	0	100
blast furnace slag mix		V1/N*	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
hydraulic mix aggregate			ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
lightly stabilised phosphor slag		V2	0	0	0	0	84	16	16	84	0	0	0	0
lightly stabilised steel slag			ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
stabilised MSWI bottom ash		V2	0	1	0	0	50	49	0	46	0	8	46	0
lightly stabilised E fly ash			ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
blast furnace slag			0	22	1	0	77	0	4	20	6	0	70	0
LD slag		V1	1	10	2	0	58	28	9	7	45	0	39	0
phosphor slag		V1/N*	0	0	0	0	71	29	16	0	84	0	0	0
copper slag			ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
hydr. stabilised E fly ash aggr.			ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
sand cement stabilization +	with sieve sand		100	0	0	0	0	0	100	0	0	0	0	0
aerated concrete	with E fly ash		100	0	0	0	0	0	100	0	0	0	0	0
cleaned soil			100	0	0	0	0	0	100	0	0	0	0	0
crushed asphalt cement			100	0	0	0	0	0	100	0	0	0	0	0

* Prefabricated construction material evaluated as non-prefabricated construction material.

Appendix 17 Calculation of the costs for analysis and dumping in 1990/2000, assuming the categorization of the construction materials according to the adapted standard setting and the set of construction materials which belong to the set of Van Ruiten.

Table a. Calculation of the expected costs for analysis and dumping in 1990 assuming the categorization of construction according to the adapted standard setting and the set of construction materials belonging to the set of Van Ruiten.

Table b. Calculation of the costs for analysis and dumping in 1990 with 95% confidence assuming the categorization of construction materials according to the adapted standard setting and the set of construction materials which belong to the Van Ruiten set.

Table c. Calculation of the expected costs for analysis and dumping in 2000 assuming the categorization of construction materials according to the adapted standard setting and the set of construction materials belonging to the Van Ruiten set.

table d. Calculation of the costs for analysis and dumping in 2000 with 95% confidence assuming the categorization of construction materials according to the adapted standard setting and the set of construction materials which belong to the Van Ruiten set.

column 1. Name of the construction material and comments concerning the construction material.

columns 2-6 and 8

See surveys below. See also Chapter 13.3.

column 7. Amount of construction material in the "special category" based on the adapted standard setting.

column 8. See survey I.

column 9. Total use per construction material.

column 10. Evaluated use (right), use not evaluated (left)

column 11. Number of critical compounds for the leaching, see table 12.7.1.1.-2 and 12.7.2.1.-2.

column 12. Number of critical compounds for the composition, see table 12.7.1.1.-2., and 12.7.2.1.-2.

Survey I. oBB.

<table>
<tr><td colspan="2" rowspan="2">NUMBERS IN Kton</td><td colspan="5">LEACHING</td></tr>
<tr><td>certainly cat. 1</td><td>uncertain cat. 1 of 2</td><td>certainly cat. 2</td><td>uncertain cat. 2 or dumping</td><td>certainly dumping</td></tr>
<tr><td rowspan="3">COMPOSITION</td><td>applicable</td><td>cat. 1
column 4</td><td>cat. 1 of cat. 2
column 5</td><td>cat. 2
column 7</td><td></td><td rowspan="2"></td></tr>
<tr><td>unknown</td><td>cat. 1 or dumping
column 6</td><td colspan="3">apply in cat.1, cat. 2 or dumping
column 8</td></tr>
<tr><td>not applicable</td><td colspan="5">dumping
column 9</td></tr>
</table>

column 13. Analysis costs certainly leaching in Kf.

column 14. Analysis costs uncertain leaching in Kf.

column 15. Analysis costs certainly composition in Kf.

column 16. Analysis costs uncertain composition in Kf.

column 17. Analysis costs total certainly in Kf.

column 18. Analysis costs total uncertain in Kf.

column 19. Analysis costs in guilders per ton of used construction material.

column 20. Dumping costs total certainly in Kf.

column 21. Dumping costs total uncertain in Kf.

column 22. Dumping costs in guilders per ton of used construction material.

ERR No data available.

Table a: Calculation of costs for analysis and dumping (expected) assuming the categorization of construction materials according to the adapted standard setting and the set of construction materials belonging to the Van Ruiten set.

BINOMIAL DISTRIBUTION
95_BO_90.wk1
THIN LAYER

construction material remark	combination leaching and composition organic/(inorganic oBB) in Kton cat 1	cat 1 or cat 2	cat 1 or dumping	cat 2	cat 1 cat 2 or dumping	"spec. dumping cat"		total	eval. of mat. use critical Kton	leach	compos. org/inorg	1990 analysis costs leaching certainly	uncertain	composition org certainly	org uncertain	total certainly in Kf	total uncertain in Kf	per ton f/ton	f125/ton certainly in Kf	unknown in Kf	dumping costs per ton f/ton
sand cement stab.+sieve sand								100.00	100												
cement aggregate	1032	0	0	0	0		0	1032	1032	2	1	57.8	0.0	0.0	0.0	57.8	0.0	0.06	0.0	0.0	0.00
masonry aggregate	708	0	0	0	0		0	708	708	4	1	54.5	0.0	0.0	0.0	54.5	0.0	0.08	0.0	0.0	0.00
mixed aggr. cert.	2148	0	0	358	0		0	2506	2506	3	1	166.6	0.0	0.0	0.0	166.6	0.0	0.07	0.0	0.0	0.00
E bottom ash	61	0	0	39	0		0	100	100	2		5.6	0.0	0.0	0.0	5.6	0.0	0.06	0.0	0.0	0.00
lightly stabilised E fly ash								500.00	500												
cement concr.+gran. B F slag	1100	0	0	0	0		0	1100	1100	2		246.4	0.0	0.0	0.0	246.4	0.0	0.22	0.0	0.0	0.00
with E fly ash (8%)	100	0	0	0	0		0	100	100	2		22.4	0.0	0.0	0.0	22.4	0.0	0.22	0.0	0.0	0.00
with MSWI bottom ash (8%)	0	0	0	0	0		0	0	0	2		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.00
with jarosite end slag									0												
asphalt cement recycl.	500	0	0	0	0		0	500	500	3		133.0	0.0	0.0	0.0	133.0	0.0	0.27	0.0	0.0	0.00
with MSWI fly ash (2%)	100	0	0	0	0		0	100	100	3		26.6	0.0	0.0	0.0	26.6	0.0	0.27	0.0	0.0	0.00
with E fly ash (6%)	100	0	0	0	0		0	100	100	3		26.6	0.0	0.0	0.0	26.6	0.0	0.27	0.0	0.0	0.00
with phosphor slag (59%)	100	0	0	0	0		0	100	100	3		26.6	0.0	0.0	0.0	26.6	0.0	0.27	0.0	0.0	0.00
crushed asphalt cement								100.00	100												
blast furnace slag mix	400	0	0	300	0		0	700	700	2		156.8	0.0	0.0	0.0	156.8	0.0	0.22	0.0	0.0	0.00
LD slag	100	0	0	0	0		0	100	100	3		26.6	0.0	0.0	0.0	26.6	0.0	0.27	0.0	0.0	0.00
phosphor slag	33	0	0	67	0		0	100	100	2		22.4	0.0	0.0	0.0	22.4	0.0	0.22	0.0	0.0	0.00
Total cat. 1.	**6482**	**0**	**0**	**764**	**0**	**0**	**0**	**7946.0**	**7246.0**												
masonry aggregate	0	0	0	0	0		0	0	0	4		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
mixed aggregate	825	0	0	275	0		0	1100	1100	3	1	73.2	0.0	0.0	0.0	73.2	0.0	0.07	0.0	0.0	0.00
asphalt aggregate	1500	0	0	0	0		0	1500	1500	3	1	99.8	0.0	0.0	0.0	99.8	0.0	0.07	0.0	0.0	0.00
sieve sand	252	0	0	0	0		131	383	383	2	5	14.1	0.0	9.6	0.0	23.8	0.0	0.06	16347.6	0.0	42.68
E fly ash	17	0	0	0	0	83 (0)		100	100	2		0.9	0.0	0.0	0.0	0.9	0.0	0.01	0.0	0.0	0.00
stabilised MSWI bottom ash	0	0	0	0	0		0	0	0	1		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.00
MSWI slag	25	0	0	76	0	499 0		600	600	6		spec. cat		spec. cat		0.0	0.0	0.00	0.0	0.0	0.00
lightly stabilised phosphor slag	400	0	0	0	0		0	400	400	1		72.8	0.0	0.0	0.0	72.8	0.0	0.18	0.0	0.0	0.00
Total cat. 2.	**3019**	**0**	**0**	**351**	**0**	**582**	**131**	**4083.0**	**4083.0**												
fluid bed bottom ash	61	0	0	39	0		0	100	100	2		5.6	0.0	0.0	0.0	5.6	0.0	0.06	0.0	0.0	0.00
coal gassing bottom ash	0	0	0	0	0		0	0	0	2		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.00
aerated concr. with E fly ash								100.00	100												
cleaned soil								400.00	400												
RO gypsum								200.00	200												
phosphor acid gypsum	0	0	0	0	0		0	0.00	0	5		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total others	**61**	**0**	**0**	**39**	**0**	**0**	**0**	**800.0**	**100.0**												
TOTAL	9562	0	0	1154	0	582	131	12829	11429	67	10	1238	0	10	0	1248	0	0.15	16348	0	1.86
																1248			16348		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22

Table b: Calculation of costs for analysis and dumping (95%-confidence) assuming the categorization of construction materials according to the adapted standard setting and the set of construction materials belonging to the Van Ruiten set.

BINOMIAL DISTRIBUTION																					
95_BO_90.wk1	combination leaching and composition organic/(inorganic oBB)													1990							
THIN LAYER	in Kton								eval. of mat.					analysis co	analysis co	analysis costs					dumping
	cat 1	cat 1	cat 1	cat 2	cat 1	"spec.	dumping	total	use critical	leaching		leaching		composition		total	total		f125/ton		costs
construction		or	or		cat 2 or	cat"			Kton	leachin	compos.			org	org	certainly	uncertain	per ton	certainly	unknown	per ton
material remark		cat 2	dumping		dumping						org/inorg	certainly	uncertain	certainly	uncertain	in Kf	in Kf	f/ton	in Kf	in Kf	f/ton
sand cement stabilization +								100.00	100												
cement aggregate	474	212	239	0	107		0	1032	1032	2	1	26.6	71.3	0.0	26.0	26.6	97.3	0.12	0.0	43273.6	41.93
masonry aggregate	82	125	199	0	302		0	708	708	4	1	6.3	131.4	0.0	37.6	6.3	168.9	0.25	0.0	62622.8	88.45
mixed aggregate certified	1123	514	311	0	558		0	2506	2506	3	1	74.7	285.1	0.0	40.8	74.7	325.9	0.16	0.0	108695.8	43.37
E bottom ash	47	27	0	20	7		0	100	100	2		3.7	7.5	0.0	0.0	3.7	7.5	0.11	0.0	866.7	8.67
lightly stabilised E fly ash								500.00	500												
cement concrete+gran. B F slag	883	213	3	0	1		0	1100	1100	2		197.8	239.3	0.0	0.4	197.8	239.7	0.40	0.0	507.4	0.46
with E fly ash (8%)	80	19	0	0	0		0	100	100	2		18.0	21.8	0.0	0.0	18.0	21.8	0.40	0.0	46.1	0.46
with MSWI bottom ash (8%)	0	0	0	0	0		0	0	0	2		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.46
with jarosite end slag									0												
asphalt cement recycling	334	86	64	0	16		0	500	500	3		88.8	136.3	0.0	8.0	88.8	144.3	0.47	0.0	10027.2	20.05
with MSWI fly ash (2%)	67	17	13	0	3		0	100	100	3		17.8	27.3	0.0	1.6	17.8	28.9	0.47	0.0	2005.4	20.05
with E fly ash (6%)	67	17	13	0	3		0	100	100	3		17.8	27.3	0.0	1.6	17.8	28.9	0.47	0.0	2005.4	20.05
with phosphor slag (59%)	67	17	13	0	3		0	100	100	3		17.8	27.3	0.0	1.6	17.8	28.9	0.47	0.0	2005.4	20.05
crushed asphalt cement								100.00	100												
blast furnace slag mix	128	362	0	0	209		0	700	700	2		28.8	639.6	0.0	0.3	28.8	639.9	0.96	0.0	26218.8	37.46
LD slag	54	46	0	0	0		0	100	100	3		14.3	61.1	0.0	0.0	14.3	61.1	0.75	0.0	46.1	0.46
phosphor slag	1	55	0	0	44		0	100	100	2		0.2	111.1	0.0	0.0	0.2	111.1	1.11	0.0	5491.0	54.91
Total cat. 1.	3406	1709	856	20	1254	0	0	7946.0	7246.0												
masonry aggregate	0	0	0	0	0		0	0	0	4		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
mixed aggregate	301	351	83	0	365		0	1100	1100	3	1	20.0	190.5	0.0	17.9	20.0	208.4	0.21	0.0	56063.2	50.97
asphalt aggregate	720	612	91	0	77		0	1500	1500	3	1	47.9	183.3	0.0	12.6	47.9	195.9	0.16	0.0	20965.9	13.98
sieve sand	119	70	74	0	43		77	383	383	2	5	6.7	25.4	5.7	34.6	12.3	60.0	0.19	9583.0	14642.8	63.25
E fly ash	0	32	0	0	32 :	36 (0)		100	100	2		0.0	14.3	0.0	0.0	0.0	14.3	0.14	0.0	3996.8	39.97
stabilised MSWI bottom ash	0	0	0	0	0		0	0	0	1		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	57.68
MSWI slag	4	48	1	0	113	434 0		600	600	6		spec.cat		spec.cat		0.0	0.0	0.00	0.0	14238.1	23.73
lightly stabilised phosphor slag	63	335	0	0	1		0	400	400	1		11.5	306.2	0.0	0.1	11.5	306.4	0.79	0.0	184.5	0.46
Total cat. 2.	1208	1448	249	0	632	470	77	4083.0	4083.0												
fluid bed bottom ash	47	27	0	20	7		0	100	100	2		3.7	7.5	0.0	0.0	3.7	7.5	0.11	0.0	866.7	8.67
coal gassing bottom ash	0	0	0	0	0		0	0	0	2		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.46
aerated concr. with E fly ash								100.00	100												
cleaned soil								400.00	400												
RO gypsum								200.00	200												
phosphor acid gypsum	0	0	0	0	0		0	0.00	0	5		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total others	47	27	0	20	7	0	0	800.0	100.0												
TOTAL	4661	3184	1106	40	1892	470	77	12829	11429	67	10	602	2513	6	183	608	2697	0.39	9583	374770	26.78
																3304			384353		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22

Table c: Calculation of costs for analysis and dumping (expected) assuming the categorization of construction materials according to the adapted standard setting and the set of construction materials belonging to the Van Ruiten set.

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construction material / remark	combination leaching and composition organic/(inorganic oBB) in Kton cat 1	cat 1 or cat 2	cat 1 or dumping	cat 2	cat 1 cat 2 or dumping	"spec. cat"	dumping	total	eval. of mat. use Kton	critical leaching	impos. org/inorg	leaching certainly	leaching uncertain	analysis co composition org certainly	1990 analysis co org uncertain	analysis costs total certainly in Kf	total uncertain in Kf	per ton f/ton	f125/ton certainly in Kf	unknown in Kf	dumping costs per ton f/ton
sand cement stabilization +								300.00	300												
cement aggregate	1118	0	0	0	0		0	1118	1118	2	1	62.6	0.0	0.0	0.0	62.6	0.0	0.06	0.0	0.0	0.00
masonry aggregate	767	0	0	0	0		0	767	767	4	1	59.1	0.0	0.0	0.0	59.1	0.0	0.08	0.0	0.0	0.00
mixed aggregate certified	2326	0	0	388	0		0	2714	2714	3	1	180.5	0.0	0.0	0.0	180.5	0.0	0.07	0.0	0.0	0.00
E bottom ash	61	0	0	39	0		0	100	100	2		5.6	0.0	0.0	0.0	5.6	0.0	0.06	0.0	0.0	0.00
lightly stabilised E fly ash								600.00	600												
cement concrete+gran. B F slag	1100	0	0	0	0		0	1100	1100	2		246.4	0.0	0.0	0.0	246.4	0.0	0.22	0.0	0.0	0.00
with E fly ash (8%)	300	0	0	0	0		0	300	300	2		67.2	0.0	0.0	0.0	67.2	0.0	0.22	0.0	0.0	0.00
with MSWI bottom ash (8%)	100	0	0	0	0		0	100	100	2		22.4	0.0	0.0	0.0	22.4	0.0		0.0	0.0	0.00
with jarosite end slag								100	100										0.0	0.0	
asphalt cement recycling	800	0	0	0	0		0	800	800	3		212.8	0.0	0.0	0.0	212.8	0.0	0.27	0.0	0.0	0.00
with MSWI fly ash (2%)	100	0	0	0	0		0	100	100	3		26.6	0.0	0.0	0.0	26.6	0.0	0.27	0.0	0.0	0.00
with E fly ash (6%)	100	0	0	0	0		0	100	100	3		26.6	0.0	0.0	0.0	26.6	0.0	0.27	0.0	0.0	0.00
with phosphor slag (59%)	200	0	0	0	0		0	200	200	3		53.2	0.0	0.0	0.0	53.2	0.0	0.27	0.0	0.0	0.00
crushed asphalt cement								0.00	0												
blast furnace slag mix	400	0	0	300	0		0	700	700	2		156.8	0.0	0.0	0.0	156.8	0.0	0.22	0.0	0.0	0.00
LD slag	100	0	0	0	0		0	100	100	3		26.6	0.0	0.0	0.0	26.6	0.0	0.27	0.0	0.0	0.00
phosphor slag	33	0	0	67	0		0	100	100	2		22.4	0.0	0.0	0.0	22.4	0.0	0.22	0.0	0.0	0.00
Total cat. 1.	7505	0	0	794	0	0	0	9299.0	8299.000												
masonry aggregate	0	0	0	0	0		0	0	0	4		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
mixed aggregate	0	0	0	0	0		0	0	0	3	1	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0.0	
asphalt aggregate	2400	0	0	0	0		0	2400	2400	3	1	159.6	0.0	0.0	0.0	159.6	0.0	0.07	0.0	0.0	0.00
sieve sand	1449	0	0	0	0		751	2200	2200	2	5	81.1	0.0	55.4	0.0	136.5	0.0	0.06	93902.4	0.0	42.68
E fly ash	33	0	0	0	0 :	167 (0)		200	200	2		1.9	0.0	0.0	0.0	1.9	0.0	0.01	0.0	0.0	0.00
stabilised MSWI bottom ash	0	0	0	0	0		0	0	0	1		0.0	0.0	0.0	0.0	0.0	0.0				
MSWI slag	63	0	0	190	0	1246 0		1500	1500	6		spec. cat		spec. cat		0.0	0.0	0.00	0.0	0.0	0.00
lightly stabilised phosphor slag	400	0	0	0	0		0	400	400	1		72.8	0.0	0.0	0.0	72.8	0.0	0.18	0.0	0.0	0.00
Total cat. 2.	4345	0	0	190	0	1413	751	6700.0	6700.000												
fluid bed bottom ash	61	0	0	39	0		0	100	100	2		5.6	0.0	0.0	0.0	5.6	0.0	0.06	0.0	0.0	0.00
coal gassing bottom ash	100	0	0	0	0		0	100	100	2		5.6	0.0	0.0	0.0	5.6	0.0		0.0	0.0	0.00
aerated concr. with E fly ash								100.00	100												
cleaned soil								1500.00	1500												
RO gypsum								300.00	300												
phosphor acid gypsum	0	0	0	0	0		0	0.00	0	5		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total others	161	0	0	39	0	0	0	2100.0	200.000												
TOTAL	12012	0	0	1023	0	1413	751	18099	15199	67	10	1495	0	55	0	1551	0	0.14	93902	0	2.03
																1551			93902		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22

Table d: Calculation of costs for analysis and dumping (95%-confidence) assuming the categorization of construction materials according to the adapted standard setting and the set of construction materials belonging to the Van Ruiten set.

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construction material / remark	combination leaching and composition organic/(inorganic oBB) in Kton: cat 1	cat 1 or cat 2	cat 1 or dumping	cat 2	cat 1 cat 2 or dumping	"spec. dumping cat"		total	eval. of mat. use critical Kton	leachi	mpos. org/inorg	1990 analysis costs leaching certainly	leaching uncertain	analysis co composition org certainly	composition org uncertain	analysis costs total certainly in Kf	total uncertain in Kf	per ton f/ton	f125/ton certainly in Kf	unknown in Kf	dumping costs per ton f/ton
sand cement stabilization +								300.00	300												
cement aggregate	514	229	259	0	116		0	1118	1118	2	1	28.8	77.2	0.0	28.1	28.8	105.4	0.12	0.0	46879.8	41.93
masonry aggregate	89	135	216	0	327		0	767	767	4	1	6.9	142.3	0.0	40.7	6.9	183.0	0.25	0.0	67841.4	88.45
mixed aggregate certified	1216	556	337	0	605		0	2714	2714	3	1	80.9	308.8	0.0	44.2	80.9	353.0	0.16	0.0	117717.7	43.37
E bottom ash	47	27	0	20	7		0	100	100	2		3.7	7.5	0.0	0.0	3.7	7.5	0.11	0.0	866.7	8.67
lightly stabilised E fly ash								600.00	600												
cement concrete+gran. B F slag	883	213	3	0	1		0	1100	1100	2		197.8	239.3	0.0	0.4	197.8	239.7	0.40	0.0	507.4	0.46
with E fly ash (8%)	241	58	1	0	0		0	300	300	2		53.9	65.3	0.0	0.1	53.9	65.4	0.40	0.0	138.4	0.46
with MSWI bottom ash (8%)	80	19	0	0	0		0	100	100	2		18.0	21.8	0.0	0.0	18.0	21.8		0.0	46.1	0.46
with jarosite end slag								100	100										0.0	0.0	
asphalt cement recycling	534	138	102	0	26		0	800	800	3		142.0	218.1	0.0	12.8	142.0	231.0	0.47	0.0	16043.5	20.05
with MSWI fly ash (2%)	67	17	13	0	3		0	100	100	3		17.8	27.3	0.0	1.6	17.8	28.9	0.47	0.0	2005.4	20.05
with E fly ash (6%)	67	17	13	0	3		0	100	100	3		17.8	27.3	0.0	1.6	17.8	28.9	0.47	0.0	2005.4	20.05
with phosphor slag (59%)	133	34	26	0	7		0	200	200	3		35.5	54.5	0.0	3.2	35.5	57.7	0.47	0.0	4010.9	20.05
crushed asphalt cement								0.00	0												
blast furnace slag mix	128	362	0	0	209		0	700	700	2		28.8	639.6	0.0	0.3	28.8	639.9	0.96	0.0	26218.8	37.46
LD slag	54	46	0	0	0		0	100	100	3		14.3	61.1	0.0	0.0	14.3	61.1	0.75	0.0	46.1	0.46
phosphor slag	1	55	0	0	44		0	100	100	2		0.2	111.1	0.0	0.0	0.2	111.1	1.11	0.0	5491.0	54.91
Total cat. 1.	4054	1907	971	20	1348	0	0	9299.0	8299.000												
masonry aggregate	0	0	0	0	0		0	0	0	4		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
mixed aggregate	0	0	0	0	0		0	0	0	3	1	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.0	0.0	
asphalt aggregate	1152	979	145	0	123		0	2400	2400	3	1	76.6	293.3	0.0	20.1	76.6	313.4	0.16	0.0	33545.5	13.98
sieve sand	685	402	424	0	249		440	2200	2200	2	5	38.3	145.9	32.5	198.5	70.8	344.4	0.19	55045.8	84109.8	63.25
E fly ash	1	63	0	0	64	: 72 (0)		200	200	2		0.0	28.5	0.0	0.0	0.0	28.6	0.14	0.0	7993.6	39.97
stabilised MSWI bottom ash	0	0	0	0	0		0	0	0	1		0.0	0.0	0.0	0.0	0.0	0.0				
MSWI slag	10	120	3	0	282	1085 0		1500	1500	6		spec. cat		spec. cat		0.0	0.0	0.00	0.0	35595.1	23.73
lightly stabilised phosphor slag	63	335	0	0	1		0	400	400	1		11.5	306.2	0.0	0.1	11.5	306.4	0.79	0.0	184.5	0.46
Total cat. 2.	1911	1900	572	0	719	1157	440	6700.0	6700.000												
fluid bed bottom ash	47	27	0	20	7		0	100	100	2		3.7	7.5	0.0	0.0	3.7	7.5	0.11	0.0	866.7	8.67
coal gassing bottom ash	40	60	0	0	0		0	100	100	2		2.2	13.5	0.0	0.0	2.2	13.5		0.0	46.1	0.46
aerated concr. with E fly ash								100.00	100												
cleaned soil								1500.00	1500												
RO gypsum								300.00	300												
phosphor acid gypsum	0	0	0	0	0		0	0.00	0	5		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	
Total others	86	87	0	20	7	0	0	2100.0	200.000												
TOTAL	6051	3894	1543	40	2074	1157	440	18099	15199	67	10	779	2796	32	352	811	3148	0.38	55046	452160	24.16
																3959			507206		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22

Appendix 18 Comparison PAH standard BB with RIVM report

In table 18.1., the results of a search through the RIVM construction materials data base (BASIS) for construction materials to which PAHs are measured, are reproduced.

Table 18.1. Construction materials of which data is stored in BASIS, and the number of rejections for PAH total = 50mg/kg and PAH total = 75 mg/kg with IBS.

Construction material		type of construction material	available in 1990 (kton)	total number in the data base, analyzed on PAHs	number rejected for PAH-tot > 50 mg/kg	number rejected for PAH-tot > 75 mg/kg and demands for individual PAHs (10-IBS)
asphalt cement	without tar,	V	7000	29	0	0
	with tar	V	0	7	7	7
asphalt aggregate	without tar,	N	1500	10	2	0
	with tar	N	500	2	2	2
construction and demolition waste	undefined	N	4000	81	10	8
mix aggregate	certified,	N	2506	15	1	0
	non-certified	N	1032	8	1	0
recycling breaker sand	certified,	N	368	15	3	2
	non-certified	N		23	2	2
sieve sand		N	383	141	28	22

Note: The difference between both observations is mostly only 1 observation. Because of the small number of observations in the data base, this can lead to shifts of 5-10%. It seems desireable to carefully trace construction materials quantitatively and qualitatively in the period up to 1997 in which the Building Materials Decree becomes completely valid.

In table 18.2., the financial results are charted. These are, of course, surrounded with the same uncertainty as those which are reproduced in the RIVM report. The rates and the evaluation methods applied are also the same.

Converted to guilders, the standard decrease to PAH total = 50mg/kg leads to extra isolation costs for the special category to a sum of 2.9 million per year, and leads to extra dumping costs to a sum of 40.1 million/yr. Both amounts are valid for the price level in 1990.

If only those construction materials which were also the basis for Part 3 of the RIVM report are taken into account, then this gives an extra post of 40 million/yr (extra isolation plus dumping costs). In these 40 million, the shifts as a result of the construction material breaker sand are not counted. These 40 million/yr must therefore be added to the total of scenario 1 table 13.14.1-3 of the RIVM report. Furthermore, it must be mentioned that also the leaching behaviour of inorganic compounds is included in the evaluation. For the construction materials sieve sand and construction and demolition waste (undefined), mineral oil is the most critical component. Adapting of the PAH standard does, then, not lead to large shifts.

Table 18.2. Financial consequences of the PAH standard shift.

Construction material		type of construc-tion mate-rial	available in 1990 (kton)	total num-ber in the data base, analyzed on PAHs	PAH-tot >50 mg/kg expected dumping amounts in kton, ba-sed on the results of 1992	number rejected for PAH-tot > 75 mg/kg and demands for individual PAHs (10-IBS)
asphalt cement	without tar,	V	7000/500	29	0	0
	with tar	V	0	7	is not made anymore	is not made anymore
asphalt aggregate	without tar,	N	1500	10	91	0
	with tar	N	500	2	500	500
construction and demo-lition waste	undefined	N	4000	81	mineral oil is the most crtical compo-nent	mineral oil is the most crtical compo-nent
mix aggregate	certified,	N	2506	15	167	0
	non-certified	N	1032	8	129	0
recycling breaker sand	certified,	N	368	15	74	49
	non-certified	N		23	32	32
sieve sand		N	383	141	mineral oil is the most crtical compo-nent	mineral oil is the most crtical compo-nent

APPENDIX A

EMISSION AND COMPOSITION OF INORGANIC COMPOUNDS OF NON-PREFABRICATED AND PREFABRICATED CONSTRUCTION MATERIALS AND THE COMPOSITION OF ORGANIC COMPOUNDS OF CONSTRUCTION MATERIALS

Appendix A Emission and composition of inorganic compounds of non-prefabricated and prefabricated construction materials and the composition of organic compounds of construction materials. For code see table.

construction material	bouwmateriaal (Dutch)	opmerking	kolomproef	diffusie-proef	samenstelling organisch		samenstelling organisch	
					niet-vormge-geven bouw-materiaal	vorm gegeven bouwmateriaal	niet-vormge-geven bouw-materiaal	vorm gegeven bouw-materiaal
clay	klei		NV8000		PACN8000		PCBN8000	
loam	leem		NV8001					
gravel	grind		NV8002		PACN8002		PCBN8002	
natural sand	natuurlijk zand		NV8003		PACN8003		PCBN8003	
natural sand	natuurlijk zand	ontzilt zeezand	NV8004		PACN8004		PCBN8004	
lime stone	kalksteen		NV8005	V4005				
basalt	basalt		NV8008	V4008				
flugsand	flugsand		NV8011					
lava stone	lavasteen		NV8012		PACN8012		PCBN8012	
cement concrete	cementbeton		NV8013	V4013	PACN8013		PCBN8013	
cement concrete	cementbeton	met aardelite	NV8CB01	V4CB01				
cement concrete	cementbeton	met avi-bodem-as	NV8CB02	V4CB02				
cement concrete	cementbeton	met ec-vliegas	NV8CB03	V4CB03				
cement concrete	cementbeton	met jarosiet-eindslak	NV8CB04	V4CB04				
cement concrete	cementbeton	met lytag		V4CB05				
asphalt cement	asfaltbeton		NV8015	V4015	PACN8015		PCBN8015	
asphalt cement	asfaltbeton	overigen			PACN8AB1		PCBN8AB1	
asphalt cement	asfaltbeton	recycling			PACN8AB2		PCBN8AB2	
asphalt cement	asfaltbeton	met avi-bodem-as	NV8AB01	V4AB01				
asphalt cement	asfaltbeton	met avi-vliegas	NV8AB02	V4AB02				
asphalt cement	asfaltbeton	met ec- en avi-vliegas	NV8AB03	V4AB03				
asphalt cement	asfaltbeton	met ec-vliegas	NV8AB04	V4AB04				
asphalt cement	asfaltbeton	met fosforslak	NV8AB05	V4AB05				
asphalt cement	asfaltbeton	met jaro-siet-eindslak	NV8AB06	V4AB06				
mortar	mortel	met ec-vliegas	NV8018	V4018				
rough ceramic products	grof kerami-sche produkt-en		NV8019	V4019				
rough ceramic products	grof kerami-sche produkt-en	met ec-vliegas	NV8020	V4020				
Ca-silicate bricks	kalkzandsteen		NV8023	V4023				
Ca-silicate bricks	kalkzandsteen	met ec-vliegas	NV8KZ01	V4KZ01				
Ca-silicate bricks	kalkzandsteen	met overige toe-voegingen		V4KZ02				

construction material	bouwmateriaal (Dutch)	opmerking	kolomproef	diffusie-proef	samenstelling organisch		samenstelling organisch	
					niet-vormge-geven bouw-materiaal	vorm gegeven bouwmateriaal	niet-vormge-geven bouw-materiaal	vorm gegeven bouw-materiaal
aerated concrete	gasbeton		NV8025	V4025				
aerated concrete	gasbeton	met ec-vliegas	NV8026	V4026				
sand ce-mentstabi-lisation	zandcement-stabilisatie		NV8029	V4029				
sand ce-mentstabi-lisation	zandcement-stabilisatie	met ec-vliegas	NV8030	V4030				
asphalt aggregate	asfaltgranulaat		NV8032	V4032	PACN8032		PCBN8032	
asphalt aggregate	asfaltgranulaat	overigen			PACN8AG1		PCBN8AG1	
asphalt aggregate	asfaltgranulaat	recycling			PACN8AG2		PCBN8AG2	
asphalt aggregate	asfaltgranulaat	teerhoudend			PACN8AG3		PCBN8AG3	
blast furnace slag mix	hoogovenslak-kenmengsel		NV8034	V4034				
hydraulic mix aggregate	hydraulisch menggranulaat		NV8035	V4035				
lichtly stabilised phosphor slag	lichtgebonden fosforslakken		NV8036	V4036				
lichtly stabilised steel slag	lichtgebonden staalslakken		NV8037	V4037				
stabilised MSWI bottom ash	gebonden avi-bodemas		NV8038	V4038				
lichtly stabilised E fly ash	lichtgebonden ec-vliegas		NV8040	V4040				
cement aggregate	betongranulaat		NV8042		PACN8042		PCBN8042	
masonry aggregate	metselwerk-granulaat		NV8043		PACN8043		PCBN8043	
mix aggregate	menggranulaat		NV8044		PACN8044		PCBN8044	
mix aggregate	menggranulaat	gecertificeerd	NV8MG01		PACN8MG1		PCBN8MG1	
mix aggregate	menggranulaat	niet-gecerti-ficeerd	NV8MG02		PACN8MG2		PCBN8MG2	
sieve sand	zeefzand		NV8045		PACN8045		PCBN8045	
breaker sand	brekerzand		NV8046		PACN8046		PCBN8046	
constr. and demol. waste	bouw-en sloopafval	ongedefinieerd	NV8047		PACN8047		PCBN8047	
smoke-gas desulph. gypsum	rookontzwavel-ingsgips		NV8048					
phosphor acid gypsum	fosforzuurgips		NV8049					
mine stone	mijnsteen		NV8050		PACN8050		PCBN8050	
mine stone	mijnsteen	gesorteerd	NV8MS01		PACN8MS1		PCBN8MS1	
mine stone	mijnsteen	gewassen	NV8MS02					
mine stone	mijnsteen	nederland	NV8MS03		PACN8MS2		PCBN8MS2	

construction material	bouwmateriaal (Dutch)	opmerking	kolomproef	diffusie-proef	samenstelling organisch		samenstelling organisch	
					niet-vormge-geven bouw-materiaal	vorm gegeven bouwmateriaal	niet-vormge-geven bouw-materiaal	vorm gegeven bouw-materiaal
mine stone	mijnsteen	overigen	NV8MS04		PACN8MS3		PCBN8MS3	
E fly ash	ec-vliegas		NV8052		PACN8052		PCBN8052	
E bottom ash	ec-bodemas		NV8053		PACN8053		PCBN8053	
E bottom ash	ec-bodemas	gecertificeerd	NV8EB01					
E bottom ash	ec-bodemas	niet-gecertifi-ceerd	NV8EB02					
fluid bed fly ash	wervelbed-vliegas		NV8054					
fluid bed bottom ash	wervelbed-bodemas		NV8055					
coal gassing bottom ash	vergassings-bodemas		NV8056					
coal gassing fly ash	vergassings-vliegas		NV8058					
MSWI bottom ash	avi-bodemas		NV8059		PACN8059		PCBN8059	
MSWI fly ash	avi-vliegas		NV8060		PACN8060		PCBN8060	
blast furnace slag	hoogovenstuk-slak		NV8061	V4061	PACN8061		PCBN8061	
blast furnace foam slag	hoogoven-schuimslak		NV8062		PACN8062		PCBN8062	
granulated blast furnace slag	gegranuleerde hoogovenslak		NV8063		PACN8063		PCBN8063	
blast furnace slag sand	hoogovenslak-kenzand		NV8064					
jarosite end - slag	jarosiet-eindslak		NV8065					
LD slag	ld-staalslak		NV8066	V4066	PACN8066		PCBN8066	
phosphor slag	fosforslak		NV8067	V4067	PACN8067		PCBN8067	
ELO slag	elo-slak		NV8068		PACN8068		PCBN8068	
copper slag	koperslak			V4069				
E fly ash aggregate	ec-vliegas-granulaat		NV8071	V4071				
expanded clay aggregate	geexpandeerd kleigranulaat		NV8072	V4072				
hydraulic stabilised E fly ash aggregate	hydraulisch gebonden ec-vliegasgranu-laat		NV8073	V4073				
porous masonry bricks	poreuze metsel-baksteen	met ec-vliegas	NV8PM01	V4PM01				

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Building material: **klei**

identification number: NV8000.wk1

16-Dec-93

adjusted values granular materials				leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	1	0.186		0.186	0.186							26	6.583	1.886	2.640	20.000	0.817	0.167		•	D
Ba	5.50	58.00	7500.00	1	0.496		0.496	0.496							11	147.647	94.019	35.000	328.944	2.074	0.322			
Cd	0.03	0.07	10.00	1	0.001		0.001	0.001						D	23	0.339	0.279	0.069	1.000	-0.609	0.360			D
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	6	14.911	8.695	3.960	28.301					
Cr	1.30	12.00	1250.00	1	0.122		0.122	0.122							13	54.121	30.023	18.480	120.000	1.673	0.240			
Cu	0.72	3.50	375.00	1	0.035		0.035	0.035						D	12	14.421	10.748	6.336	70.000	1.131	0.337		•	
Hg	0.02	0.08	5.00	1	0.001		0.001	0.001							3	0.095	0.005	0.090	0.100					D
Mo	0.28	0.91	125.00	1	0.100		0.100	0.100							23	3.956	2.916	0.528	11.000	0.478	0.353			D
Ni	1.10	3.70	250.00	1	0.110		0.110	0.110						D	12	30.278	17.364	13.200	57.000	1.420	0.236			
Pb	1.90	8.70	1250.00	1	0.011		0.011	0.011						D	11	13.870	2.133	10.000	21.648	1.154	0.088		•	
Sb	0.05	0.43	50.00	1	0.034		0.034	0.034							9	1.172	0.836	0.264	2.000					
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	8	2.998	1.868	0.502	5.280					
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	2	1.188	0.560	0.792	20.000				•	D
V	1.60	32.00	1250.00	1	0.066		0.066	0.066							26	46.447	21.971	21.120	140.000	1.650	0.194		•	
Zn	3.80	15.00	1250.00	1	0.146		0.146	0.146						D	12	38.494	31.198	10.560	410.000	1.563	0.432		•	
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	1	8		8	8							2	264		264	264					D
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	4	125.040	140.845	3.120	256.080					
SO4	750.00	22000.00	25000.00	1	443		443	443						D	2	1227	320	1001	1453					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **klei**

identification number: PACN8000.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
Benzeen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	1	0.100		0.100	0.100					D
Ethylbenz.	*************	1000000.00	1.25	NA	NA	NA							NA	NA	1	0.100		0.100	0.100					
Tolueen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	1	0.100		0.100	0.100					D
Xylenen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	1	0.100		0.100	0.100					D
Fenolen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	2	0.500		0.500	0.500					D
Cl-fenol	*************	1000000.00	1.25	NA	NA	NA							NA	NA	2	1.000		1.000	1.000					D
Arom.(tot)	*************	1000000.00	1.25	NA	NA	NA							NA	NA	1	0.400		0.400	0.400					
Naf	*************	1000000.00	5.00	NA	NA	NA							NA	NA	3	0.100	0.000	0.100	0.100					D
Ph	*************	1000000.00	20.00	NA	NA	NA							NA	NA	2	0.100		0.100	0.100					D
An	*************	1000000.00	10.00	NA	NA	NA							NA	NA	2	0.100		0.100	0.100					D
Fla	*************	1000000.00	35.00	NA	NA	NA							NA	NA	2	0.100		0.100	0.100					D
Chr	*************	1000000.00	10.00	NA	NA	NA							NA	NA	2	0.100		0.100	0.100					D
BaA	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.100		0.100	0.100					D
BaP	*************	1000000.00	10.00	NA	NA	NA							NA	NA	2	0.200		0.200	0.200					D
BkF	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.200		0.200	0.200					D
IP	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.200		0.200	0.200					D
BPe	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.200		0	0					D
PAK10(tot)	*************	1000000.00	75.00	NA	NA	NA							NA	NA	2	1.400		1.400	1.400					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

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Building material: **klei**

identification number: PCBN8000.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	2	0.050		0.050	0.050					D
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	2	0.050		0.050	0.050					D
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	2	0.050		0.050	0.050					D
PCB-118	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	2	0.050		0.050	0.050					D
PCB-138	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	2	0.050		0.050	0.050					D
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	2	0.050		0.050	0.050					D
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	2	0.050		0.050	0.050					D
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	2	0.300		0.300	0.300					D
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	2	0.450	0.212	0.300	0.600					D
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	2	2.250		2.250	2.250			2		D
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	2	1.700		1.700	1.700			2		
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	4	25.775	27.974	1.200	50.000					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

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Building material: **leem**

identification number: NV8001.wk1

16-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	NA	NA	NA							NA	NA	2	2.904	0.597	2.482	3.326					D
Ba	5.50	58.00	7500.00	NA	NA	NA							NA	NA	2	202.752	14.187	192.720	212.784					
Cd	0.03	0.07	10.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	2	20.407	2.203	18.850	21.965					
Cr	1.30	12.00	1250.00	NA	NA	NA							NA	NA	2	33.264	1.493	32.208	34.320					
Cu	0.72	3.50	375.00	NA	NA	NA							NA	NA	2	1.584		1.584	1.584					D
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Mo	0.28	0.91	125.00	NA	NA	NA							NA	NA	2	9.240	0.373	8.976	9.504					D
Ni	1.10	3.70	250.00	NA	NA	NA							NA	NA	2	21.384	6.347	16.896	25.872					
Pb	1.90	8.70	1250.00	NA	NA	NA							NA	NA	2	11.880	1.120	11.088	12.672					
Sb	0.05	0.43	50.00	NA	NA	NA							NA	NA	2	0.253	0.015	0.243	0.264					D
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	2	11.616	2.987	9.504	13.728					
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
V	1.60	32.00	1250.00	NA	NA	NA							NA	NA	2	12.038	0.373	11.774	12.302					D
Zn	3.80	15.00	1250.00	NA	NA	NA							NA	NA	2	7.656	3.360	5.280	10.032					D
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	750.00	22000.00	25000.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

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Building material: **grind**

identification number: NV8002.wk1

16-Dec-93

adjusted values granular materials				leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	2	0.016	0.008	0.010	0.021						D	3	4.146	0.904	3.200	5.000					D
Ba	5.50	58.00	7500.00	2	0.087	0.022	0.072	0.103						D	3	43.792	24.689	19.000	68.377					
Cd	0.03	0.07	10.00	2	0.002	0.001	0.001	0.002						D	3	0.080	0.034	0.041	0.100					D
Co	0.42	2.50	250.00	1	0.021		0.021	0.021							2	7.500	0.707	7.000	8.000					
Cr	1.30	12.00	1250.00	2	0.055	0.017	0.043	0.067						D	3	112.012	57.355	46.036	150.000					
Cu	0.72	3.50	375.00	2	0.044	0.038	0.017	0.071						D	3	5.031	1.047	4.000	6.093					
Hg	0.02	0.08	5.00	1	0.001		0.001	0.001							3	0.136	0.150	0.007	0.300					
Mo	0.28	0.91	125.00	2	0.170	0.184	0.040	0.300	1						2	2.000	ERR	2.000	3.724				*	D
Ni	1.10	3.70	250.00	2	0.018	0.008	0.012	0.023						D	3	32.401	23.075	13.202	58.000					
Pb	1.90	8.70	1250.00	2	0.015	0.007	0.010	0.020						D	3	8.590	2.176	6.770	11.000					D
Sb	0.05	0.43	50.00	2	0.010	0.000	0.010	0.010							3	0.442	0.317	0.200	0.800					D
Se	0.04	0.10	50.00	1	0.015		0.015	0.015							3	0.545	0.442	0.034	0.800					D
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	3	6.677	4.146	2.031	10.000					D
V	1.60	32.00	1250.00	2	0.071	0.030	0.050	0.092							3	10.954	1.932	9.000	12.863					D
Zn	3.80	15.00	1250.00	2	0.175	0.106	0.100	0.250							3	21.190	7.725	15.571	30.000					
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	1	16		16	16							1	339		339	339					D
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	1	61.607		61.607	61.607					
SO4	750.00	22000.00	25000.00	1	53		53	53						D	1	68		68	68					D
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **grind**

identification number: PACN8002.wk1

17-Dec-93

adjusted values granular materials				leaching characteristics L/S=10 columntest in mg/kg											composition aqua regia in mg/kg									
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
Benzeen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ethylbenz.	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Tolueen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Xylenen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Fenolen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-fenol	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Arom.(tot)	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Naf	*************	1000000.00	5.00	NA	NA	NA							NA	NA	2	0.050		0.050	0.050					D
Ph	*************	1000000.00	20.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
An	*************	1000000.00	10.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
Fla	*************	1000000.00	35.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
Chr	*************	1000000.00	10.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
BaA	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
BaP	*************	1000000.00	10.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
BkF	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
IP	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
BPe	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.010		0	0					D
PAK10(tot)	*************	1000000.00	75.00	NA	NA	NA							NA	NA	2	0.140		0.140	0.140					D
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

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Building material: **grind**
identification number: PCBN8002.wk1

17-Dec-93

	adjusted values granular materials			leaching characteristics			L/S=10 columntest in mg/kg								composition				aqua regia in mg/kg					
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-118	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-138	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **natuurlijk zand**

identification number: NV8003.wk1

16-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	6	0.057	0.039	0.020	0.120							68	1.619	1.669	0.494	11.000	0.098	0.316		*	D
Ba	5.50	58.00	7500.00	4	0.286	0.135	0.155	0.460							149	159.807	76.121	3.000	327.668	2.125	0.320			
Cd	0.03	0.07	10.00	5	0.002	0.002	0.000	0.013					*	D	9	0.090	0.055	0.007	1.000	-1.066	0.568		*	D
Co	0.42	2.50	250.00	3	0.018	0.005	0.012	0.021							21	25.219	17.526	0.406	48.541	1.085	0.730			
Cr	1.30	12.00	1250.00	4	0.089	0.012	0.071	0.099							151	9.638	7.337	0.677	43.667	0.886	0.306		*	
Cu	0.72	3.50	375.00	5	0.030	0.017	0.015	0.150					*	D	150	3.422	3.052	0.677	39.000	0.441	0.278		*	D
Hg	0.02	0.08	5.00	1	0.001		0.001	0.001							6	0.088	0.030	0.027	0.300				*	D
Mo	0.28	0.91	125.00	5	0.048	0.032	0.021	0.100						D	65	19.018	14.276	0.677	137.431	1.131	0.468	1	*	D
Ni	1.10	3.70	250.00	4	0.024	0.014	0.012	0.041						D	150	18.776	24.078	0.677	93.426	0.816	0.676			
Pb	1.90	8.70	1250.00	6	0.023	0.016	0.012	0.050						D	137	8.566	4.169	0.677	50.000	0.871	0.278		*	D
Sb	0.05	0.43	50.00	5	0.008	0.003	0.005	0.013							66	0.336	0.189	0.169	2.000	-0.494	0.179		*	D
Se	0.04	0.10	50.00	4	0.012	0.003	0.009	0.015						D	21	8.466	6.072	0.068	37.912	0.709	0.664		*	
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	4	7.008	3.449	2.031	10.000					D
V	1.60	32.00	1250.00	4	0.033	0.015	0.021	0.210					*	D	148	12.259	9.688	0.677	41.974	0.921	0.422			D
Zn	3.80	15.00	1250.00	5	0.088	0.049	0.017	0.500					*	D	106	10.757	5.923	1.354	61.000	0.940	0.354		*	D
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	1	12		12	12							1	339		339	339					D
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	1	0.451		0.451	0.451						D	1	64.315		64.315	64.315					
SO4	750.00	22000.00	25000.00	2	19	2	17	227					*	D	1	81		81	81					D
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **natuurlijk zand**

identification number: PACN8003.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
Benzeen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ethylbenz.	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Tolueen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Xylenen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Fenolen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-fenol	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Arom.(tot)	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Naf	*************	1000000.00	5.00	NA	NA	NA							NA	NA	5	0.044	0.013	0.020	0.050					D
Ph	*************	1000000.00	20.00	NA	NA	NA							NA	NA	4	0.035	0.044	0.010	2.500				•	D
An	*************	1000000.00	10.00	NA	NA	NA							NA	NA	4	0.015	0.010	0.010	1.000				•	D
Fla	*************	1000000.00	35.00	NA	NA	NA							NA	NA	4	0.060	0.062	0.010	2.100				•	D
Chr	*************	1000000.00	10.00	NA	NA	NA							NA	NA	4	0.020	0.020	0.010	0.580				•	D
BaA	*************	1000000.00	50.00	NA	NA	NA							NA	NA	4	0.022	0.025	0.010	0.520				•	D
BaP	*************	1000000.00	10.00	NA	NA	NA							NA	NA	4	0.022	0.025	0.010	0.660				•	D
BkF	*************	1000000.00	50.00	NA	NA	NA							NA	NA	4	0.018	0.015	0.010	0.200				•	D
IP	*************	1000000.00	50.00	NA	NA	NA							NA	NA	4	0.023	0.025	0.010	0.220				•	D
BPe	*************	1000000.00	50.00	NA	NA	NA							NA	NA	5	0.046	0.057	0	0					D
PAK10(tot)	*************	1000000.00	75.00	NA	NA	NA							NA	NA	4	0.288	0.249	0.140	7.940				•	D
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **natuurlijk zand**

identification number: PCBN8003.wk1

17-Dec-93

	adjusted values granular materials			leaching characteristics L/S=10 columntest in mg/kg											composition aqua regia in mg/kg									
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-118	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-138	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	1	0.100		0.100	0.100					D
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	1	0.100		0.100	0.100					D
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	3	4540.000	4812.775	20.000	9600.000			2		
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

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Building material: ontzilt zeezand

identification number: NV8004.wk1

16-Dec-93

adjusted values granular materials				leaching characteristics L/S=10 columntest in mg/kg											composition aqua regia in mg/kg									
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	1	0.084		0.084	0.084							1	3.600		3.600	3.600					D
Ba	5.50	58.00	7500.00	1	0.021		0.021	0.021						D	1	4.000		4.000	4.000					
Cd	0.03	0.07	10.00	1	0.002		0.002	0.002						D	1	0.100		0.100	0.100					D
Co	0.42	2.50	250.00	1	0.012		0.012	0.012						D	1	2.000		2.000	2.000					D
Cr	1.30	12.00	1250.00	1	0.088		0.088	0.088							1	10.000		10.000	10.000					
Cu	0.72	3.50	375.00	1	0.058		0.058	0.058						D	1	1.000		1.000	1.000					D
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	1	0.100		0.100	0.100					
Mo	0.28	0.91	125.00	1	0.024		0.024	0.024						D	1	2.000		2.000	2.000					D
Ni	1.10	3.70	250.00	1	0.016		0.016	0.016						D	1	4.000		4.000	4.000					D
Pb	1.90	8.70	1250.00	1	0.016		0.016	0.016						D	1	2.000		2.000	2.000					D
Sb	0.05	0.43	50.00	1	0.003		0.003	0.003						D	1	0.200		0.200	0.200					D
Se	0.04	0.10	50.00	1	0.009		0.009	0.009						D	1	0.800		0.800	0.800					D
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	1	10.000		10.000	10.000					D
V	1.60	32.00	1250.00	1	0.300		0.300	0.300							1	6.000		6.000	6.000					D
Zn	3.80	15.00	1250.00	1	0.220		0.220	0.220							1	8.000		8.000	8.000					D
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	750.00	22000.00	25000.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **ontzilt zeezand**

identification number: PACN8004.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
Benzeen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ethylbenz.	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Tolueen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Xylenen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Fenolen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-fenol	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Arom.(tot)	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Naf	*************	1000000.00	5.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ph	*************	1000000.00	20.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
An	*************	1000000.00	10.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Fla	*************	1000000.00	35.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Chr	*************	1000000.00	10.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
BaA	*************	1000000.00	50.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
BaP	*************	1000000.00	10.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
BkF	*************	1000000.00	50.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
IP	*************	1000000.00	50.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
BPe	*************	1000000.00	50.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PAK10(tot)	*************	1000000.00	75.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **ontzilt zeezand**

identification number: PCBN8004.wk1

17-Dec-93

adjusted values granular materials				leaching characteristics				L/S=10 columntest in mg/kg							composition				aqua regia in mg/kg					
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-118	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-138	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

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Building material: **kalksteen**

identification number: NV8005.wk1

16-Dec-93

	adjusted values granular materials			leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	NA	NA	NA							NA	NA	4	2.382	1.435	1.000	4.397					D
Ba	5.50	58.00	7500.00	NA	NA	NA							NA	NA	3	59.965	45.456	14.000	104.894					
Cd	0.03	0.07	10.00	NA	NA	NA							NA	NA	3	0.128	0.049	0.074	0.500					D
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	2	5.082	6.955	0.164	10.000					
Cr	1.30	12.00	1250.00	NA	NA	NA							NA	NA	4	12.052	11.586	1.640	27.568					
Cu	0.72	3.50	375.00	NA	NA	NA							NA	NA	4	5.706	3.981	0.410	9.414					
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	3	0.208	0.198	0.013	0.410					
Mo	0.28	0.91	125.00	NA	NA	NA							NA	NA	2	0.746	0.104	0.672	0.820					D
Ni	1.10	3.70	250.00	NA	NA	NA							NA	NA	4	10.553	9.494	0.410	21.000					
Pb	1.90	8.70	1250.00	NA	NA	NA							NA	NA	4	6.809	4.562	2.000	12.776					D
Sb	0.05	0.43	50.00	NA	NA	NA							NA	NA	3	0.837	1.018	0.107	2.000					D
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	3	1.225	1.047	0.034	2.000					D
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	2	5.336	6.596	0.672	10.000					D
V	1.60	32.00	1250.00	NA	NA	NA							NA	NA	3	18.229	13.429	8.200	33.486					D
Zn	3.80	15.00	1250.00	NA	NA	NA							NA	NA	4	19.892	13.502	8.200	35.000					D
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	1	0.582		0.582	0.582					D
Cl	600.00	8800.00	5000.00	NA	NA	NA							NA	NA	2	219	165	103	336					D
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	2	253.487	300.501	41.000	465.973					
SO4	750.00	22000.00	25000.00	NA	NA	NA							NA	NA	1	2174		2174	2174					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

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Building material: **kalksteen**

identification number: V4005.wk1

06-Jun-94

element	adjusted values products U1	U2	S1	leaching characteristics 64 days diffusiontest in mg/m2 N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	41.0	140.0	750.0	NA	NA	NA							NA	NA	4	2.382	1.435	1.000	4.397					D
Ba	600.0	2000.0	15000.0	NA	NA	NA							NA	NA	3	59.965	45.456	14.000	104.894					
Cd	1.1	3.8	20.0	NA	NA	NA							NA	NA	3	0.128	0.049	0.074	0.500					D
Co	29.0	95.0	500.0	NA	NA	NA							NA	NA	2	5.082	6.955	0.164	10.000					
Cr	140.0	480.0	2500.0	NA	NA	NA							NA	NA	4	12.052	11.586	1.640	27.568					
Cu	51.0	170.0	750.0	NA	NA	NA							NA	NA	4	5.706	3.981	0.410	9.414					
Hg	0.4	1.4	10.0	NA	NA	NA							NA	NA	3	0.208	0.198	0.013	0.410					
Mo	14.0	48.0	250.0	NA	NA	NA							NA	NA	2	0.746	0.104	0.672	0.820					D
Ni	50.0	170.0	500.0	NA	NA	NA							NA	NA	4	10.553	9.494	0.410	21.000					
Pb	120.0	400.0	2500.0	NA	NA	NA							NA	NA	4	6.809	4.562	2.000	12.776					D
Sb	3.7	12.0	100.0	NA	NA	NA							NA	NA	3	0.837	1.018	0.107	2.000					D
Se	1.4	4.8	100.0	NA	NA	NA							NA	NA	3	1.225	1.047	0.034	2.000					D
Sn	29.0	95.0	500.0	NA	NA	NA							NA	NA	2	5.336	6.596	0.672	10.000					D
V	230.0	760.0	2500.0	NA	NA	NA							NA	NA	3	18.229	13.429	8.200	33.486					D
Zn	200.0	670.0	2500.0	NA	NA	NA							NA	NA	4	19.892	13.502	8.200	35.000					D
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	1	0.582		0.582	0.582					D
Cl	18000.0	54000.0	1000000.0	NA	NA	NA							NA	NA	2	219	165	103	336					D
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	NA	NA	NA							NA	NA	2	253.487	300.501	41.000	465.973					
SO4	27000.0	80000.0	40000.0	NA	NA	NA							NA	NA	1	2174		2174	2174					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material:				basalt																				
identification number:				NV8008.wk1																				
16-Dec-93				leaching characteristics					L/S=10 columntest in mg/kg						composition				aqua regia in mg/kg					
	adjusted values granular materials																							
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ba	5.50	58.00	7500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cd	0.03	0.07	10.00	NA	NA	NA							NA	NA	1	0.677		0.677	0.677					D
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	1.30	12.00	1250.00	NA	NA	NA							NA	NA	1	250.490		250.490	250.490					
Cu	0.72	3.50	375.00	NA	NA	NA							NA	NA	1	47.390		47.390	47.390					
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Mo	0.28	0.91	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ni	1.10	3.70	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Pb	1.90	8.70	1250.00	NA	NA	NA							NA	NA	1	13.540		13.540	13.540					
Sb	0.05	0.43	50.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
V	1.60	32.00	1250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Zn	3.80	15.00	1250.00	NA	NA	NA							NA	NA	1	121.860		121.860	121.860					
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	750.00	22000.00	25000.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **basalt**

identification number: V4008.wk1

06-Jun-94

element	adjusted values products U1	U2	S1	leaching characteristics 64 days diffusiontest in mg/m2 N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	41.0	140.0	750.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ba	600.0	2000.0	15000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cd	1.1	3.8	20.0	NA	NA	NA							NA	NA	1	0.677		0.677	0.677					D
Co	29.0	95.0	500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	140.0	480.0	2500.0	NA	NA	NA							NA	NA	1	250.490		250.490	250.490					
Cu	51.0	170.0	750.0	NA	NA	NA							NA	NA	1	47.390		47.390	47.390					
Hg	0.4	1.4	10.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Mo	14.0	48.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ni	50.0	170.0	500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Pb	120.0	400.0	2500.0	NA	NA	NA							NA	NA	1	13.540		13.540	13.540					
Sb	3.7	12.0	100.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Se	1.4	4.8	100.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Sn	29.0	95.0	500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
V	230.0	760.0	2500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Zn	200.0	670.0	2500.0	NA	NA	NA							NA	NA	1	121.860		121.860	121.860					
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	27000.0	80000.0	40000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **flugsand**

identification number: NV8011.wk1

16-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	1	0.012		0.012	0.012						D	6	9.256	10.295	1.354	23.000					
Ba	5.50	58.00	7500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cd	0.03	0.07	10.00	1	0.003		0.003	0.003						D	3	0.519	0.274	0.203	0.677					D
Co	0.42	2.50	250.00	1	0.003		0.003	0.003						D	3	10.381	3.127	6.770	12.186					
Cr	1.30	12.00	1250.00	1	0.002		0.002	0.002						D	6	28.016	26.949	5.000	60.930					
Cu	0.72	3.50	375.00	1	0.050		0.050	0.050						D	6	9.730	2.094	6.770	13.000					
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	2	0.135		0.135	0.135					
Mo	0.28	0.91	125.00	1	0.010		0.010	0.010						D	2	13.540	0.000	13.540	21.664				•	D
Ni	1.10	3.70	250.00	1	0.010		0.010	0.010						D	6	16.447	3.145	13.540	20.000					
Pb	1.90	8.70	1250.00	1	0.030		0.030	0.030						D	2	14.217	0.000	14.217	14.894				•	
Sb	0.05	0.43	50.00	1	0.010		0.010	0.010							2	0.372	0.000	0.372	4.739				•	D
Se	0.04	0.10	50.00	1	0.020		0.020	0.020							2	0.034	ERR	0.034	6.093				•	D
Sn	0.27	2.40	250.00	1	0.010		0.010	0.010						D	3	54.273	46.709	0.339	81.240					D
V	1.60	32.00	1250.00	1	0.065		0.065	0.065							3	78.983	15.635	60.930	88.010					
Zn	3.80	15.00	1250.00	1	0.200		0.200	0.200							2	66.346	0.000	66.346	67.700				•	
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	NA	NA	NA							NA	NA	2	339		339	339					D
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	750.00	22000.00	25000.00	1	55		55	55						D	1	664		664	664					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **lavasteen**

identification number: NV8012.wk1

16-Dec-93

	adjusted values granular materials			leaching characteristics L/S=10 columntest in mg/kg											composition aqua regia in mg/kg									
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	2	0.022	0.019	0.009	0.850					*	D	9	5.761	9.214	0.800	22.000					D
Ba	5.50	58.00	7500.00	1	0.320		0.320	0.320							4	420.996	99.250	328.000	555.984					
Cd	0.03	0.07	10.00	2	0.002	0.001	0.001	0.027					*	D	4	0.086	0.018	0.063	1.000				*	D
Co	0.42	2.50	250.00	1	0.036		0.036	0.036							4	32.436	6.840	24.000	38.000					
Cr	1.30	12.00	1250.00	3	0.040	0.026	0.010	0.059						D	8	53.768	51.460	5.000	245.000				*	
Cu	0.72	3.50	375.00	3	0.046	0.027	0.024	0.076						D	9	40.182	12.955	13.000	53.000					
Hg	0.02	0.08	5.00	1	0.001		0.001	0.001						D	4	0.078	0.045	0.011	0.100					D
Mo	0.28	0.91	125.00	3	0.049	0.030	0.020	0.079						D	3	1.773	0.393	1.320	40.000				*	D
Ni	1.10	3.70	250.00	3	0.021	0.012	0.010	0.034						D	9	70.730	39.930	13.000	148.368					
Pb	1.90	8.70	1250.00	3	0.036	0.023	0.010	0.050						D	6	6.627	6.847	1.000	19.008					D
Sb	0.05	0.43	50.00	1	0.008		0.008	0.008							4	0.206	0.006	0.200	2.000				*	D
Se	0.04	0.10	50.00	1	0.015		0.015	0.015							4	0.907	0.815	0.026	2.000					D
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	3	5.949	3.552	1.848	8.000					D
V	1.60	32.00	1250.00	2	0.358	0.427	0.056	0.660							4	158.736	12.519	141.000	223.344				*	
Zn	3.80	15.00	1250.00	3	0.093	0.086	0.028	0.190						D	6	45.984	8.812	31.000	56.000					
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	2	29	29	9	50							1	500		500	500					
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	1	5.010		5.010	5.010							1	493.680		493.680	493.680					
SO4	750.00	22000.00	25000.00	2	41	13	31	50						D	2	424	250	247	600					D
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **lavasteen**

identification number: PACN8012.wk1

17-Dec-93

	adjusted values granular materials			leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
Benzeen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ethylbenz.	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Tolueen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Xylenen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Fenolen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-fenol	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Arom.(tot)	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Naf	*************	1000000.00	5.00	NA	NA	NA							NA	NA	2	0.050		0.050	0.050					D
Ph	*************	1000000.00	20.00	NA	NA	NA							NA	NA	2	0.020	0.014	0.010	0.030					D
An	*************	1000000.00	10.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
Fla	*************	1000000.00	35.00	NA	NA	NA							NA	NA	2	0.025	0.021	0.010	0.040					D
Chr	*************	1000000.00	10.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
BaA	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
BaP	*************	1000000.00	10.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
BkF	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
IP	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
BPe	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.010		0	0					D
PAK10(tot)	*************	1000000.00	75.00	NA	NA	NA							NA	NA	2	0.165	0.035	0.140	0.190					D
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **lavasteen**

identification number: PCBN8012.wk1

17-Dec-93

	adjusted values granular materials			leaching characteristics		L/S=10 columntest in mg/kg									composition			aqua regia in mg/kg						
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-118	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-138	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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man and environment

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Building material: **cementbeton**

identification number: NV8013.wk1

16-Dec-93

adjusted values granular materials				leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	3	0.030	0.017	0.010	0.040							2	3.906	0.150	3.800	20.064				*	D
Ba	5.50	58.00	7500.00	2	4.279	2.233	2.700	5.858	1						2	106.218	11.952	97.766	279.680				*	
Cd	0.03	0.07	10.00	3	0.005	0.005	0.001	0.010							3	0.043	0.016	0.030	0.061					D
Co	0.42	2.50	250.00	1	0.010		0.010	0.010						D	1	4.682		4.682	4.682					
Cr	1.30	12.00	1250.00	3	0.127	0.163	0.010	0.313							3	28.327	5.188	22.654	32.832					
Cu	0.72	3.50	375.00	3	0.087	0.099	0.015	0.200						D	2	5.609	0.520	5.241	18.240				*	
Hg	0.02	0.08	5.00	3	0.001	0.001	0.000	0.003							2	0.015	0.004	0.012	0.243				*	D
Mo	0.28	0.91	125.00	2	0.085	0.021	0.070	1.716	1	1			*		3	1.708	0.354	1.301	1.940					D
Ni	1.10	3.70	250.00	2	0.016	0.006	0.011	1.000					*	D	3	12.482	3.441	10.032	16.416					
Pb	1.90	8.70	1250.00	2	0.020	0.014	0.010	0.500					*	D	2	5.144	0.138	5.046	8.269				*	D
Sb	0.05	0.43	50.00	2	0.020	0.014	0.010	0.030							2	0.641	0.004	0.638	4.621				*	D
Se	0.04	0.10	50.00	1	0.030		0.030	0.030							2	0.049	0.000	0.049	1.824				*	D
Sn	0.27	2.40	250.00	1	0.030		0.030	0.030						D	2	1.578	0.013	1.569	2.432				*	D
V	1.60	32.00	1250.00	3	0.061	0.028	0.040	0.093							2	15.306	0.443	14.993	31.008				*	D
Zn	3.80	15.00	1250.00	2	0.100	ERR	0.100	1.072					*	D	3	22.504	6.867	17.924	30.400					
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	2	3	3	1	5						D	2	295	0	295	295					D
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	2	114.760	4.256	111.750	117.770					
SO4	750.00	22000.00	25000.00	3	48	28	20	76						D	2	3014	197	2875	9667				*	
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

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Building material:				cementbeton																				
identification number:				V4013.wk1																				
06-Jun-94				leaching characteristics				64 days diffusiontest in mg/m2							composition			aqua regia in mg/kg						
	adjusted values products																							
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	41.0	140.0	750.0	2	0.412	0.083	0.353	5.800					•		2	3.906	0.150	3.800	20.064				•	D
Ba	600.0	2000.0	15000.0	8	32.600	20.818	16.000	66.000							2	106.218	11.952	97.766	279.680				•	
Cd	1.1	3.8	20.0	8	0.667	0.462	0.055	1.000							3	0.043	0.016	0.030	0.061					D
Co	29.0	95.0	500.0	6	1.917	0.204	1.500	2.000							1	4.682		4.682	4.682					
Cr	140.0	480.0	2500.0	7	1.720	0.919	1.000	5.540					•	D	3	28.327	5.188	22.654	32.832					
Cu	51.0	170.0	750.0	7	2.117	0.431	1.600	8.300					•		2	5.609	0.520	5.241	18.240				•	
Hg	0.4	1.4	10.0	1	0.400		0.400	0.400							2	0.015	0.004	0.012	0.243				•	D
Mo	14.0	48.0	250.0	7	2.034	0.856	0.640	13.710					•		3	1.708	0.354	1.301	1.940					D
Ni	50.0	170.0	500.0	7	4.526	5.820	2.000	27.700					•	D	3	12.482	3.441	10.032	16.416					
Pb	120.0	400.0	2500.0	2	0.183	0.004	0.180	9.900					•	D	2	5.144	0.138	5.046	8.269				•	D
Sb	3.7	12.0	100.0	2	0.598	0.068	0.550	4.400	1				•		2	0.641	0.004	0.638	4.621				•	D
Se	1.4	4.8	100.0	2	0.051	0.022	0.035	4.400	1				•	D	2	0.049	0.000	0.049	1.824				•	D
Sn	29.0	95.0	500.0	3	29.433	22.258	4.400	46.990	2					D	2	1.578	0.013	1.569	2.432				•	D
V	230.0	760.0	2500.0	3	3.887	1.946	1.910	5.800							2	15.306	0.443	14.993	31.008				•	D
Zn	200.0	670.0	2500.0	7	2.247	1.468	0.430	15.000					•	D	3	22.504	6.867	17.924	30.400					
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	2	165	208	18	312						D	2	295	0	295	295					D
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	2	25.080	6.689	20.350	29.810							2	114.760	4.256	111.750	117.770					
SO4	27000.0	80000.0	40000.0	3	1659	934	581	2225						D	2	3014	197	2875	9667				•	
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

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Building material: **cementbeton**

identification number: PACN8013.wk1

17-Dec-93

	adjusted values granular materials			leaching characteristics		L/S=10 columntest in mg/kg									composition			aqua regia in mg/kg						
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
Benzeen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ethylbenz.	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Tolueen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Xylenen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Fenolen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-fenol	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Arom.(tot)	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Naf	*************	1000000.00	5.00	NA	NA	NA							NA	NA	2	0.001	0.000	0.001	0.007					D
Ph	*************	1000000.00	20.00	NA	NA	NA							NA	NA	2	0.002	0.000	0.002	0.003					D
An	*************	1000000.00	10.00	NA	NA	NA							NA	NA	3	0.002		0.002	0.002					D
Fla	*************	1000000.00	35.00	NA	NA	NA							NA	NA	3	0.005		0.005	0.005					D
Chr	*************	1000000.00	10.00	NA	NA	NA							NA	NA	3	0.020		0.020	0.020					D
BaA	*************	1000000.00	50.00	NA	NA	NA							NA	NA	3	0.020		0.020	0.020					D
BaP	*************	1000000.00	10.00	NA	NA	NA							NA	NA	3	0.050	0.000	0.050	0.050					D
BkF	*************	1000000.00	50.00	NA	NA	NA							NA	NA	3	0.050	0.000	0.050	0.050					D
IP	*************	1000000.00	50.00	NA	NA	NA							NA	NA	3	0.050	0.000	0.050	0.050					D
BPe	*************	1000000.00	50.00	NA	NA	NA							NA	NA	3	0.050	0.000	0	0					D
PAK10(tot)	*************	1000000.00	75.00	NA	NA	NA							NA	NA	2	0.250	0.000	0.250	0.257					D
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

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Building material: **cementbeton**

identification number: PCBN8013.wk1

17-Dec-93

adjusted values granular materials				leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-118	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-138	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **cementbeton met aardelite**

identification number: NV8cb01.wk1

17-Dec-93

element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
	adjusted values granular materials			leaching characteristics L/S=10 columntest in mg/kg											composition aqua regia in mg/kg									
As	0.88	7.00	375.00	3	0.040		0.040	0.040							2	19.456		19.456	19.456					
Ba	5.50	58.00	7500.00	3	2.300	1.311	0.900	3.500							2	401.584	22.786	385.472	417.896					
Cd	0.03	0.07	10.00	3	0.001		0.001	0.001						D	2	4.834	1.935	3.466	6.202					
Co	0.42	2.50	250.00	3	0.010		0.010	0.010						D	2	4.560	0.946	3.891	5.229					
Cr	1.30	12.00	1250.00	3	0.017	0.006	0.010	0.020						D	2	59.888	20.206	45.600	74.176					
Cu	0.72	3.50	375.00	3	0.015		0.015	0.015						D	2	38.912	10.318	31.616	46.208					
Hg	0.02	0.08	5.00	3	0.003	0.000	0.003	0.003							2	0.243		0.243	0.243					
Mo	0.28	0.91	125.00	3	0.670	0.346	0.310	1.000	3	1					2	5.350	1.720	4.134	6.566					D
Ni	1.10	3.70	250.00	3	0.020		0.020	0.020						D	2	17.328	0.430	17.024	17.632					
Pb	1.90	8.70	1250.00	3	0.030		0.030	0.030						D	2	123.728	48.581	89.376	158.080					
Sb	0.05	0.43	50.00	3	0.030		0.030	0.030							2	15.808	3.439	13.376	18.240					
Se	0.04	0.10	50.00	3	0.030		0.030	0.030							2	1.824		1.824	1.824					D
Sn	0.27	2.40	250.00	3	0.030		0.030	0.030						D	2	18.848	4.299	15.808	21.888					D
V	1.60	32.00	1250.00	3	0.040		0.040	0.040						D	2	36.784	3.869	34.048	39.520					D
Zn	3.80	15.00	1250.00	3	0.100	0.000	0.100	0.100						D	2	276.640	98.882	206.720	346.560					
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	750.00	22000.00	25000.00	2	244	1	243	270					•	D	2	13589	387	13315	13862					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **cementbeton met aardelite**

identification number: V4cb01.wk1

18-Dec-93

adjusted values products | leaching characteristics: 64 days diffusiontest in mg/m2 | composition: aqua regia in mg/kg

element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	41.0	140.0	750.0	4	3.550	2.598	1.300	5.800							2	19.456		19.456	19.456					
Ba	600.0	2000.0	15000.0	2	18.800	1.556	17.700	19.900							2	401.584	22.786	385.472	417.696					
Cd	1.1	3.8	20.0	2	0.200		0.200	0.200							2	4.834	1.935	3.466	6.202					
Co	29.0	95.0	500.0	2	1.500		1.500	1.500							2	4.560	0.946	3.891	5.229					
Cr	140.0	480.0	2500.0	2	1.500		1.500	1.500						D	2	59.888	20.206	45.600	74.176					
Cu	51.0	170.0	750.0	3	1.767	0.473	1.400	5.200							2	38.912	10.318	31.616	46.208					
Hg	0.4	1.4	10.0	2	0.400		0.400	0.400							2	0.243		0.243	0.243					
Mo	14.0	48.0	250.0	4	3.275	0.472	2.600	3.600							2	5.350	1.720	4.134	6.566					D
Ni	50.0	170.0	500.0	4	2.175	0.954	1.300	3.000						D	2	17.328	0.430	17.024	17.632					
Pb	120.0	400.0	2500.0	2	11.050	0.212	10.900	11.200							2	123.728	48.581	89.376	158.080					
Sb	3.7	12.0	100.0	2	4.400		4.400	4.400	2						2	15.808	3.439	13.376	18.240					
Se	1.4	4.8	100.0	2	4.400		4.400	4.400	2						2	1.824		1.824	1.824					D
Sn	29.0	95.0	500.0	2	4.400		4.400	4.400						D	2	18.848	4.299	15.808	21.888					D
V	230.0	760.0	2500.0	2	5.800		5.800	5.800							2	36.784	3.869	34.048	39.520					D
Zn	200.0	670.0	2500.0	2	15.000		15.000	15.000							2	276.640	98.882	206.720	346.560					
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	27000.0	80000.0	40000.0	2	2370	594	1950	2790						D	2	13589	387	13315	13862					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

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Building material: **cementbeton met AVI-slak**

identification number: NV8cb02.wk1

17-Dec-93

	adjusted values granular materials			leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	1	0.010		0.010	0.010						D	3	4.673	0.128	4.548	4.803					D
Ba	5.50	58.00	7500.00	1	8.294		8.294	8.294	1						3	175.367	15.370	159.053	189.574					
Cd	0.03	0.07	10.00	1	0.001		0.001	0.001						D	2	0.122	0.000	0.122	0.492				*	D
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	1.30	12.00	1250.00	1	0.347		0.347	0.347							3	34.984	3.845	32.364	39.398					
Cu	0.72	3.50	375.00	1	0.253		0.253	0.253							3	95.557	86.546	33.914	194.499					
Hg	0.02	0.08	5.00	1	0.001		0.001	0.001							2	0.018	ERR	0.018	0.024				*	D
Mo	0.28	0.91	125.00	1	0.100		0.100	0.100							3	1.650	0.193	1.496	1.867					D
Ni	1.10	3.70	250.00	1	0.065		0.065	0.065						D	2	11.555	0.219	11.400	14.525				*	
Pb	1.90	8.70	1250.00	1	0.045		0.045	0.045						D	3	72.159	25.856	50.859	100.928					
Sb	0.05	0.43	50.00	1	0.010		0.010	0.010							3	3.480	0.724	2.681	4.092					
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	3	0.073		0.073	0.073					D
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	3	4.830	0.967	4.061	5.916					D
V	1.60	32.00	1250.00	1	0.050		0.050	0.050							3	17.287	0.510	16.915	17.869					D
Zn	3.80	15.00	1250.00	1	0.101		0.101	0.101						D	3	103.117	36.660	71.379	143.245					
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	1	48		48	48							3	368	47	317	409					D
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	3	136.395	2.958	134.307	139.779					
SO4	750.00	22000.00	25000.00	1	69		69	69						D	3	3825	217	3605	4040					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material:				cementbeton met AVI-slak																				
identification number:				V4cb02.wk1																				
18-Dec-93				leaching characteristics					64 days diffusiontest in mg/m2						composition				aqua regia in mg/kg					
	adjusted values products																							
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	41.0	140.0	750.0	3	0.497	0.055	0.440	0.550							3	4.673	0.128	4.548	4.803					D
Ba	600.0	2000.0	15000.0	3	31.167	10.006	20.300	40.000							3	175.367	15.370	159.053	189.574					
Cd	1.1	3.8	20.0	3	0.050	0.026	0.031	0.079						D	2	0.122	0.000	0.122	0.492				•	D
Co	29.0	95.0	500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	140.0	480.0	2500.0	3	3.760	0.508	3.200	4.190							3	34.984	3.845	32.364	39.398					
Cu	51.0	170.0	750.0	2	1.700	0.141	1.600	3.930					•		3	95.557	86.546	33.914	194.499					
Hg	0.4	1.4	10.0	NA	NA	NA							NA	NA	2	0.018	ERR	0.018	0.024				•	D
Mo	14.0	48.0	250.0	3	0.530	0.017	0.510	0.540						D	3	1.650	0.193	1.496	1.867					D
Ni	50.0	170.0	500.0	3	16.097	0.336	15.730	16.390							2	11.555	0.219	11.400	14.525				•	
Pb	120.0	400.0	2500.0	2	0.167	0.089	0.104	1.630					•	D	3	72.159	25.856	50.859	100.928					
Sb	3.7	12.0	100.0	2	0.590	0.000	0.590	0.610					•		3	3.480	0.724	2.681	4.092					
Se	1.4	4.8	100.0	3	0.038	0.010	0.031	0.050						D	3	0.073		0.073	0.073					D
Sn	29.0	95.0	500.0	3	32.280	0.717	31.460	32.790	3					D	3	4.830	0.967	4.061	5.916					D
V	230.0	760.0	2500.0	2	3.140	0.014	3.130	4.020					•		3	17.287	0.510	16.915	17.869					D
Zn	200.0	670.0	2500.0	2	0.239	0.100	0.168	0.310						D	3	103.117	36.660	71.379	143.245					
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	3	158	134	16	282						D	3	368	47	317	409					D
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	3	34.607	2.895	31.710	37.500							3	136.395	2.958	134.307	139.779					
SO4	27000.0	80000.0	40000.0	3	2203	107	2080	2270						D	3	3825	217	3605	4040					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **cementbeton met EC-vliegas**

identification number: NV8cb03.wk1

17-Dec-93

	adjusted values granular materials			leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	2	0.025	0.021	0.010	0.040						D	4	5.910	0.498	5.478	6.341					D
Ba	5.50	58.00	7500.00	1	6.672		6.672	6.672	1						4	165.239	11.244	155.162	178.691					
Cd	0.03	0.07	10.00	2	0.006	0.006	0.001	0.010							4	0.067	0.011	0.055	0.079					D
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	1.30	12.00	1250.00	2	0.183	0.184	0.054	0.313							4	30.561	4.628	26.491	34.674					
Cu	0.72	3.50	375.00	2	0.125	0.148	0.020	0.230							4	13.957	3.582	10.141	18.684					
Hg	0.02	0.08	5.00	2	0.001	0.000	0.000	0.001						D	4	0.021	0.003	0.018	0.024					D
Mo	0.28	0.91	125.00	2	0.719	0.861	0.111	1.328	1	1					4	2.181	0.486	1.721	2.657					D
Ni	1.10	3.70	250.00	2	0.506	0.699	0.011	1.000							4	15.077	1.527	13.461	16.860					
Pb	1.90	8.70	1250.00	2	0.255	0.346	0.010	0.500							4	8.655	0.885	7.813	9.533					D
Sb	0.05	0.43	50.00	1	0.010		0.010	0.010							4	1.056	0.075	0.973	1.155					
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	4	0.600	0.146	0.438	0.790					D
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	4	1.774	0.157	1.617	1.976					D
V	1.60	32.00	1250.00	2	0.069	0.027	0.050	0.088							4	26.858	2.899	23.645	30.564					D
Zn	3.80	15.00	1250.00	2	0.119	0.026	0.101	0.137						D	4	23.793	1.384	22.320	25.427					
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	2	10	7	5	14							4	252	87	122	297					D
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	4	103.740	15.483	82.688	115.946					
SO4	750.00	22000.00	25000.00	1	53		53	53						D	4	2609	561	1915	3095					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **cementbeton met EC-vliegas**

identification number: V4cb03.wk1

18-Dec-93

	adjusted values products			leaching characteristics	64 days diffusiontest in mg/m2										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	41.0	140.0	750.0	4	0.695	0.086	0.600	0.790							4	5.910	0.498	5.478	6.341					D
Ba	600.0	2000.0	15000.0	4	4.775	0.716	4.070	5.460							4	165.239	11.244	155.162	178.691					
Cd	1.1	3.8	20.0	3	0.062	0.012	0.054	0.254						D	4	0.067	0.011	0.055	0.079					D
Co	29.0	95.0	500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	140.0	480.0	2500.0	4	6.930	1.862	5.530	9.470							4	30.561	4.628	26.491	34.674					
Cu	51.0	170.0	750.0	4	1.790	0.492	1.320	2.220							4	13.957	3.582	10.141	18.684					
Hg	0.4	1.4	10.0	NA	NA	NA							NA	NA	4	0.021	0.003	0.018	0.024					D
Mo	14.0	48.0	250.0	4	1.915	0.396	1.600	2.480							4	2.181	0.486	1.721	2.657					D
Ni	50.0	170.0	500.0	4	21.943	6.629	15.910	27.700							4	15.077	1.527	13.461	16.860					
Pb	120.0	400.0	2500.0	4	0.204	0.110	0.111	0.362						D	4	8.655	0.885	7.813	9.533					D
Sb	3.7	12.0	100.0	4	0.544	0.315	0.244	0.900							4	1.056	0.075	0.973	1.155					
Se	1.4	4.8	100.0	4	0.180	0.028	0.156	0.217						D	4	0.600	0.146	0.438	0.790					D
Sn	29.0	95.0	500.0	4	44.248	13.698	31.810	56.870	4					D	4	1.774	0.157	1.617	1.976					D
V	230.0	760.0	2500.0	4	5.764	1.309	4.544	7.100							4	26.858	2.899	23.645	30.564					D
Zn	200.0	670.0	2500.0	4	3.042	3.374	0.237	7.030						D	4	23.793	1.384	22.320	25.427					
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	4	174	167	17	356						D	4	252	87	122	297					D
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	4	29.215	11.120	19.590	40.420							4	103.740	15.483	82.688	115.946					
SO4	27000.0	80000.0	40000.0	4	4068	2925	1127	7626							4	2609	561	1915	3095					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **cementbeton met jarosiet-eindslak**

identification number: NV8cb04.wk1

17-Dec-93

	adjusted values granular materials			leaching characteristics L/S=10 columntest in mg/kg											composition aqua regia in mg/kg									
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	NA	NA	NA							NA	NA	12	28.790	23.855	0.669	58.000	1.061	0.814			
Ba	5.50	58.00	7500.00	NA	NA	NA							NA	NA	10	1928.048	756.598	674.880	3090.000	3.244	0.219			
Cd	0.03	0.07	10.00	NA	NA	NA							NA	NA	12	0.315	0.290	0.061	0.800	-0.740	0.507			D
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	11	37.011	6.039	30.000	60.000	1.581	0.092		*	
Cr	1.30	12.00	1250.00	NA	NA	NA							NA	NA	8	**********	7893.589	383.040	**********			6		
Cu	0.72	3.50	375.00	NA	NA	NA							NA	NA	11	1219.498	609.664	760.000	3568.960	3.088	0.231	12	*	
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	5	0.542	0.476	0.050	1.000					
Mo	0.28	0.91	125.00	NA	NA	NA							NA	NA	3	20.064	2.106	17.632	145.920			1	*	D
Ni	1.10	3.70	250.00	NA	NA	NA							NA	NA	12	150.036	45.872	60.192	210.000	2.154	0.155			
Pb	1.90	8.70	1250.00	NA	NA	NA							NA	NA	12	64.243	25.906	30.400	98.000	1.772	0.190			
Sb	0.05	0.43	50.00	NA	NA	NA							NA	NA	20	58.794	26.305	24.928	109.440	1.723	0.213	11		
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	5	1.443	0.516	1.000	2.000					D
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	2	4.500	0.707	4.000	5.000					D
V	1.60	32.00	1250.00	NA	NA	NA							NA	NA	2	93.000	4.243	90.000	96.000					
Zn	3.80	15.00	1250.00	NA	NA	NA							NA	NA	10	1604.800	255.037	1216.000	1933.440	3.200	0.072	8		
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	750.00	22000.00	25000.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

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Building material:				cementbeton met jarosiet-eindslak																				
identification number:				V4cb04.wk1																				
18-Dec-93				leaching characteristics					64 days diffusiontest in mg/m2						composition				aqua regia in mg/kg					
	adjusted values products																							
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	41.0	140.0	750.0	18	1.419	1.112	0.300	2.970			0.016	0.362			12	28.790	23.855	0.669	58.000	1.061	0.814			
Ba	600.0	2000.0	15000.0	18	197.204	277.731	5.300	593.640			1.457	0.950			10	1928.048	756.598	674.880	3090.000	3.244	0.219			
Cd	1.1	3.8	20.0	6	1.130	0.046	1.100	1.190	2						12	0.315	0.290	0.061	0.800	-0.740	0.507			D
Co	29.0	95.0	500.0	18	2.377	2.490	0.300	5.940			0.106	0.512			11	37.011	6.039	30.000	60.000	1.581	0.092		*	
Cr	140.0	480.0	2500.0	14	8.277	1.896	4.200	10.700			0.905	0.114			8	**********	7893.589	383.040	**********			6		
Cu	51.0	170.0	750.0	17	1.581	2.363	0.200	14.100			-0.067	0.590	*		11	1219.498	609.664	760.000	3568.960	3.088	0.231	12	*	
Hg	0.4	1.4	10.0	6	5.780	0.124	5.700	5.940	6	6					5	0.542	0.476	0.050	1.000					
Mo	14.0	48.0	250.0	13	7.088	6.874	1.000	45.000	3		0.688	0.554	*		3	20.064	2.106	17.632	145.920				*	D
Ni	50.0	170.0	500.0	18	4.374	5.233	0.300	11.870			0.260	0.606		D	12	150.036	45.872	60.192	210.000	2.154	0.155			
Pb	120.0	400.0	2500.0	18	1.479	1.273	0.300	4.080			0.007	0.396			12	64.243	25.906	30.400	98.000	1.772	0.190			
Sb	3.7	12.0	100.0	18	4.612	3.170	1.190	8.000	8		0.538	0.359			20	58.794	26.305	24.928	109.440	1.723	0.213	2		
Se	1.4	4.8	100.0	6	5.780	0.124	5.700	5.940	6	6					5	1.443	0.516	1.000	2.000					D
Sn	29.0	95.0	500.0	6	2.923	0.036	2.900	2.970						D	2	4.500	0.707	4.000	5.000					D
V	230.0	760.0	2500.0	6	14.797	7.049	5.940	20.400							2	93.000	4.243	90.000	96.000					
Zn	200.0	670.0	2500.0	18	23.462	25.116	2.800	59.360			1.088	0.523			10	1604.800	255.037	1216.000	1933.440	3.200	0.072			
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	27000.0	80000.0	40000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **cementbeton met lytag**

identification number: V4cb05.wk1

18-Dec-93

adjusted values products | leaching characteristics — 64 days diffusiontest in mg/m2

element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.
As	41.0	140.0	750.0	2	1.400		1.400	1.400						
Ba	600.0	2000.0	15000.0	NA	NA	NA							NA	NA
Cd	1.1	3.8	20.0	NA	NA	NA							NA	NA
Co	29.0	95.0	500.0	NA	NA	NA							NA	NA
Cr	140.0	480.0	2500.0	NA	NA	NA							NA	NA
Cu	51.0	170.0	750.0	2	1.450	0.071	1.400	1.500						D
Hg	0.4	1.4	10.0	NA	NA	NA							NA	NA
Mo	14.0	48.0	250.0	2	2.900	0.283	2.700	3.100						
Ni	50.0	170.0	500.0	2	1.500	0.141	1.400	1.600						D
Pb	120.0	400.0	2500.0	NA	NA	NA							NA	NA
Sb	3.7	12.0	100.0	NA	NA	NA							NA	NA
Se	1.4	4.8	100.0	NA	NA	NA							NA	NA
Sn	29.0	95.0	500.0	NA	NA	NA							NA	NA
V	230.0	760.0	2500.0	NA	NA	NA							NA	NA
Zn	200.0	670.0	2500.0	NA	NA	NA							NA	NA
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA
Cl	18000.0	54000.0	1000000.0	NA	NA	NA							NA	NA
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA
F-tot	1300.0	4400.0	9000.0	NA	NA	NA							NA	NA
SO4	27000.0	80000.0	40000.0	NA	NA	NA							NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o

composition — aqua regia in mg/kg

element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	41.0	140.0	750.0	NA	NA	NA						NA	NA
Ba	600.0	2000.0	15000.0	NA	NA	NA						NA	NA
Cd	1.1	3.8	20.0	NA	NA	NA						NA	NA
Co	29.0	95.0	500.0	NA	NA	NA						NA	NA
Cr	140.0	480.0	2500.0	NA	NA	NA						NA	NA
Cu	51.0	170.0	750.0	NA	NA	NA						NA	NA
Hg	0.4	1.4	10.0	NA	NA	NA						NA	NA
Mo	14.0	48.0	250.0	NA	NA	NA						NA	NA
Ni	50.0	170.0	500.0	NA	NA	NA						NA	NA
Pb	120.0	400.0	2500.0	NA	NA	NA						NA	NA
Sb	3.7	12.0	100.0	NA	NA	NA						NA	NA
Se	1.4	4.8	100.0	NA	NA	NA						NA	NA
Sn	29.0	95.0	500.0	NA	NA	NA						NA	NA
V	230.0	760.0	2500.0	NA	NA	NA						NA	NA
Zn	200.0	670.0	2500.0	NA	NA	NA						NA	NA
Br	29.0	95.0	1000.0	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	NA	NA	NA						NA	NA
CN-comp	7.1	24.0	250.0	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	NA	NA	NA						NA	NA
SO4	27000.0	80000.0	40000.0	NA	NA	NA						NA	NA
a	b	c	d	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

RIVM
research for
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database

Building material: **asfaltbeton**

identification number: NV8015.wk1

16-Dec-93

	adjusted values granular materials			leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	4	0.042	0.016	0.019	0.050							15	3.137	1.895	0.250	6.200	0.332	0.499			D
Ba	5.50	58.00	7500.00	3	0.100	0.000	0.100	0.105					•	D	15	34.342	29.852	0.500	104.625	1.333	0.549			
Cd	0.03	0.07	10.00	4	0.038	0.024	0.001	0.050	3						14	0.770	0.382	0.027	7.000	-0.169	0.523		•	D
Co	0.42	2.50	250.00	3	0.100	0.000	0.100	0.100							3	11.667	2.517	9.000	14.000					
Cr	1.30	12.00	1250.00	4	0.092	0.024	0.056	0.110							14	38.867	38.200	11.000	277.000	1.506	0.428		•	
Cu	0.72	3.50	375.00	4	0.093	0.058	0.013	0.150							15	11.057	8.207	2.000	25.000	0.921	0.352			
Hg	0.02	0.08	5.00	4	0.002	0.000	0.001	0.002							3	0.010	0.000	0.010	0.014				•	D
Mo	0.28	0.91	125.00	3	0.101	0.002	0.100	0.130					•		14	4.927	2.158	0.500	14.000	0.627	0.410		•	D
Ni	1.10	3.70	250.00	4	0.078	0.044	0.012	0.100						D	14	19.951	17.380	6.000	110.000	1.248	0.360		•	
Pb	1.90	8.70	1250.00	4	0.094	0.012	0.076	0.100							14	13.367	16.624	0.500	286.000	1.047	0.576		•	
Sb	0.05	0.43	50.00	4	0.040	0.020	0.010	0.050	3						10	0.201	0.058	0.100	0.257	-0.719	0.155			D
Se	0.04	0.10	50.00	3	0.050	0.000	0.050	0.050	3						10	0.677	0.422	0.020	1.000	-0.350	0.551			D
Sn	0.27	2.40	250.00	3	0.100	0.000	0.100	0.100						D	3	0.500		0.500	1.863				•	D
V	1.60	32.00	1250.00	4	0.088	0.025	0.050	0.100							15	33.579	23.308	10.685	88.000	1.434	0.290			D
Zn	3.80	15.00	1250.00	3	0.100	0.000	0.100	0.270					•	D	14	34.619	22.520	10.665	420.000	1.543	0.390		•	
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	1	12		12	12							1	324		324	324					D
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	3	1480.005	1998.843	84.578	3769.875					
SO4	750.00	22000.00	25000.00	1	38		38	38						D	1	198		198	198					D
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **asfaltbeton**

identification number: V4015.wk1

06-Jun-94

element	adjusted values products U1	U2	S1	leaching characteristics N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
				64 days diffusiontest in mg/m2											aqua regia in mg/kg									
As	41.0	140.0	750.0	4	0.195	0.050	0.120	0.220						D	15	3.137	1.895	0.250	6.200	0.332	0.499			D
Ba	600.0	2000.0	15000.0	3	3.310	2.062	1.600	58.000					•		15	34.342	29.852	0.500	104.625	1.333	0.549			
Cd	1.1	3.8	20.0	4	0.089	0.042	0.027	0.110							14	0.770	0.382	0.027	7.000	-0.169	0.523		•	D
Co	29.0	95.0	500.0	NA	NA	NA							NA	NA	3	11.667	2.517	9.000	14.000					
Cr	140.0	480.0	2500.0	4	1.218	0.953	0.560	2.600						D	14	38.867	38.200	11.000	277.000	1.506	0.428		•	
Cu	51.0	170.0	750.0	4	1.547	1.066	0.687	3.100							15	11.057	8.207	2.000	25.000	0.921	0.352			
Hg	0.4	1.4	10.0	NA	NA	NA							NA	NA	3	0.010	0.000	0.010	0.014				•	D
Mo	14.0	48.0	250.0	4	1.715	0.970	0.260	2.200							14	4.927	2.158	0.500	14.000	0.627	0.410		•	D
Ni	50.0	170.0	500.0	3	1.800	1.212	1.100	13.010					•	D	14	19.951	17.380	6.000	110.000	1.248	0.360		•	
Pb	120.0	400.0	2500.0	4	0.905	0.390	0.320	1.100							14	13.367	16.624	0.500	286.000	1.047	0.576		•	
Sb	3.7	12.0	100.0	4	0.218	0.076	0.110	0.290							10	0.201	0.058	0.100	0.257	-0.719	0.155			D
Se	1.4	4.8	100.0	4	0.832	0.537	0.026	1.100							10	0.677	0.422	0.020	1.000	-0.350	0.551			D
Sn	29.0	95.0	500.0	1	26.020		26.020	26.020						D	3	0.500		0.500	1.863				•	D
V	230.0	760.0	2500.0	4	1.658	1.084	0.033	2.200						D	15	33.579	23.308	10.685	88.000	1.434	0.290			D
Zn	200.0	670.0	2500.0	3	9.067	2.542	7.500	31.500					•		14	34.619	22.520	10.665	420.000	1.543	0.390		•	
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	1	130		130	130						D	1	324		324	324					D
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	3	17.743	13.527	3.230	30.000							3	1480.005	1998.843	84.578	3769.875					
SO4	27000.0	80000.0	40000.0	1	139		139	139						D	1	198		198	198					D
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

RIVM
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Building material: **asfaltbeton**

identification number: PACN8015.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
Benzeen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ethylbenz.	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Tolueen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Xylenen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Fenolen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-fenol	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Arom.(tot)	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Naf	*************	1000000.00	5.00	NA	NA	NA							NA	NA	11	22.234	56.110	0.070	280.000	0.538	1.179	4	•	D
Ph	*************	1000000.00	20.00	NA	NA	NA							NA	NA	11	43.505	73.773	0.200	320.000	0.923	1.191	6	•	
An	*************	1000000.00	10.00	NA	NA	NA							NA	NA	11	7.442	9.814	0.050	49.000	0.278	1.132	5	•	D
Fla	*************	1000000.00	35.00	NA	NA	NA							NA	NA	11	33.621	47.736	0.050	200.000	0.863	1.207	4	•	
Chr	*************	1000000.00	10.00	NA	NA	NA							NA	NA	12	11.834	11.429	0.010	35.000	0.360	1.314	7		
BaA	*************	1000000.00	50.00	NA	NA	NA							NA	NA	12	12.624	12.804	0.010	40.000	0.357	1.332			D
BaP	*************	1000000.00	10.00	NA	NA	NA							NA	NA	11	7.510	8.490	0.050	40.000	0.332	1.112	4	•	D
BkF	*************	1000000.00	50.00	NA	NA	NA							NA	NA	12	3.972	4.668	0.010	14.000	-0.103	1.164			D
IP	*************	1000000.00	50.00	NA	NA	NA							NA	NA	10	5.833	6.166	0.050	30.000	0.353	0.996		•	D
BPe	*************	1000000.00	50.00	NA	NA	NA							NA	NA	10	4.385	4.903	0	25	0.266	0.942		•	D
PAK10(tot)	*************	1000000.00	75.00	NA	NA	NA							NA	NA	17	95.648	184.757	0.910	1030.000	1.124	1.117	7	•	
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

RIVM
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Building material: **asfaltbeton**

identification number: PCBN8015.wk1

17-Dec-93

	adjusted values granular materials			leaching characteristics						L/S=10 columntest in mg/kg					composition				aqua regia in mg/kg					
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-118	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-138	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **asfaltbeton (overigen)**

identification number: PACN8ab1.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
Benzeen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ethylbenz.	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Tolueen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Xylenen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Fenolen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-fenol	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Arom.(tot)	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Naf	*************	1000000.00	5.00	NA	NA	NA							NA	NA	11	22.234	56.110	0.070	280.000	0.538	1.179	4	*	D
Ph	*************	1000000.00	20.00	NA	NA	NA							NA	NA	11	43.505	73.773	0.200	320.000	0.923	1.191	6	*	
An	*************	1000000.00	10.00	NA	NA	NA							NA	NA	11	7.442	9.814	0.050	49.000	0.278	1.132	5	*	D
Fla	*************	1000000.00	35.00	NA	NA	NA							NA	NA	11	33.621	47.736	0.050	200.000	0.863	1.207	4	*	
Chr	*************	1000000.00	10.00	NA	NA	NA							NA	NA	12	11.834	11.429	0.010	35.000	0.360	1.314	7		
BaA	*************	1000000.00	50.00	NA	NA	NA							NA	NA	12	12.624	12.804	0.010	40.000	0.357	1.332			D
BaP	*************	1000000.00	10.00	NA	NA	NA							NA	NA	11	7.510	8.490	0.050	40.000	0.332	1.112	4	*	D
BkF	*************	1000000.00	50.00	NA	NA	NA							NA	NA	12	3.972	4.668	0.010	14.000	-0.103	1.164			D
IP	*************	1000000.00	50.00	NA	NA	NA							NA	NA	10	5.833	6.166	0.050	30.000	0.353	0.996		*	D
BPe	*************	1000000.00	50.00	NA	NA	NA							NA	NA	10	4.385	4.903	0	25	0.266	0.942		*	D
PAK10(tot)	*************	1000000.00	75.00	NA	NA	NA							NA	NA	17	95.648	184.757	0.910	1030.000	1.124	1.117	7	*	
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

RIVM
research for
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Building material: **asfaltbeton (overigen)**

identification number: PCBN8ab1.wk1

17-Dec-93

adjusted values granular materials				leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-118	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-138	1000000.Q	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

RIVM
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Building material: **asfaltbeton (recycling asfalt)**

identification number: PACN8ab2.wk1

17-Dec-93

adjusted values granular materials				leaching characteristics L/S=10 columntest in mg/kg											composition aqua regia in mg/kg									
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
Benzeen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ethylbenz.	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Tolueen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Xylenen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Fenolen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-fenol	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Arom.(tot)	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Naf	*************	1000000.00	5.00	NA	NA	NA							NA	NA	17	0.500	0.000	0.500	1.100	-0.282	0.081		*	D
Ph	*************	1000000.00	20.00	NA	NA	NA							NA	NA	17	1.647	2.631	0.500	20.000	0.034	0.509		*	D
An	*************	1000000.00	10.00	NA	NA	NA							NA	NA	17	0.682	0.656	0.500	3.700	-0.194	0.273		*	D
Fla	*************	1000000.00	35.00	NA	NA	NA							NA	NA	17	2.847	4.419	0.500	19.000	0.140	0.595		*	
Chr	*************	1000000.00	10.00	NA	NA	NA							NA	NA	18	1.600	1.884	0.500	5.800	-0.031	0.429			D
BaA	*************	1000000.00	50.00	NA	NA	NA							NA	NA	18	1.372	1.546	0.500	5.000	-0.063	0.391			D
BaP	*************	1000000.00	10.00	NA	NA	NA							NA	NA	17	0.929	0.860	0.500	3.800	-0.107	0.330		*	D
BkF	*************	1000000.00	50.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
IP	*************	1000000.00	50.00	NA	NA	NA							NA	NA	17	0.647	0.310	0.500	2.000	-0.193	0.198		*	D
BPe	*************	1000000.00	50.00	NA	NA	NA							NA	NA	17	0.641	0.285	1	2	-0.197	0.183		*	D
PAK10(tot)	*************	1000000.00	75.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **asfaltbeton (recycling asfalt)**

identification number: PCBN8ab2.wk1

17-Dec-93

adjusted values granular materials				leaching characteristics L/S=10 columntest in mg/kg											composition aqua regia in mg/kg									
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-118	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-138	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

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Building material: **asfaltbeton met AVI-slak**

identification number: NV8ab01.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	NA	NA	NA							NA	NA	1	3.800		3.800	3.800					D
Ba	5.50	58.00	7500.00	NA	NA	NA							NA	NA	1	334.000		334.000	334.000					
Cd	0.03	0.07	10.00	NA	NA	NA							NA	NA	1	1.400		1.400	1.400					
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	1	3.100		3.100	3.100					
Cr	1.30	12.00	1250.00	NA	NA	NA							NA	NA	1	28.000		28.000	28.000					
Cu	0.72	3.50	375.00	NA	NA	NA							NA	NA	1	606.000		606.000	606.000			1		
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	1	0.200		0.200	0.200					
Mo	0.28	0.91	125.00	NA	NA	NA							NA	NA	1	6.600		6.600	6.600					D
Ni	1.10	3.70	250.00	NA	NA	NA							NA	NA	1	17.000		17.000	17.000					
Pb	1.90	8.70	1250.00	NA	NA	NA							NA	NA	1	284.000		284.000	284.000					
Sb	0.05	0.43	50.00	NA	NA	NA							NA	NA	1	9.400		9.400	9.400					
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	1	0.100		0.100	0.100					D
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	1	4.900		4.900	4.900					D
V	1.60	32.00	1250.00	NA	NA	NA							NA	NA	1	0.020		0.020	0.020					D
Zn	3.80	15.00	1250.00	NA	NA	NA							NA	NA	1	707.000		707.000	707.000					
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	750.00	22000.00	25000.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **asfaltbeton met AVI-slak**

identification number: V4ab01.wk1

18-Dec-93

adjusted values products				leaching characteristics	64 days diffusiontest in mg/m2										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	41.0	140.0	750.0	3	1.200		1.200	1.200							1	3.800		3.800	3.800					D
Ba	600.0	2000.0	15000.0	NA	NA	NA							NA	NA	1	334.000		334.000	334.000					
Cd	1.1	3.8	20.0	3	0.100	0.000	0.100	0.100							1	1.400		1.400	1.400					
Co	29.0	95.0	500.0	NA	NA	NA							NA	NA	1	3.100		3.100	3.100					
Cr	140.0	480.0	2500.0	3	0.300		0.300	0.300						D	1	28.000		28.000	28.000					
Cu	51.0	170.0	750.0	3	1.033	0.379	0.600	1.300						D	1	606.000		606.000	606.000					
Hg	0.4	1.4	10.0	NA	NA	NA							NA	NA	1	0.200		0.200	0.200					
Mo	14.0	48.0	250.0	3	5.867	0.058	5.800	5.900							1	6.600		6.600	6.600					D
Ni	50.0	170.0	500.0	3	1.200		1.200	1.200						D	1	17.000		17.000	17.000					
Pb	120.0	400.0	2500.0	2	1.200	ERR	1.200	1.700							1	284.000		284.000	284.000					
Sb	3.7	12.0	100.0	NA	NA	NA							NA	NA	1	9.400		9.400	9.400					
Se	1.4	4.8	100.0	NA	NA	NA							NA	NA	1	0.100		0.100	0.100					D
Sn	29.0	95.0	500.0	NA	NA	NA							NA	NA	1	4.900		4.900	4.900					D
V	230.0	760.0	2500.0	NA	NA	NA							NA	NA	1	0.020		0.020	0.020					D
Zn	200.0	670.0	2500.0	3	23.667	0.577	23.000	24.000							1	707.000		707.000	707.000					
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	27000.0	80000.0	40000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **asfaltbeton met AVI-vliegas**

identification number: NV8ab02.wk1

17-Dec-93

adjusted values granular materials				leaching characteristics L/S=10 columntest in mg/kg											composition aqua regia in mg/kg									
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	3	0.083	0.034	0.056	0.121							3	3.929	0.031	3.895	3.956					D
Ba	5.50	58.00	7500.00	1	0.244		0.244	0.244						D	3	125.955	1.978	124.403	128.183					
Cd	0.03	0.07	10.00	2	0.001	0.001	0.000	0.032	1				•	D	3	3.438	0.592	2.970	4.104					
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	1.30	12.00	1250.00	2	0.116	0.002	0.114	0.145					•		3	34.742	2.025	32.434	36.221					
Cu	0.72	3.50	375.00	3	0.033	0.009	0.026	0.043						D	3	12.787	1.256	11.765	14.189					
Hg	0.02	0.08	5.00	1	0.001		0.001	0.001							3	0.095	0.052	0.046	0.150					D
Mo	0.28	0.91	125.00	2	0.152	0.051	0.116	0.189							3	2.293	0.095	2.194	2.383					D
Ni	1.10	3.70	250.00	3	0.006	0.005	0.003	0.011						D	2	10.834	0.038	10.807	11.536				•	
Pb	1.90	8.70	1250.00	2	0.001	0.000	0.001	0.014					•	D	3	86.378	2.229	84.105	88.560					
Sb	0.05	0.43	50.00	1	0.085		0.085	0.085	1						3	4.448	0.679	3.760	5.117					
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	3	0.169	0.007	0.162	0.176					D
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	3	11.300	2.364	9.234	13.878					D
V	1.60	32.00	1250.00	1	0.052		0.052	0.052							3	10.503	0.106	10.429	10.625					D
Zn	3.80	15.00	1250.00	2	0.015	0.001	0.014	0.146					•	D	3	201.330	9.552	191.700	210.803					
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	1	1277		1277	1277	1						3	801	254	513	991					
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	3	102.195	2.322	99.563	103.950					
SO4	750.00	22000.00	25000.00	1	735		735	735						D	3	1018	67	956	1089					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

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Building material: **asfaltbeton met AVI-vliegas**

identification number: V4ab02.wk1

18-Dec-93

element	adjusted values products U1	U2	S1	leaching characteristics 64 days diffusiontest in mg/m2 N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	41.0	140.0	750.0	3	0.167	0.006	0.160	0.170						D	3	3.929	0.031	3.895	3.956					D
Ba	600.0	2000.0	15000.0	2	5.225	0.078	5.170	10.400					•		3	125.955	1.978	124.403	128.183					
Cd	1.1	3.8	20.0	2	0.387	0.023	0.370	0.760					•		3	3.438	0.592	2.970	4.104					
Co	29.0	95.0	500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	140.0	480.0	2500.0	3	2.600		2.600	2.600						D	3	34.742	2.025	32.434	36.221					
Cu	51.0	170.0	750.0	3	0.993	0.081	0.900	1.040						D	3	12.787	1.256	11.765	14.189					
Hg	0.4	1.4	10.0	NA	NA	NA							NA	NA	3	0.095	0.052	0.046	0.150					D
Mo	14.0	48.0	250.0	3	0.393	0.081	0.320	0.480						D	3	2.293	0.095	2.194	2.383					D
Ni	50.0	170.0	500.0	3	13.007	0.023	12.980	13.020							2	10.834	0.038	10.807	11.536				•	
Pb	120.0	400.0	2500.0	3	1.667	0.388	1.390	2.110							3	86.378	2.229	84.105	88.560					
Sb	3.7	12.0	100.0	3	0.436	0.075	0.360	0.510							3	4.448	0.679	3.760	5.117					
Se	1.4	4.8	100.0	3	0.044	0.011	0.033	0.054						D	3	0.169	0.007	0.162	0.176					D
Sn	29.0	95.0	500.0	2	25.995	0.049	25.960	26.730					•	D	3	11.300	2.364	9.234	13.878					D
V	230.0	760.0	2500.0	3	0.094	0.065	0.045	0.167						D	3	10.503	0.106	10.429	10.625					D
Zn	200.0	670.0	2500.0	3	16.900	4.616	12.800	21.900							3	201.330	9.552	191.700	210.803					
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	3	3420	958	2334	4146							3	801	254	513	991					
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	3	17.827	1.114	16.770	18.990							3	102.195	2.322	99.563	103.950					
SO4	27000.0	80000.0	40000.0	3	1422	109	1332	1543						D	3	1018	67	956	1089					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

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Building material: **asfaltbeton met EC- en AVI-vliegas**

identification number: NV8ab03.wk1

17-Dec-93

adjusted values granular materials				leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	1	0.009		0.009	0.009						D	6	3.767	0.855	2.500	4.800					D
Ba	5.50	58.00	7500.00	1	0.590		0.590	0.590							6	39.667	10.152	25.000	56.000					
Cd	0.03	0.07	10.00	1										D	5	1.000	0.000	1.000	1.100				*	
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	3	3.000	1.000	2.000	4.000					
Cr	1.30	12.00	1250.00	1	0.300		0.300	0.300							5	16.800	9.418	10.000	61.000				*	
Cu	0.72	3.50	375.00	1	0.044		0.044	0.044						D	6	10.167	1.941	8.000	13.000					
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	2	0.100	0.000	0.100	0.200				*	
Mo	0.28	0.91	125.00	1	0.110		0.110	0.110							6	3.500	2.739	1.000	6.000					D
Ni	1.10	3.70	250.00	1										D	6	17.000	11.559	8.000	36.000					
Pb	1.90	8.70	1250.00	1	0.001		0.001	0.001						D	6	20.000	10.488	10.000	35.000					
Sb	0.05	0.43	50.00	1	0.130		0.130	0.130	1						6	1.333	0.301	0.900	1.600					
Se	0.04	0.10	50.00	1										D	6	1.000		1.000	1.000					D
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
V	1.60	32.00	1250.00	1	0.110		0.110	0.110							6	33.833	18.104	16.000	61.000					D
Zn	3.80	15.00	1250.00	1	0.010		0.010	0.010						D	6	57.500	21.778	32.000	81.000					
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	750.00	22000.00	25000.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

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Building material: **asfaltbeton met EC- en AVI-vliegas**

identification number: V4ab03.wk1

18-Dec-93

element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
	adjusted values products			leaching characteristics			64 days diffusiontest in mg/m2								composition			aqua regia in mg/kg						
As	41.0	140.0	750.0	3	0.303	0.104	0.220	1.100					•		6	3.767	0.855	2.500	4.800					D
Ba	600.0	2000.0	15000.0	3	3.567	1.007	2.500	17.000					•		6	39.667	10.152	25.000	56.000					
Cd	1.1	3.8	20.0	3	0.110	ERR	0.110	0.160					•		5	1.000	0.000	1.000	1.100				•	
Co	29.0	95.0	500.0	NA	NA	NA							NA	NA	3	3.000	1.000	2.000	4.000					
Cr	140.0	480.0	2500.0	4	0.470	0.223	0.140	0.630						D	5	16.800	9.418	10.000	61.000				•	
Cu	51.0	170.0	750.0	3	0.933	0.256	0.690	3.700					•	D	6	10.167	1.941	8.000	13.000					
Hg	0.4	1.4	10.0	NA	NA	NA							NA	NA	2	0.100	0.000	0.100	0.200				•	
Mo	14.0	48.0	250.0	4	1.800	1.208		2.500							6	3.500	2.739	1.000	6.000					D
Ni	50.0	170.0	500.0	3	1.100	0.000	1.100	2.100					•	D	6	17.000	11.559	8.000	36.000					
Pb	120.0	400.0	2500.0	3	1.053	0.081	0.960	1.800					•		6	20.000	10.488	10.000	35.000					
Sb	3.7	12.0	100.0	3	0.227	0.078	0.140	0.800					•		6	1.333	0.301	0.900	1.600					
Se	1.4	4.8	100.0	4	0.825	0.550		1.100							6	1.000		1.000	1.000					D
Sn	29.0	95.0	500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
V	230.0	760.0	2500.0	4	2.500	1.352	1.200	4.400							6	33.833	18.104	16.000	61.000					D
Zn	200.0	670.0	2500.0	3	7.667	0.058	7.600	8.200					•		6	57.500	21.778	32.000	81.000					
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	27000.0	80000.0	40000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **asfaltbeton met EC-vliegas**

identification number: NV8ab04.wk1

17-Dec-93

adjusted values granular materials				leaching characteristics					L/S=10 columntest in mg/kg						composition				aqua regia in mg/kg					
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	3	0.085	0.063	0.016	0.138							5	4.815	0.677	4.000	5.488					D
Ba	5.50	58.00	7500.00	1	0.128		0.128	0.128						D	5	92.096	67.542	37.000	174.555					
Cd	0.03	0.07	10.00	3	0.001	0.000	0.001	0.001						D	5	0.623	0.516	0.054	1.000					D
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	1.30	12.00	1250.00	3	0.030	0.023	0.014	0.057						D	4	29.202	4.821	22.000	61.000				*	
Cu	0.72	3.50	375.00	3	0.019	0.008	0.013	0.029						D	5	11.706	2.373	9.000	14.796					
Hg	0.02	0.08	5.00	1	0.001		0.001	0.001							2	0.024	0.005	0.020	0.027					D
Mo	0.28	0.91	125.00	2	0.231	0.156	0.121	0.342	1						5	4.641	1.861	2.552	6.000					D
Ni	1.10	3.70	250.00	3	0.009	0.004	0.006	0.014						D	5	21.508	9.135	14.303	36.000					
Pb	1.90	8.70	1250.00	2	0.001	0.000	0.001	0.011					*	D	4	9.796	0.250	9.491	15.000				*	D
Sb	0.05	0.43	50.00	1	0.016		0.016	0.016							4	0.836	0.142	0.682	1.600				*	D
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	5	0.830	0.239	0.500	1.000					D
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	2	2.106	0.172	1.985	2.228					D
V	1.60	32.00	1250.00	1	0.050		0.050	0.050							5	36.351	18.736	20.500	61.000					D
Zn	3.80	15.00	1250.00	2	0.015	0.000	0.015	0.100					*	D	4	24.168	9.052	15.890	81.000				*	
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	1	10		10	10							2	324		324	324					D
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	2	63.106	1.002	62.397	63.815					
SO4	750.00	22000.00	25000.00	1	157		157	157						D	2	245	54	207	283					D
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **asfaltbeton met EC-vliegas**

identification number: V4ab04.wk1

18-Dec-93

element	adjusted values products U1	U2	S1	leaching characteristics 64 days diffusiontest in mg/m2 N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	41.0	140.0	750.0	2	0.319	0.197	0.179	0.458							5	4.815	0.677	4.000	5.488					D
Ba	600.0	2000.0	15000.0	2	2.330	1.555	1.230	3.429							5	92.096	67.542	37.000	174.555					
Cd	1.1	3.8	20.0	2	0.036	0.014	0.026	0.046						D	5	0.623	0.516	0.054	1.000					D
Co	29.0	95.0	500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	140.0	480.0	2500.0	2	2.600		2.600	2.600						D	4	29.202	4.821	22.000	61.000				•	
Cu	51.0	170.0	750.0	2	0.942	0.010	0.935	0.949						D	5	11.706	2.373	9.000	14.796					
Hg	0.4	1.4	10.0	NA	NA	NA							NA	NA	2	0.024	0.005	0.020	0.027					D
Mo	14.0	48.0	250.0	2	0.554	0.326	0.323	0.784						D	5	4.641	1.861	2.552	6.000					D
Ni	50.0	170.0	500.0	2	12.985	0.007	12.980	12.990							5	21.508	9.135	14.303	36.000					
Pb	120.0	400.0	2500.0	2	0.205	0.182	0.076	0.333						D	4	9.796	0.250	9.491	15.000				•	D
Sb	3.7	12.0	100.0	2	0.121	0.025	0.103	0.139						D	4	0.836	0.142	0.682	1.600				•	D
Se	1.4	4.8	100.0	2	0.048	0.013	0.038	0.057						D	5	0.830	0.239	0.500	1.000					D
Sn	29.0	95.0	500.0	2	25.970	0.014	25.960	25.980						D	2	2.106	0.172	1.985	2.228					D
V	230.0	760.0	2500.0	2	0.343	0.315	0.120	0.566						D	5	36.351	18.736	20.500	61.000					D
Zn	200.0	670.0	2500.0	2	30.750	25.668	12.600	48.900							4	24.168	9.052	15.890	81.000				•	
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	2	133	4	130	135						D	2	324		324	324					D
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	2	1.385	0.247	1.210	1.560						D	2	63.106	1.002	62.397	63.815					
SO4	27000.0	80000.0	40000.0	2	230	99	160	300						D	2	245	54	207	283					D
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

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Building material: **asfaltbeton met fosforslak**

identification number: NV8ab05.wk1

17-Dec-93

	adjusted values granular materials			leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ba	5.50	58.00	7500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cd	0.03	0.07	10.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	1.30	12.00	1250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cu	0.72	3.50	375.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Mo	0.28	0.91	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ni	1.10	3.70	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Pb	1.90	8.70	1250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Sb	0.05	0.43	50.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
V	1.60	32.00	1250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Zn	3.80	15.00	1250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	2	***********	2434.215	***********	***********			2		
SO4	750.00	22000.00	25000.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

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Building material: **asfaltbeton met fosforslak**

identification number: V4ab05.wk1

18-Dec-93

	adjusted values products			leaching characteristics				64 days diffusiontest in mg/m2							composition				aqua regia in mg/kg					
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	41.0	140.0	750.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ba	600.0	2000.0	15000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cd	1.1	3.8	20.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Co	29.0	95.0	500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	140.0	480.0	2500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cu	51.0	170.0	750.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Hg	0.4	1.4	10.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Mo	14.0	48.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ni	50.0	170.0	500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Pb	120.0	400.0	2500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Sb	3.7	12.0	100.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Se	1.4	4.8	100.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Sn	29.0	95.0	500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
V	230.0	760.0	2500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Zn	200.0	670.0	2500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	2	588.500	242.538	417.000	760.000							2	***********	2434.215	***********	***********			2		
SO4	27000.0	80000.0	40000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **asfaltbeton met jarosiet-eindslak**

identification number: NV8ab06.wk1

17-Dec-93

adjusted values granular materials				leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	NA	NA	NA							NA	NA	8	12.950	14.608	0.743	37.000					
Ba	5.50	58.00	7500.00	NA	NA	NA							NA	NA	8	2294.625	843.567	1113.750	3470.000					
Cd	0.03	0.07	10.00	NA	NA	NA							NA	NA	8	0.271	0.245	0.068	0.700					D
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	8	33.047	15.324	11.000	51.975					
Cr	1.30	12.00	1250.00	NA	NA	NA							NA	NA	4	8673.750	9321.836	391.500	***********			2		
Cu	0.72	3.50	375.00	NA	NA	NA							NA	NA	8	3386.594	2116.348	1370.250	6590.000			8		
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	4	0.050	0.000	0.050	0.050					D
Mo	0.28	0.91	125.00	NA	NA	NA							NA	NA	4	115.256	110.603	23.625	249.750			2		
Ni	1.10	3.70	250.00	NA	NA	NA							NA	NA	8	163.531	60.104	67.500	260.000			1		
Pb	1.90	8.70	1250.00	NA	NA	NA							NA	NA	8	73.138	48.107	20.000	130.000					
Sb	0.05	0.43	50.00	NA	NA	NA							NA	NA	8	175.172	120.207	50.625	400.000			8		
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	4	1.000		1.000	1.000					D
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	4	25.000	7.348	16.000	31.000					D
V	1.60	32.00	1250.00	NA	NA	NA							NA	NA	4	61.250	12.148	49.000	78.000					
Zn	3.80	15.00	1250.00	NA	NA	NA							NA	NA	7	1675.893	348.840	1039.500	3210.000			7		
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	750.00	22000.00	25000.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **asfaltbeton met jarosiet-eindslak**

identification number: V4ab06.wk1

18-Dec-93

element	adjusted values products U1	U2	S1	leaching characteristics 64 days diffusiontest in mg/m2 N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	41.0	140.0	750.0	14	0.967	0.878	0.300	2.970			-0.137	0.322			8	12.950	14.608	0.743	37.000					
Ba	600.0	2000.0	15000.0	14	97.856	210.149	5.600	593.640			1.364	0.636			8	2294.625	843.567	1113.750	3470.000					
Cd	1.1	3.8	20.0	2	1.190		1.190	1.190	2						8	0.271	0.245	0.068	0.700					D
Co	29.0	95.0	500.0	14	1.520	1.887	0.300	5.940			-0.003	0.364			8	33.047	15.324	11.000	51.975					
Cr	140.0	480.0	2500.0	10	1.508	2.336	0.400	5.940			-0.164	0.494		D	4	8673.750	9321.836	391.500	***********			2		
Cu	51.0	170.0	750.0	13	0.785	0.910	0.200	6.310			-0.168	0.411	*	D	8	3386.594	2116.348	1370.250	6590.000			8		
Hg	0.4	1.4	10.0	2	5.940		5.940	5.940	2	2					4	0.050	0.000	0.050	0.050					D
Mo	14.0	48.0	250.0	9	1.273	0.469	1.000	3.600			0.132	0.194	*	D	4	115.256	110.603	23.625	249.750					
Ni	50.0	170.0	500.0	14	2.353	4.040	0.300	11.870			0.029	0.471		D	8	163.531	60.104	67.500	260.000					
Pb	120.0	400.0	2500.0	13	0.813	0.690	0.300	4.820			-0.122	0.356	*		8	73.138	48.107	20.000	130.000					
Sb	3.7	12.0	100.0	14	5.602	2.899	1.450	8.000	8		0.673	0.287			8	175.172	120.207	50.625	400.000			6		
Se	1.4	4.8	100.0	2	7.420	2.093	5.940	8.900	2	2					4	1.000		1.000	1.000					D
Sn	29.0	95.0	500.0	2	2.970		2.970	2.970						D	4	25.000	7.348	16.000	31.000					D
V	230.0	760.0	2500.0	2	5.940		5.940	5.940							4	61.250	12.148	49.000	78.000					
Zn	200.0	670.0	2500.0	14	30.194	15.195	14.000	59.360			1.432	0.208			7	1675.893	348.840	1039.500	3210.000			1	*	
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	27000.0	80000.0	40000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **mortel + toevoeging**

identification number: NV8018.wk1

16-Dec-93

adjusted values granular materials				leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	NA	NA	NA							NA	NA	1	9.120		9.120	9.120					
Ba	5.50	58.00	7500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cd	0.03	0.07	10.00	NA	NA	NA							NA	NA	1	0.182		0.182	0.182					D
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	1.30	12.00	1250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cu	0.72	3.50	375.00	NA	NA	NA							NA	NA	1	15.200		15.200	15.200					
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Mo	0.28	0.91	125.00	NA	NA	NA							NA	NA	1	1.520		1.520	1.520					D
Ni	1.10	3.70	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Pb	1.90	8.70	1250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Sb	0.05	0.43	50.00	NA	NA	NA							NA	NA	1	1.520		1.520	1.520					
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	1	5.776		5.776	5.776					
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
V	1.60	32.00	1250.00	NA	NA	NA							NA	NA	1	41.344		41.344	41.344					D
Zn	3.80	15.00	1250.00	NA	NA	NA							NA	NA	1	47.424		47.424	47.424					
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	1	24.320		24.320	24.320					D
SO4	750.00	22000.00	25000.00	NA	NA	NA							NA	NA	1	5472		5472	5472					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

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Building material: **mortel + toevoeging**

identification number: V4018.wk1

06-Jun-94

element	adjusted values products U1	U2	S1	leaching characteristics 64 days diffusiontest in mg/m2 N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	41.0	140.0	750.0	NA	NA	NA							NA	NA	1	9.120		9.120	9.120					
Ba	600.0	2000.0	15000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cd	1.1	3.8	20.0	NA	NA	NA							NA	NA	1	0.182		0.182	0.182					D
Co	29.0	95.0	500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	140.0	480.0	2500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cu	51.0	170.0	750.0	NA	NA	NA							NA	NA	1	15.200		15.200	15.200					
Hg	0.4	1.4	10.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Mo	14.0	48.0	250.0	NA	NA	NA							NA	NA	1	1.520		1.520	1.520					D
Ni	50.0	170.0	500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Pb	120.0	400.0	2500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Sb	3.7	12.0	100.0	NA	NA	NA							NA	NA	1	1.520		1.520	1.520					
Se	1.4	4.8	100.0	NA	NA	NA							NA	NA	1	5.776		5.776	5.776					
Sn	29.0	95.0	500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
V	230.0	760.0	2500.0	NA	NA	NA							NA	NA	1	41.344		41.344	41.344					D
Zn	200.0	670.0	2500.0	NA	NA	NA							NA	NA	1	47.424		47.424	47.424					
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	NA	NA	NA							NA	NA	1	24.320		24.320	24.320					D
SO4	27000.0	80000.0	40000.0	NA	NA	NA							NA	NA	1	5472		5472	5472					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **grof keramische produkten**

identification number: NV8019.wk1

16-Dec-93

adjusted values granular materials				leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	38	1.767	1.464	0.020	8.500	25	1	0.068	0.524	*		29	8.618	2.349	4.000	16.500	0.927	0.146		*	
Ba	5.50	58.00	7500.00	NA	NA	NA							NA	NA	2	9.750	0.354	9.500	10.000					
Cd	0.03	0.07	10.00	30	0.001	0.000	0.001	0.020			-3.146	0.311	*	D	27	1.343	1.620	0.135	4.928	-0.152	0.495			
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	2	5.000		5.000	5.000					
Cr	1.30	12.00	1250.00	1	1.000		1.000	1.000							8	73.884	73.250	7.700	210.000					
Cu	0.72	3.50	375.00	NA	NA	NA							NA	NA	7	13.996	10.413	7.400	70.000				*	
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	3	0.100	0.000	0.100	0.100					
Mo	0.28	0.91	125.00	30	1.089	0.875	0.050	26.000	22	18	-0.117	0.562	*		24	21.539	22.587	0.675	74.250	0.954	0.728			D
Ni	1.10	3.70	250.00	NA	NA	NA							NA	NA	8	45.753	37.704	8.300	104.625					
Pb	1.90	8.70	1250.00	NA	NA	NA							NA	NA	8	14.703	10.197	5.000	33.750					
Sb	0.05	0.43	50.00	NA	NA	NA							NA	NA	2	1.000		1.000	1.000					
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	2	1.000		1.000	1.000					D
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	2	27.500	2.121	26.000	29.000					D
V	1.60	32.00	1250.00	32	1.905	1.496	0.050	4.950	14		0.058	0.543			23	54.000	21.053	11.000	170.100	1.718	0.228		*	
Zn	3.80	15.00	1250.00	NA	NA	NA							NA	NA	8	135.250	151.143	40.500	410.000					
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	2	2.000		2.000	2.000					D
Cl	600.00	8800.00	5000.00	NA	NA	NA							NA	NA	2	5		5	5					D
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	2	138.000	9.899	131.000	145.000					
SO4	750.00	22000.00	25000.00	NA	NA	NA							NA	NA	2	513	18	500	525					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: grof keramische produkten

identification number: V4019.wk1

06-Jun-94

adjusted values products | leaching characteristics — 64 days diffusiontest in mg/m2 | composition — aqua regia in mg/kg

element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	41.0	140.0	750.0	11	6.943	4.640	1.700	15.300			0.736	0.334			29	8.618	2.349	4.000	16.500	0.927	0.146		*	
Ba	600.0	2000.0	15000.0	10	9.280	14.205	2.200	39.000			0.637	0.487			2	9.750	0.354	9.500	10.000					
Cd	1.1	3.8	20.0	10	3.490	0.099	3.300	3.600	10		0.543	0.012			27	1.343	1.620	0.135	4.928	-0.152	0.495			
Co	29.0	95.0	500.0	10	8.200	0.291	7.700	8.500			0.914	0.016			2	5.000		5.000	5.000					
Cr	140.0	480.0	2500.0	9	5.622	1.634	4.400	21.700			0.796	0.216	*		8	73.884	73.250	7.700	210.000					
Cu	51.0	170.0	750.0	10	6.960	0.222	6.600	7.200			0.842	0.014			7	13.996	10.413	7.400	70.000				*	
Hg	0.4	1.4	10.0	10	0.328	0.017	0.320	0.360			-0.485	0.022			3	0.100	0.000	0.100	0.100					
Mo	14.0	48.0	250.0	11	5.575	1.172	2.220	6.800			0.732	0.131			24	21.539	22.587	0.675	74.250	0.954	0.728			D
Ni	50.0	170.0	500.0	10	4.680	0.169	4.400	4.900			0.670	0.016		D	8	45.753	37.704	8.300	104.625					
Pb	120.0	400.0	2500.0	10	19.792	0.652	18.640	20.400			1.296	0.015			8	14.703	10.197	5.000	33.750					
Sb	3.7	12.0	100.0	10	2.320	0.092	2.200	2.400			0.365	0.017			2	1.000		1.000	1.000					
Se	1.4	4.8	100.0	10	0.820	0.042	0.800	0.900			-0.087	0.022			2	1.000		1.000	1.000					D
Sn	29.0	95.0	500.0	10	1.020	0.042	1.000	1.100			0.008	0.017		D	2	27.500	2.121	26.000	29.000					D
V	230.0	760.0	2500.0	11	40.122	18.941	16.000	75.400			1.555	0.222			23	54.000	21.053	11.000	170.100	1.718	0.228		*	
Zn	200.0	670.0	2500.0	10	1.220	0.132	1.100	1.500			0.084	0.045		D	8	135.250	151.143	40.500	410.000					
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	2	2.000		2.000	2.000					D
Cl	18000.0	54000.0	1000000.0	NA	NA	NA							NA	NA	2	5		5	5					D
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	5	271.600	184.333	125.000	501.000							2	138.000	9.899	131.000	145.000					
SO4	27000.0	80000.0	40000.0	9	3	1	1	831			0.710	0.802	*	D	2	513	18	500	525					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **grof keramische produkten + toevoeging**
identification number: NV8020.wk1

16-Dec-93

adjusted values granular materials				leaching characteristics L/S=10 columntest in mg/kg											composition aqua regia in mg/kg									
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	19	1.295	1.687	0.050	9.100	9	2	-0.132	0.622	*		25	25.650	8.107	16.200	45.225	1.391	0.122			
Ba	5.50	58.00	7500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cd	0.03	0.07	10.00	14	0.000	0.000		0.002			ERR	ERR	*	D	25	5.983	0.806	4.590	7.223	0.773	0.059			
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	1.30	12.00	1250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cu	0.72	3.50	375.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Mo	0.28	0.91	125.00	15	0.203	0.182	0.040	1.250	2	1	-0.752	0.388	*		24	4.837	3.474	0.675	127.575	0.632	0.455	1	*	D
Ni	1.10	3.70	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Pb	1.90	8.70	1250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Sb	0.05	0.43	50.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
V	1.60	32.00	1250.00	16	1.195	0.961	0.050	3.100	5		-0.123	0.514			24	122.231	28.556	46.575	222.075	2.084	0.132		*	
Zn	3.80	15.00	1250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	750.00	22000.00	25000.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

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Building material: **grof keramische produkten + toevoeging**

identification number: V4020.wk1

06-Jun-94

element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
	adjusted values products			leaching characteristics			64 days diffusiontest in mg/m2								composition			aqua regia in mg/kg						
As	41.0	140.0	750.0	7	15.184	12.073	2.270	29.480							25	25.650	8.107	16.200	45.225	1.391	0.122			
Ba	600.0	2000.0	15000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cd	1.1	3.8	20.0	NA	NA	NA							NA	NA	25	5.983	0.806	4.590	7.223	0.773	0.059			
Co	29.0	95.0	500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	140.0	480.0	2500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cu	51.0	170.0	750.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Hg	0.4	1.4	10.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Mo	14.0	48.0	250.0	7	9.527	8.554	1.040	23.160	2						24	4.837	3.474	0.675	127.575	0.632	0.455		•	D
Ni	50.0	170.0	500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Pb	120.0	400.0	2500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Sb	3.7	12.0	100.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Se	1.4	4.8	100.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Sn	29.0	95.0	500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
V	230.0	760.0	2500.0	7	24.120	21.804	5.170	55.280							24	122.231	28.556	46.575	222.075	2.084	0.132		•	
Zn	200.0	670.0	2500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	27000.0	80000.0	40000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **kalkzandsteen**

identification number: NV8023.wk1

16-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	2	0.050	0.000	0.050	0.050							5	2.124	0.275	1.702	3.344				•	D
Ba	5.50	58.00	7500.00	NA	NA	NA							NA	NA	6	71.506	36.492	26.752	117.162					
Cd	0.03	0.07	10.00	1	0.010		0.010	0.010							5	0.159	0.117	0.006	1.000				•	D
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	1	10.000		10.000	10.000					
Cr	1.30	12.00	1250.00	2	0.525	0.672	0.050	1.000							6	14.597	10.226	3.648	28.000					
Cu	0.72	3.50	375.00	1	0.200		0.200	0.200							5	3.282	2.177	1.210	14.000				•	D
Hg	0.02	0.08	5.00	1	0.000		0.000	0.000						D	6	0.061	0.024	0.024	0.100					D
Mo	0.28	0.91	125.00	1	0.050		0.050	0.050						D	6	6.321	5.327	0.565	15.200					D
Ni	1.10	3.70	250.00	1	1.000		1.000	1.000							6	24.101	21.461	1.824	55.328					
Pb	1.90	8.70	1250.00	1	0.500		0.500	0.500							2	12.411	10.733	4.821	20.000					
Sb	0.05	0.43	50.00	1	0.020		0.020	0.020							5	0.544	0.496	0.164	5.000				•	D
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	2	2.503	3.531	0.006	5.000					
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	2	90.851	126.075	1.702	180.000					D
V	1.60	32.00	1250.00	2	0.147	0.067	0.100	0.194							5	6.825	3.163	3.040	24.000				•	D
Zn	3.80	15.00	1250.00	2	0.550	0.636	0.100	1.000							5	10.027	7.821	0.608	48.000				•	D
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	1	5		5	5							1	296		296	296					D
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	1	52.841		52.841	52.841					
SO4	750.00	22000.00	25000.00	1	20		20	20						D	1	145		145	145					D
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **kalkzandsteen**
identification number: V4023.wk1
06-Jun-94

element	adjusted values products U1	U2	S1	leaching characteristics 64 days diffusiontest in mg/m2 N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	41.0	140.0	750.0	2	0.625	0.460	0.300	0.950							5	2.124	0.275	1.702	3.344				•	D
Ba	600.0	2000.0	15000.0	2	3.930	2.022	2.500	5.360							6	71.506	36.492	26.752	117.162					
Cd	1.1	3.8	20.0	1	0.037		0.037	0.037						D	5	0.159	0.117	0.006	1.000				•	D
Co	29.0	95.0	500.0	NA	NA	NA							NA	NA	1	10.000		10.000	10.000					
Cr	140.0	480.0	2500.0	2	2.190	1.824	0.900	3.480						D	6	14.597	10.226	3.648	28.000					
Cu	51.0	170.0	750.0	1	1.190		1.190	1.190						D	5	3.282	2.177	1.210	14.000				•	D
Hg	0.4	1.4	10.0	NA	NA	NA							NA	NA	6	0.061	0.024	0.024	0.100					D
Mo	14.0	48.0	250.0	2	1.548	1.347	0.595	2.500							6	6.321	5.327	0.565	15.200					D
Ni	50.0	170.0	500.0	1	17.390		17.390	17.390							6	24.101	21.461	1.824	55.328					
Pb	120.0	400.0	2500.0	1	0.164		0.164	0.164						D	2	12.411	10.733	4.821	20.000					
Sb	3.7	12.0	100.0	1	0.190		0.190	0.190						D	5	0.544	0.496	0.164	5.000				•	D
Se	1.4	4.8	100.0	1	0.114		0.114	0.114						D	2	2.503	3.531	0.006	5.000					
Sn	29.0	95.0	500.0	1	34.770		34.770	34.770	1					D	2	90.851	126.075	1.702	180.000					D
V	230.0	760.0	2500.0	2	8.400	8.485	2.400	14.400							5	6.825	3.163	3.040	24.000				•	D
Zn	200.0	670.0	2500.0	2	4.645	3.330	2.290	7.000							5	10.027	7.821	0.608	48.000				•	D
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	1	120		120	120						D	1	296		296	296					D
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	1	2.919		2.919	2.919						D	1	52.841		52.841	52.841					
SO4	27000.0	80000.0	40000.0	1	378		378	378						D	1	145		145	145					D
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

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Building material: **kalkzandsteen met EC-vliegas**

identification number: NV8kz01.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	2	0.699	0.665	0.229	1.169	1						3	10.524	6.745	2.736	14.422					
Ba	5.50	58.00	7500.00	1	0.105		0.105	0.105						D	3	324.915	209.003	91.200	493.878					
Cd	0.03	0.07	10.00	2	0.006	0.006	0.002	0.010							3	0.154	0.082	0.061	0.213					D
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	1.30	12.00	1250.00	2	0.584	0.368	0.324	0.845							3	36.415	8.384	26.752	41.757					
Cu	0.72	3.50	375.00	2	0.113	0.124	0.025	0.200							3	35.592	30.144	4.864	65.117					
Hg	0.02	0.08	5.00	2	0.001	0.000	0.000	0.001						D	3	0.055	0.011	0.043	0.062					D
Mo	0.28	0.91	125.00	2	0.339	0.051	0.303	0.376	2						2	4.022	0.400	3.739	15.200					D
Ni	1.10	3.70	250.00	2	0.507	0.697	0.015	1.000							3	23.459	18.395	2.432	36.577					
Pb	1.90	8.70	1250.00	2	0.255	0.346	0.010	0.500							2	24.201	0.804	23.633	24.770					
Sb	0.05	0.43	50.00	1	0.073		0.073	0.073	1						3	2.071	1.392	0.486	3.095					
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	2	3.134	0.606	2.706	3.563					
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	2	2.608	0.963	1.927	3.289					D
V	1.60	32.00	1250.00	2	3.071	2.849	1.056	5.085	1						3	56.564	36.639	15.200	84.938					
Zn	3.80	15.00	1250.00	2	0.155	0.044	0.124	0.186							3	32.966	18.190	12.160	45.861					
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	2	10	6	5	14							2	296		296	296					D
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	2	68.157	5.589	64.205	72.109					
SO4	750.00	22000.00	25000.00	2	80	20	66	94						D	2	1117	302	903	1330					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

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Building material: **kalkzandsteen met EC-vliegas**

identification number: V4kz01.wk1

18-Dec-93

adjusted values products				leaching characteristics 64 days diffusiontest in mg/m2											composition aqua regia in mg/kg									
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	41.0	140.0	750.0	3	6.077	7.314	0.300	14.300							3	10.524	6.745	2.736	14.422					
Ba	600.0	2000.0	15000.0	3	6.750	5.001	1.800	11.800							3	324.915	209.003	91.200	493.878					
Cd	1.1	3.8	20.0	2	0.035	0.001	0.034	0.036						D	3	0.154	0.082	0.061	0.213					D
Co	29.0	95.0	500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	140.0	480.0	2500.0	3	6.987	7.647	0.700	15.500							3	36.415	8.384	26.752	41.757					
Cu	51.0	170.0	750.0	2	1.201	0.214	1.050	1.352						D	3	35.592	30.144	4.864	65.117					
Hg	0.4	1.4	10.0	NA	NA	NA							NA	NA	3	0.055	0.011	0.043	0.062					D
Mo	14.0	48.0	250.0	3	7.797	4.707	2.500	11.500							2	4.022	0.400	3.739	15.200					D
Ni	50.0	170.0	500.0	2	17.670	0.636	17.220	18.120							3	23.459	18.395	2.432	36.577					
Pb	120.0	400.0	2500.0	2	0.212	0.249	0.036	0.388						D	2	24.201	0.804	23.633	24.770					
Sb	3.7	12.0	100.0	2	1.054	0.518	0.688	1.420							3	2.071	1.392	0.486	3.095					
Se	1.4	4.8	100.0	2	1.475	1.747	0.239	2.710	1						2	3.134	0.606	2.706	3.563					
Sn	29.0	95.0	500.0	2	35.335	1.266	34.440	36.230	2					D	2	2.608	0.963	1.927	3.289					D
V	230.0	760.0	2500.0	3	36.700	37.373	11.200	79.600							3	56.564	36.639	15.200	84.938					
Zn	200.0	670.0	2500.0	3	4.720	2.241	2.520	7.000							3	32.966	18.190	12.160	45.861					
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	2	448	23	432	464						D	2	296		296	296					D
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	2	6.625	1.330	5.684	7.565						D	2	68.157	5.589	64.205	72.109					
SO4	27000.0	80000.0	40000.0	2	2030	86	1969	2091						D	2	1117	302	903	1330					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

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Building material:				kalkzandsteen met overige toevoeging																				
identification number:				V4kz02.wk1																				
18-Dec-93				leaching characteristics				64 days diffusiontest in mg/m2							composition				aqua regia in mg/kg					
	adjusted values products																							
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	41.0	140.0	750.0	3	2.367	0.737	1.800	3.200							NA	NA	NA						NA	NA
Ba	600.0	2000.0	15000.0	3	3.767	1.250	2.500	5.000							NA	NA	NA						NA	NA
Cd	1.1	3.8	20.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Co	29.0	95.0	500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	140.0	480.0	2500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cu	51.0	170.0	750.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Hg	0.4	1.4	10.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Mo	14.0	48.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ni	50.0	170.0	500.0	3	1.200		1.200	1.200						D	NA	NA	NA						NA	NA
Pb	120.0	400.0	2500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Sb	3.7	12.0	100.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Se	1.4	4.8	100.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Sn	29.0	95.0	500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
V	230.0	760.0	2500.0	3	22.700	8.136	16.900	32.000							NA	NA	NA						NA	NA
Zn	200.0	670.0	2500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	27000.0	80000.0	40000.0	1	91150		91150	91150	1	1					NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

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Building material: **gasbeton**

identification number: V4025.wk1

06-Jun-94

adjusted values products | leaching characteristics — 64 days diffusiontest in mg/m2 | composition — aqua regia in mg/kg

element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	41.0	140.0	750.0	1	0.729		0.729	0.729							5	3.546	1.018	2.736	5.229					D
Ba	600.0	2000.0	15000.0	1	3.430		3.430	3.430							3	8.350	1.071	7.357	102.266				•	
Cd	1.1	3.8	20.0	1	0.038		0.038	0.038						D	4	0.052	0.018	0.024	0.231				•	D
Co	29.0	95.0	500.0	NA	NA	NA							NA	NA	3	3.709	2.425	0.973	5.594					
Cr	140.0	480.0	2500.0	1	3.390		3.390	3.390							5	14.131	3.465	9.728	18.240					
Cu	51.0	170.0	750.0	1	1.173		1.173	1.173						D	4	4.533	1.452	3.040	6.506					D
Hg	0.4	1.4	10.0	NA	NA	NA							NA	NA	1	0.018		0.018	0.018					D
Mo	14.0	48.0	250.0	1	3.970		3.970	3.970							5	1.180	0.538	0.547	2.006					D
Ni	50.0	170.0	500.0	1	16.930		16.930	16.930							5	5.333	1.914	2.554	7.515					
Pb	120.0	400.0	2500.0	1	0.068		0.068	0.068						D	4	1.935	1.234	1.034	3.727					D
Sb	3.7	12.0	100.0	1	0.257		0.257	0.257							1	0.590		0.590	0.590					D
Se	1.4	4.8	100.0	1	0.043		0.043	0.043						D	4	0.924	0.584	0.049	1.216					D
Sn	29.0	95.0	500.0	1	32.100		32.100	32.100	1					D	1	1.295		1.295	1.295					D
V	230.0	760.0	2500.0	1	5.940		5.940	5.940							4	11.218	1.571	9.120	12.646					D
Zn	200.0	670.0	2500.0	1	0.484		0.484	0.484						D	4	16.352	12.728	5.837	34.656					D
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	1	462		462	462						D	1	264		264	264					D
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	1	64.800		64.800	64.800							1	107.373		107.373	107.373					
SO4	27000.0	80000.0	40000.0	1	64420		64420	64420	1						1	15961		15961	15961					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **gasbeton**

identification number: V4025.wk1

18-Dec-93

element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
	adjusted values granular materials			leaching characteristics L/S=10 columntest in mg/kg											composition aqua regia in mg/kg									
As	0.88	7.00	375.00	1	0.729		0.729	0.729							5	3.546	1.018	2.736	5.229					D
Ba	5.50	58.00	7500.00	1	3.430		3.430	3.430							3	8.350	1.071	7.357	102.266				•	
Cd	0.03	0.07	10.00	1	0.038		0.038	0.038							4	0.052	0.018	0.024	0.231				•	D
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	3	3.709	2.425	0.973	5.594					
Cr	1.30	12.00	1250.00	1	3.390		3.390	3.390							5	14.131	3.465	9.728	18.240					
Cu	0.72	3.50	375.00	1	1.173		1.173	1.173							4	4.533	1.452	3.040	6.506					D
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	1	0.018		0.018	0.018					D
Mo	0.28	0.91	125.00	1	3.970		3.970	3.970							5	1.180	0.538	0.547	2.006					D
Ni	1.10	3.70	250.00	1	16.930		16.930	16.930							5	5.333	1.914	2.554	7.515					
Pb	1.90	8.70	1250.00	1	0.068		0.068	0.068						D	4	1.935	1.234	1.034	3.727					D
Sb	0.05	0.43	50.00	1	0.257		0.257	0.257							1	0.590		0.590	0.590					D
Se	0.04	0.10	50.00	1	0.043		0.043	0.043							4	0.924	0.584	0.049	1.216					D
Sn	0.27	2.40	250.00	1	32.100		32.100	32.100	1						1	1.295		1.295	1.295					D
V	1.60	32.00	1250.00	1	5.940		5.940	5.940							4	11.218	1.571	9.120	12.646					D
Zn	3.80	15.00	1250.00	1	0.484		0.484	0.484							4	16.352	12.728	5.837	34.656					D
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	1	462		462	462							1	264		264	264					D
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	1	64.800		64.800	64.800							1	107.373		107.373	107.373					
SO4	750.00	22000.00	25000.00	1	64420		64420	64420	1						1	15961		15961	15961					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

RIVM
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BASIS
database

Building material: **gasbeton + toevoeging**

identification number: NV8026.wk1

16-Dec-93

adjusted values granular materials | leaching characteristics L/S=10 columntest in mg/kg | composition aqua regia in mg/kg

element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	2	0.016	0.003	0.015	0.018						D	7	19.890	7.338	10.944	34.048					
Ba	5.50	58.00	7500.00	2	0.238	0.107	0.162	0.313						D	2	601.373	113.413	521.178	681.568					
Cd	0.03	0.07	10.00	2	0.001	0.000	0.001	0.001						D	7	0.404	0.191	0.207	0.730					D
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	1.30	12.00	1250.00	2	1.056	0.053	1.018	1.093							6	54.294	13.614	34.048	71.136					
Cu	0.72	3.50	375.00	2	0.035	0.021	0.021	0.050						D	3	77.413	22.444	58.775	102.326					
Hg	0.02	0.08	5.00	2	0.001		0.001	0.001							2	0.064	0.021	0.049	0.079					D
Mo	0.28	0.91	125.00	2	0.549	0.242	0.377	0.720	2						6	4.588	1.702	1.824	13.376				*	D
Ni	1.10	3.70	250.00	2	0.014	0.005	0.011	0.018						D	6	57.509	21.329	34.656	94.848					
Pb	1.90	8.70	1250.00	2	0.018	0.011	0.010	0.026						D	2	33.525	1.230	32.656	34.395					
Sb	0.05	0.43	50.00	2	0.010	0.000	0.010	0.010							3	5.288	1.014	4.384	6.384					
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	3	3.563	2.339	0.973	5.521					
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	2	2.687	1.479	1.642	3.733					D
V	1.60	32.00	1250.00	2	0.830	0.196	0.691	0.968							3	127.680	14.544	110.960	137.408					
Zn	3.80	15.00	1250.00	2	0.100		0.100	0.100						D	2	75.270	5.417	71.440	182.400				*	
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	2	13	6	9	17							2	193	101	122	264					D
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	3	267.236	345.168	16.416	660.896					
SO4	750.00	22000.00	25000.00	2	7749	445	7434	8063	2						3	13678	6213	6506	17419					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

RIVM
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Building material:				gasbeton + toevoeging																				
identification number:				V4026.wk1																				
06-Jun-94				leaching characteristics					64 days diffusiontest in mg/m2						composition				aqua regia in mg/kg					
	adjusted values products																							
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	41.0	140.0	750.0	4	2.271	1.074	1.360	3.808							7	19.890	7.338	10.944	34.048					
Ba	600.0	2000.0	15000.0	2	3.475	0.148	3.370	3.580							2	601.373	113.413	521.178	681.568					
Cd	1.1	3.8	20.0	4	0.040	0.007	0.034	0.050						D	7	0.404	0.191	0.207	0.730					D
Co	29.0	95.0	500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	140.0	480.0	2500.0	4	9.115	1.005	7.920	10.378							6	54.294	13.614	34.048	71.136					
Cu	51.0	170.0	750.0	2	1.380	0.014	1.370	1.390						D	3	77.413	22.444	58.775	102.326					
Hg	0.4	1.4	10.0	NA	NA	NA							NA	NA	2	0.064	0.021	0.049	0.079					D
Mo	14.0	48.0	250.0	4	10.725	6.553	4.650	16.650	2						6	4.588	1.702	1.824	13.376				•	D
Ni	50.0	170.0	500.0	4	10.221	8.199	1.178	17.200						D	6	57.509	21.329	34.656	94.848					
Pb	120.0	400.0	2500.0	2	0.087		0.087	0.087						D	2	33.525	1.230	32.656	34.395					
Sb	3.7	12.0	100.0	2	0.534	0.062	0.490	0.577							3	5.288	1.014	4.384	6.384					
Se	1.4	4.8	100.0	2	0.877	0.175	0.753	1.000							3	3.563	2.339	0.973	5.521					
Sn	29.0	95.0	500.0	2	34.510	0.156	34.400	34.620	2					D	2	2.687	1.479	1.642	3.733					D
V	230.0	760.0	2500.0	2	20.650	3.041	18.500	22.800							3	127.680	14.544	110.960	137.408					
Zn	200.0	670.0	2500.0	2	0.615	0.157	0.504	0.726						D	2	75.270	5.417	71.440	182.400				•	
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	2	620	173	497	742						D	2	193	101	122	264					D
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	2	53.485	0.813	52.910	54.060							3	267.236	345.168	16.416	660.896					
SO4	27000.0	80000.0	40000.0	2	50260	17805	37670	62850	2						3	13678	6213	6506	17419					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

RIVM
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Building material: **zandcementstabilisatie**

identification number: NV8029.wk1

16-Dec-93

adjusted values granular materials				leaching characteristics L/S=10 columntest in mg/kg											composition aqua regia in mg/kg									
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	1	0.010		0.010	0.010						D	1	2.766		2.766	2.766					D
Ba	5.50	58.00	7500.00	1	6.583		6.583	6.583	1						1	120.992		120.992	120.992					
Cd	0.03	0.07	10.00	1	0.001		0.001	0.001						D	1	0.012		0.012	0.012					D
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	1.30	12.00	1250.00	1	0.394		0.394	0.394							1	11.771		11.771	11.771					
Cu	0.72	3.50	375.00	1	0.037		0.037	0.037						D	1	2.566		2.566	2.566					D
Hg	0.02	0.08	5.00	1	0.001		0.001	0.001							1	0.018		0.018	0.018					D
Mo	0.28	0.91	125.00	1	0.105		0.105	0.105							1	0.572		0.572	0.572					D
Ni	1.10	3.70	250.00	1	0.040		0.040	0.040						D	1	7.272		7.272	7.272					
Pb	1.90	8.70	1250.00	1	0.010		0.010	0.010						D	1	4.706		4.706	4.706					D
Sb	0.05	0.43	50.00	1	0.010		0.010	0.010							1	0.371		0.371	0.371					D
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	1	0.018		0.018	0.018					D
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	1	1.538		1.538	1.538					D
V	1.60	32.00	1250.00	1	0.051		0.051	0.051							1	9.144		9.144	9.144					D
Zn	3.80	15.00	1250.00	1	0.100		0.100	0.100						D	1	9.381		9.381	9.381					D
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	1	1324		1324	1324	1						1	912		912	912					
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	1	70.528		70.528	70.528					
SO4	750.00	22000.00	25000.00	1	59		59	59						D	1	2006		2006	2006					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **zandcementstabilisatie**

identification number: V4029.wk1

06-Jun-94

element	adjusted values products U1	U2	S1	leaching characteristics 64 days diffusiontest in mg/m2 N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	41.0	140.0	750.0	1	0.420		0.420	0.420							1	2.766		2.766	2.766					D
Ba	600.0	2000.0	15000.0	1	2.620		2.620	2.620							1	120.992		120.992	120.992					
Cd	1.1	3.8	20.0	1	0.032		0.032	0.032						D	1	0.012		0.012	0.012					D
Co	29.0	95.0	500,0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	140.0	480.0	2500.0	1	3.180		3.180	3.180							1	11.771		11.771	11.771					
Cu	51.0	170.0	750.0	1	1.270		1.270	1.270						D	1	2.566		2.566	2.566					D
Hg	0.4	1.4	10.0	NA	NA	NA							NA	NA	1	0.018		0.018	0.018					D
Mo	14.0	48.0	250.0	1	0.682		0.682	0.682						D	1	0.572		0.572	0.572					D
Ni	50.0	170.0	500.0	1	15.900		15.900	15.900							1	7.272		7.272	7.272					
Pb	120.0	400.0	2500.0	1	0.761		0.761	0.761							1	4.706		4.706	4.706					D
Sb	3.7	12.0	100.0	1	0.334		0.334	0.334							1	0.371		0.371	0.371					D
Se	1.4	4.8	100.0	1	0.040		0.040	0.040						D	1	0.018		0.018	0.018					D
Sn	29.0	95.0	500.0	1	31.300		31.300	31.300	1					D	1	1.538		1.538	1.538					D
V	230.0	760.0	2500.0	1	2.030		2.030	2.030						D	1	9.144		9.144	9.144					D
Zn	200.0	670.0	2500.0	1	2.110		2.110	2.110						D	1	9.381		9.381	9.381					D
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	1	10880		10880	10880							1	912		912	912					
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	1	36.430		36.430	36.430							1	70.528		70.528	70.528					
SO4	27000.0	80000.0	40000.0	1	620		620	620						D	1	2006		2006	2006					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: zandcementstabilisatie + toevoeging

identification number: NV8030.wk1

16-Dec-93

adjusted values granular materials				leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	1	0.098		0.098	0.098							1	26.351		26.351	26.351					
Ba	5.50	58.00	7500.00	1	0.371		0.371	0.371							1	843.296		843.296	843.296					
Cd	0.03	0.07	10.00	1	0.001		0.001	0.001						D	1	0.420		0.420	0.420					D
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	1.30	12.00	1250.00	1	2.019		2.019	2.019	1						1	74.845		74.845	74.845					
Cu	0.72	3.50	375.00	1	0.026		0.026	0.026						D	1	127.011		127.011	127.011					
Hg	0.02	0.08	5.00	1	0.001		0.001	0.001							1	0.061		0.061	0.061					D
Mo	0.28	0.91	125.00	1	1.500		1.500	1.500	1	1					1	7.801		7.801	7.801					D
Ni	1.10	3.70	250.00	1	0.012		0.012	0.012						D	1	65.725		65.725	65.725					
Pb	1.90	8.70	1250.00	1	0.010		0.010	0.010						D	1	43.046		43.046	43.046					
Sb	0.05	0.43	50.00	1	0.033		0.033	0.033							1	6.098		6.098	6.098					
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	1	6.943		6.943	6.943					
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	1	4.463		4.463	4.463					D
V	1.60	32.00	1250.00	1	2.834		2.834	2.834	1						1	163.674		163.674	163.674					
Zn	3.80	15.00	1250.00	1	0.101		0.101	0.101						D	1	81.776		81.776	81.776					
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	1	36		36	36							1	249		249	249					D
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	1	119.898		119.898	119.898					
SO4	750.00	22000.00	25000.00	1	319		319	319						D	1	4105		4105	4105					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

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Building material: **zandcementstabilisatie + toevoeging**

identification number: V4030.wk1

06-Jun-94

element	adjusted values products U1	U2	S1	leaching characteristics 64 days diffusiontest in mg/m2 N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	41.0	140.0	750.0	1	1.870		1.870	1.870							1	26.351		26.351	26.351					
Ba	600.0	2000.0	15000.0	1	26.700		26.700	26.700							1	843.296		843.296	843.296					
Cd	1.1	3.8	20.0	1	0.035		0.035	0.035						D	1	0.420		0.420	0.420					D
Co	29.0	95.0	500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	140.0	480.0	2500.0	1	66.600		66.600	66.600							1	74.845		74.845	74.845					
Cu	51.0	170.0	750.0	1	1.230		1.230	1.230						D	1	127.011		127.011	127.011					
Hg	0.4	1.4	10.0	NA	NA	NA							NA	NA	1	0.061		0.061	0.061					D
Mo	14.0	48.0	250.0	1	88.700		88.700	88.700	1	1					1	7.801		7.801	7.801					D
Ni	50.0	170.0	500.0	1	15.370		15.370	15.370							1	65.725		65.725	65.725					
Pb	120.0	400.0	2500.0	1	0.152		0.152	0.152						D	1	43.046		43.046	43.046					
Sb	3.7	12.0	100.0	1	1.580		1.580	1.580							1	6.098		6.098	6.098					
Se	1.4	4.8	100.0	1	3.020		3.020	3.020	1						1	6.943		6.943	6.943					
Sn	29.0	95.0	500.0	1	30.730		30.730	30.730	1					D	1	4.463		4.463	4.463					D
V	230.0	760.0	2500.0	1	42.500		42.500	42.500							1	163.674		163.674	163.674					
Zn	200.0	670.0	2500.0	1	0.739		0.739	0.739						D	1	81.776		81.776	81.776					
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	1	682		682	682						D	1	249		249	249					D
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	1	23.290		23.290	23.290							1	119.898		119.898	119.898					
SO4	27000.0	80000.0	40000.0	1	11350		11350	11350							1	4105		4105	4105					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **asfaltgranulaat**

identification number: NV8032.wk1

16-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	2	0.047	0.004	0.044	0.050							3	4.633	1.464	3.300	6.200					D
Ba	5.50	58.00	7500.00	2	0.240	0.198	0.100	0.380						D	2	26.500	6.364	22.000	135.000				•	
Cd	0.03	0.07	10.00	2	0.026	0.035	0.001	0.050	1						3	0.317	0.257	0.100	0.600					D
Co	0.42	2.50	250.00	2	0.058	0.059	0.016	0.100							3	2.500	1.803	0.500	4.000					D
Cr	1.30	12.00	1250.00	2	0.145	0.064	0.100	0.190							2	130.000	14.142	120.000	350.000				•	
Cu	0.72	3.50	375.00	2	0.100		0.100	0.100							3	11.000	6.557	5.000	18.000					
Hg	0.02	0.08	5.00	1	0.002		0.002	0.002							2	0.100	0.000	0.100	0.160				•	
Mo	0.28	0.91	125.00	2	0.064	0.051	0.028	0.100						D	3	1.500	0.866	0.500	2.000					D
Ni	1.10	3.70	250.00	2	0.056	0.062	0.012	0.100						D	2	43.000	4.243	40.000	106.000				•	
Pb	1.90	8.70	1250.00	2	0.057	0.062	0.013	0.100						D	3	10.833	10.251	0.500	21.000					
Sb	0.05	0.43	50.00	2	0.029	0.029	0.009	0.050	1						2	0.225	0.035	0.200	0.800				•	D
Se	0.04	0.10	50.00	2	0.028	0.031	0.006	0.050	1						3	0.617	0.318	0.250	0.800					D
Sn	0.27	2.40	250.00	1	0.100		0.100	0.100						D	3	9.500	9.836	0.500	20.000					D
V	1.60	32.00	1250.00	2	0.084	0.023	0.068	0.100							3	24.333	9.609	14.000	33.000					D
Zn	3.80	15.00	1250.00	2	0.100		0.100	0.100						D	3	47.333	20.429	24.000	62.000					
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	750.00	22000.00	25000.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **asfaltgranulaat**

identification number: V4032.wk1

06-Jun-94

element	adjusted values products U1	U2	S1	leaching characteristics 64 days diffusiontest in mg/m2 N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	41.0	140.0	750.0	NA	NA	NA							NA	NA	3	4.633	1.464	3.300	6.200					D
Ba	600.0	2000.0	15000.0	NA	NA	NA							NA	NA	2	26.500	6.364	22.000	135.000				*	
Cd	1.1	3.8	20.0	NA	NA	NA							NA	NA	3	0.317	0.257	0.100	0.600					D
Co	29.0	95.0	500.0	NA	NA	NA							NA	NA	3	2.500	1.803	0.500	4.000					D
Cr	140.0	480.0	2500.0	NA	NA	NA							NA	NA	2	130.000	14.142	120.000	350.000				*	
Cu	51.0	170.0	750.0	NA	NA	NA							NA	NA	3	11.000	6.557	5.000	18.000					
Hg	0.4	1.4	10.0	NA	NA	NA							NA	NA	2	0.100	0.000	0.100	0.160				*	
Mo	14.0	48.0	250.0	NA	NA	NA							NA	NA	3	1.500	0.866	0.500	2.000					D
Ni	50.0	170.0	500.0	NA	NA	NA							NA	NA	2	43.000	4.243	40.000	106.000				*	
Pb	120.0	400.0	2500.0	NA	NA	NA							NA	NA	3	10.833	10.251	0.500	21.000					
Sb	3.7	12.0	100.0	NA	NA	NA							NA	NA	2	0.225	0.035	0.200	0.800				*	D
Se	1.4	4.8	100.0	NA	NA	NA							NA	NA	3	0.617	0.318	0.250	0.800					D
Sn	29.0	95.0	500.0	NA	NA	NA							NA	NA	3	9.500	9.836	0.500	20.000					D
V	230.0	760.0	2500.0	NA	NA	NA							NA	NA	3	24.333	9.609	14.000	33.000					D
Zn	200.0	670.0	2500.0	NA	NA	NA							NA	NA	3	47.333	20.429	24.000	62.000					
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	27000.0	80000.0	40000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **asfaltgranulaat**

identification number: PACN8032.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
Benzeen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ethylbenz.	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Tolueen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Xylenen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Fenolen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-fenol	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Arom.(tot)	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Naf	*************	1000000.00	5.00	NA	NA	NA							NA	NA	7	0.281	0.197	0.050	5.000				•	D
Ph	*************	1000000.00	20.00	NA	NA	NA							NA	NA	8	5.951	6.440	0.200	19.000					
An	*************	1000000.00	10.00	NA	NA	NA							NA	NA	8	1.499	1.780	0.050	5.000					D
Fla	*************	1000000.00	35.00	NA	NA	NA							NA	NA	7	6.131	6.635	0.150	32.000				•	
Chr	*************	1000000.00	10.00	NA	NA	NA							NA	NA	8	3.131	2.546	0.050	7.700					
BaA	*************	1000000.00	50.00	NA	NA	NA							NA	NA	8	3.265	2.304	0.070	7.000					D
BaP	*************	1000000.00	10.00	NA	NA	NA							NA	NA	7	2.534	2.376	0.400	6.200					D
BkF	*************	1000000.00	50.00	NA	NA	NA							NA	NA	6	2.085	1.771	0.030	5.000					D
IP	*************	1000000.00	50.00	NA	NA	NA							NA	NA	6	2.548	2.049	0.100	5.000					D
BPe	*************	1000000.00	50.00	NA	NA	NA							NA	NA	5	2.450	1.891	0	5					D
PAK10(tot)	*************	1000000.00	75.00	NA	NA	NA							NA	NA	5	47.586	22.673	20.300	73.000					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **asfaltgranulaat**

identification number: PCBN8032.wk1

17-Dec-93

adjusted values granular materials				leaching characteristics L/S=10 columntest in mg/kg											composition aqua regia in mg/kg									
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-118	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-138	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	3	0.800	0.265	0.500	1.000					D
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	2	5800.000	3535.534	3300.000	8300.000			2		
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **asfaltgranulaat (overige)**

identification number: PACN8ag1.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
Benzeen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ethylbenz.	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Tolueen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Xylenen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Fenolen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-fenol	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Arom.(tot)	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Naf	*************	1000000.00	5.00	NA	NA	NA							NA	NA	7	0.281	0.197	0.050	5.000				•	D
Ph	*************	1000000.00	20.00	NA	NA	NA							NA	NA	8	5.951	6.440	0.200	19.000					
An	*************	1000000.00	10.00	NA	NA	NA							NA	NA	8	1.499	1.780	0.050	5.000					D
Fla	*************	1000000.00	35.00	NA	NA	NA							NA	NA	7	6.131	6.635	0.150	32.000				•	
Chr	*************	1000000.00	10.00	NA	NA	NA							NA	NA	8	3.131	2.546	0.050	7.700					
BaA	*************	1000000.00	50.00	NA	NA	NA							NA	NA	8	3.265	2.304	0.070	7.000					D
BaP	*************	1000000.00	10.00	NA	NA	NA							NA	NA	7	2.534	2.376	0.400	6.200					D
BkF	*************	1000000.00	50.00	NA	NA	NA							NA	NA	6	2.085	1.771	0.030	5.000					D
IP	*************	1000000.00	50.00	NA	NA	NA							NA	NA	6	2.548	2.049	0.100	5.000					D
BPe	*************	1000000.00	50.00	NA	NA	NA							NA	NA	5	2.450	1.891	0	5					D
PAK10(tot)	*************	1000000.00	75.00	NA	NA	NA							NA	NA	5	47.586	22.673	20.300	73.000					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **asfaltgranulaat (overige)**

identification number: PCBN8ag1.wk1

17-Dec-93

	adjusted values granular materials			leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-118	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-138	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	3	0.800	0.265	0.500	1.000					D
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	2	5800.000	3535.534	3300.000	8300.000			2		
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material:				asfaltgranulaat (recycling asfaltgranulaat)																				
identification number:				PACN8ag2.wk1																				
17-Dec-93				leaching characteristics					L/S=10 columntest in mg/kg						composition					aqua regia in mg/kg				
	adjusted values granular materials																							
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
Benzeen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ethylbenz.	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Tolueen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Xylenen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Fenolen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-fenol	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Arom.(tot)	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Naf	*************	1000000.00	5.00	NA	NA	NA							NA	NA	2	0.500		0.500	0.500					D
Ph	*************	1000000.00	20.00	NA	NA	NA							NA	NA	2	0.950	0.071	0.900	1.000					D
An	*************	1000000.00	10.00	NA	NA	NA							NA	NA	2	0.500		0.500	0.500					D
Fla	*************	1000000.00	35.00	NA	NA	NA							NA	NA	2	2.050	0.071	2.000	2.100					
Chr	*************	1000000.00	10.00	NA	NA	NA							NA	NA	2	0.800	0.141	0.700	0.900					D
BaA	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.600	0.141	0.500	0.700					D
BaP	*************	1000000.00	10.00	NA	NA	NA							NA	NA	2	0.550	0.071	0.500	0.600					D
BkF	*************	1000000.00	50.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
IP	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.500		0.500	0.500					D
BPe	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.500		1	1					D
PAK10(tot)	*************	1000000.00	75.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **asfaltgranulaat (recycling asfaltgranulaat)**

identification number: PCBN8ag2.wk1

17-Dec-93

	adjusted values granular materials			leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-118	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-138	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: asfaltgranulaat (teerhoudend)

identification number: PACN8ag3.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
Benzeen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ethylbenz.	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Tolueen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Xylenen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Fenolen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-fenol	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Arom.(tot)	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Naf	*************	1000000.00	5.00	NA	NA	NA							NA	NA	2	0.700	0.283	0.500	0.900					D
Ph	*************	1000000.00	20.00	NA	NA	NA							NA	NA	2	60.500	9.192	54.000	67.000			2		
An	*************	1000000.00	10.00	NA	NA	NA							NA	NA	2	8.800	0.990	8.100	9.500					D
Fla	*************	1000000.00	35.00	NA	NA	NA							NA	NA	2	75.500	9.192	69.000	82.000			2		
Chr	*************	1000000.00	10.00	NA	NA	NA							NA	NA	2	17.500	0.707	17.000	18.000			2		
BaA	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	18.000	1.414	17.000	19.000					D
BaP	*************	1000000.00	10.00	NA	NA	NA							NA	NA	2	11.500	0.707	11.000	12.000			2		D
BkF	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	5.900		5.900	5.900					D
IP	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	6.500		6.500	6.500					D
BPe	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	6.550	0.071	7	7					D
PAK10(tot)	*************	1000000.00	75.00	NA	NA	NA							NA	NA	2	211.450	22.557	195.500	227.400			2		
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **asfaltgranulaat (teerhoudend)**
identification number: PCBN8ag3.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-118	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-138	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **hoogovenslakkenmengsel**

identification number: NV8034.wk1

16-Dec-93

adjusted values granular materials				leaching characteristics			L/S=10 columntest in mg/kg								composition			aqua regia in mg/kg						
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	7	0.002	0.001	0.002	0.055					•	D	12	1.145	0.747	0.400	4.400	0.028	0.326		•	D
Ba	5.50	58.00	7500.00	7	6.526	6.121	0.580	46.000	4				•		9	804.433	540.056	340.000	1900.000					
Cd	0.03	0.07	10.00	7	0.001	ERR	0.001	0.002					•	D	12	0.769	0.419	0.022	2.600	-0.249	0.584		•	D
Co	0.42	2.50	250.00	1	0.024		0.024	0.024							1	2.000		2.000	2.000					D
Cr	1.30	12.00	1250.00	8	0.042	0.026	0.005	0.084						D	13	198.382	223.534	8.000	710.000	1.958	0.641			
Cu	0.72	3.50	375.00	8	0.025	0.018	0.005	0.060						D	13	5.233	3.569	1.000	13.000	0.590	0.387			
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	6	0.085	0.038	0.007	0.100					D
Mo	0.28	0.91	125.00	7	0.021	0.003	0.018	0.200					•	D	11	5.522	1.584	0.745	14.000	0.733	0.291		•	D
Ni	1.10	3.70	250.00	7	0.058	0.058	0.010	0.150						D	12	22.841	24.234	1.000	63.000	1.037	0.618			
Pb	1.90	8.70	1250.00	8	0.014	0.006	0.010	0.024						D	12	8.603	3.273	1.000	45.000	0.923	0.384		•	D
Sb	0.05	0.43	50.00	1	0.002		0.002	0.002						D	2	0.286	0.122	0.200	0.373					D
Se	0.04	0.10	50.00	1	0.095		0.095	0.095	1						2	1.950	0.071	1.900	2.000					D
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	1	2.235		2.235	2.235					D
V	1.60	32.00	1250.00	8	0.135	0.073	0.040	0.250							9	310.404	385.496	19.000	985.635					
Zn	3.80	15.00	1250.00	7	0.065	0.016	0.054	0.160					•	D	12	17.373	16.277	3.000	450.000	1.214	0.564		•	D
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	NA	NA	NA							NA	NA	4	868	647	373	1800					
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	1	461.900		461.900	461.900					
SO4	750.00	22000.00	25000.00	6	918	1040	240	2800	2					D	4	8088	5256	2600	13500					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **hoogovenslakkenmengsel**

identification number: V4034.wk1

06-Jun-94

element	adjusted values products U1	U2	S1	leaching characteristics 64 days diffusiontest in mg/m2 N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	41.0	140.0	750.0	NA	NA	NA							NA	NA	12	1.145	0.747	0.400	4.400	0.028	0.326		•	D
Ba	600.0	2000.0	15000.0	1	257.400		257.400	257.400							9	804.433	540.056	340.000	1900.000					
Cd	1.1	3.8	20.0	NA	NA	NA							NA	NA	12	0.769	0.419	0.022	2.600	-0.249	0.584		•	D
Co	29.0	95.0	500.0	NA	NA	NA							NA	NA	1	2.000		2.000	2.000					D
Cr	140.0	480.0	2500.0	1	1.500		1.500	1.500						D	13	198.382	223.534	8.000	710.000	1.958	0.641			
Cu	51.0	170.0	750.0	1	2.000		2.000	2.000							13	5.233	3.569	1.000	13.000	0.590	0.387			
Hg	0.4	1.4	10.0	NA	NA	NA							NA	NA	6	0.085	0.038	0.007	0.100					D
Mo	14.0	48.0	250.0	NA	NA	NA							NA	NA	11	5.522	1.584	0.745	14.000	0.733	0.291		•	D
Ni	50.0	170.0	500.0	1	1.200		1.200	1.200						D	12	22.841	24.234	1.000	63.000	1.037	0.618			
Pb	120.0	400.0	2500.0	NA	NA	NA							NA	NA	12	8.603	3.273	1.000	45.000	0.923	0.384		•	D
Sb	3.7	12.0	100.0	NA	NA	NA							NA	NA	2	0.286	0.122	0.200	0.373					D
Se	1.4	4.8	100.0	NA	NA	NA							NA	NA	2	1.950	0.071	1.900	2.000					D
Sn	29.0	95.0	500.0	NA	NA	NA							NA	NA	1	2.235		2.235	2.235					D
V	230.0	760.0	2500.0	NA	NA	NA							NA	NA	9	310.404	385.496	19.000	985.635					
Zn	200.0	670.0	2500.0	NA	NA	NA							NA	NA	12	17.373	16.277	3.000	450.000	1.214	0.564		•	D
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	NA	NA	NA							NA	NA	4	868	647	373	1800					
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	NA	NA	NA							NA	NA	1	461.900		461.900	461.900					
SO4	27000.0	80000.0	40000.0	1	143156		143156	143156	1	1					4	8088	5256	2600	13500					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **hydraulisch menggranulaat**

identification number: NV8035.wk1

16-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	2	0.093	0.124	0.005	0.180							1	6.000		6.000	6.000					D
Ba	5.50	58.00	7500.00	2	5.270	4.483	2.100	8.440	1						1	120.000		120.000	120.000					
Cd	0.03	0.07	10.00	2	0.002	0.001	0.001	0.002						D	2	1.000		1.000	1.000					
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	1.30	12.00	1250.00	2	0.090	0.113	0.010	0.170							3	930.000	589.237	290.000	1450.000			1		
Cu	0.72	3.50	375.00	2	0.210	0.071	0.160	0.260							3	129.000	98.148	17.000	200.000					
Hg	0.02	0.08	5.00	2	0.001		0.001	0.001						D	1	0.100		0.100	0.100					
Mo	0.28	0.91	125.00	2	0.635	0.332	0.400	0.870	2						1	6.000		6.000	6.000					D
Ni	1.10	3.70	250.00	2	0.060	0.028	0.040	0.080						D	2	101.000	90.510	37.000	165.000					
Pb	1.90	8.70	1250.00	2	0.080	0.057	0.040	0.120						D	2	52.500	31.820	30.000	75.000					
Sb	0.05	0.43	50.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
V	1.60	32.00	1250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Zn	3.80	15.00	1250.00	2	0.060		0.060	0.060						D	2	294.000	305.470	78.000	510.000					
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	750.00	22000.00	25000.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **hydraulisch menggranulaat**

identification number: V4035.wk1

06-Jun-94

element	adjusted values products U1	U2	S1	leaching characteristics 64 days diffusiontest in mg/m2 N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	41.0	140.0	750.0	NA	NA	NA							NA	NA	1	6.000		6.000	6.000					D
Ba	600.0	2000.0	15000.0	NA	NA	NA							NA	NA	1	120.000		120.000	120.000					
Cd	1.1	3.8	20.0	NA	NA	NA							NA	NA	2	1.000		1.000	1.000					
Co	29.0	95.0	500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	140.0	480.0	2500.0	NA	NA	NA							NA	NA	3	930.000	589.237	290.000	1450.000					
Cu	51.0	170.0	750.0	NA	NA	NA							NA	NA	3	129.000	98.148	17.000	200.000					
Hg	0.4	1.4	10.0	NA	NA	NA							NA	NA	1	0.100		0.100	0.100					
Mo	14.0	48.0	250.0	NA	NA	NA							NA	NA	1	6.000		6.000	6.000					D
Ni	50.0	170.0	500.0	NA	NA	NA							NA	NA	2	101.000	90.510	37.000	165.000					
Pb	120.0	400.0	2500.0	NA	NA	NA							NA	NA	2	52.500	31.820	30.000	75.000					
Sb	3.7	12.0	100.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Se	1.4	4.8	100.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Sn	29.0	95.0	500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
V	230.0	760.0	2500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Zn	200.0	670.0	2500.0	NA	NA	NA							NA	NA	2	294.000	305.470	78.000	510.000					
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	27000.0	80000.0	40000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **lichtgebonden fosforslak**

identification number: NV8036.wk1

16-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	NA	NA	NA							NA	NA	1	0.589		0.589	0.589					D
Ba	5.50	58.00	7500.00	NA	NA	NA							NA	NA	1	128.140		128.140	128.140					
Cd	0.03	0.07	10.00	NA	NA	NA							NA	NA	1	0.112		0.112	0.112					D
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	1.30	12.00	1250.00	NA	NA	NA							NA	NA	1	32.780		32.780	32.780					
Cu	0.72	3.50	375.00	NA	NA	NA							NA	NA	1	2.980		2.980	2.980					D
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Mo	0.28	0.91	125.00	NA	NA	NA							NA	NA	1	0.745		0.745	0.745					D
Ni	1.10	3.70	250.00	NA	NA	NA							NA	NA	1	2.980		2.980	2.980					D
Pb	1.90	8.70	1250.00	NA	NA	NA							NA	NA	1	2.235		2.235	2.235					D
Sb	0.05	0.43	50.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	1	0.671		0.671	0.671					D
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	1	2.235		2.235	2.235					D
V	1.60	32.00	1250.00	NA	NA	NA							NA	NA	1	18.960		18.960	18.960					D
Zn	3.80	15.00	1250.00	NA	NA	NA							NA	NA	1	10.430		10.430	10.430					D
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	NA	NA	NA							NA	NA	1	410		410	410					D
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	2	**********	658.493	**********	**********			2		
SO4	750.00	22000.00	25000.00	NA	NA	NA							NA	NA	1	9450		9450	9450					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material:				lichtgebonden fosforslak																				
identification number:				V4036.wk1																				
06-Jun-94				leaching characteristics				64 days diffusiontest in mg/m2							composition				aqua regia in mg/kg					
	adjusted values products																							
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	41.0	140.0	750.0	NA	NA	NA							NA	NA	1	0.589		0.589	0.589					D
Ba	600.0	2000.0	15000.0	NA	NA	NA							NA	NA	1	128.140		128.140	128.140					
Cd	1.1	3.8	20.0	NA	NA	NA							NA	NA	1	0.112		0.112	0.112					D
Co	29.0	95.0	500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	140.0	480.0	2500.0	NA	NA	NA							NA	NA	1	32.780		32.780	32.780					
Cu	51.0	170.0	750.0	NA	NA	NA							NA	NA	1	2.980		2.980	2.980					D
Hg	0.4	1.4	10.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Mo	14.0	48.0	250.0	NA	NA	NA							NA	NA	1	0.745		0.745	0.745					D
Ni	50.0	170.0	500.0	NA	NA	NA							NA	NA	1	2.980		2.980	2.980					D
Pb	120.0	400.0	2500.0	NA	NA	NA							NA	NA	1	2.235		2.235	2.235					D
Sb	3.7	12.0	100.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Se	1.4	4.8	100.0	NA	NA	NA							NA	NA	1	0.671		0.671	0.671					D
Sn	29.0	95.0	500.0	NA	NA	NA							NA	NA	1	2.235		2.235	2.235					D
V	230.0	760.0	2500.0	NA	NA	NA							NA	NA	1	18.960		18.960	18.960					D
Zn	200.0	670.0	2500.0	NA	NA	NA							NA	NA	1	10.430		10.430	10.430					D
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	NA	NA	NA							NA	NA	1	410		410	410					D
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	2	981.000	274.357	787.000	1175.000							2	**********	658.493	**********	**********			2		
SO4	27000.0	80000.0	40000.0	NA	NA	NA							NA	NA	1	9450		9450	9450					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **lichtgebonden staalslak**

identification number: NV8037.wk1

16-Dec-93

adjusted values granular materials				leaching characteristics					L/S=10 columntest in mg/kg						composition				aqua regia in mg/kg					
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	1	0.002		0.002	0.002						D	1	1.400		1.400	1.400					D
Ba	5.50	58.00	7500.00	1	3.600		3.600	3.600							1	340.000		340.000	340.000					
Cd	0.03	0.07	10.00	1	0.001		0.001	0.001						D	1	1.000		1.000	1.000					
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	1.30	12.00	1250.00	1	0.030		0.030	0.030						D	1	430.000		430.000	430.000					
Cu	0.72	3.50	375.00	1	0.030		0.030	0.030						D	1	17.000		17.000	17.000					
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Mo	0.28	0.91	125.00	1	0.033		0.033	0.033						D	1	6.000		6.000	6.000					D
Ni	1.10	3.70	250.00	1	0.100		0.100	0.100						D	1	200.000		200.000	200.000					
Pb	1.90	8.70	1250.00	1	0.065		0.065	0.065						D	1	10.000		10.000	10.000					
Sb	0.05	0.43	50.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
V	1.60	32.00	1250.00	1	0.100		0.100	0.100							1	2300.000		2300.000	2300.000			1		
Zn	3.80	15.00	1250.00	1	0.060		0.060	0.060						D	1	23.000		23.000	23.000					
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	750.00	22000.00	25000.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **lichtgebonden staalslak**

identification number: V4037.wk1

06-Jun-94

element	adjusted values products U1	U2	S1	leaching characteristics 64 days diffusiontest in mg/m2 N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	41.0	140.0	750.0	NA	NA	NA							NA	NA	1	1.400		1.400	1.400					D
Ba	600.0	2000.0	15000.0	NA	NA	NA							NA	NA	1	340.000		340.000	340.000					
Cd	1.1	3.8	20.0	NA	NA	NA							NA	NA	1	1.000		1.000	1.000					
Co	29.0	95.0	500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	140.0	480.0	2500.0	NA	NA	NA							NA	NA	1	430.000		430.000	430.000					
Cu	51.0	170.0	750.0	NA	NA	NA							NA	NA	1	17.000		17.000	17.000					
Hg	0.4	1.4	10.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Mo	14.0	48.0	250.0	NA	NA	NA							NA	NA	1	6.000		6.000	6.000					D
Ni	50.0	170.0	500.0	NA	NA	NA							NA	NA	1	200.000		200.000	200.000					
Pb	120.0	400.0	2500.0	NA	NA	NA							NA	NA	1	10.000		10.000	10.000					
Sb	3.7	12.0	100.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Se	1.4	4.8	100.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Sn	29.0	95.0	500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
V	230.0	760.0	2500.0	NA	NA	NA							NA	NA	1	2300.000		2300.000	2300.000					
Zn	200.0	670.0	2500.0	NA	NA	NA							NA	NA	1	23.000		23.000	23.000					
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	27000.0	80000.0	40000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **gebonden AVI-slak**

identification number: NV8038.wk1

16-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	NA	NA	NA							NA	NA	4	10.250	3.775	5.000	13.000					
Ba	5.50	58.00	7500.00	NA	NA	NA							NA	NA	3	784.000	306.516	576.000	1136.000					
Cd	0.03	0.07	10.00	NA	NA	NA							NA	NA	6	4.106	1.155	2.300	4.917					
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	3	7.267	2.750	4.500	10.000					
Cr	1.30	12.00	1250.00	NA	NA	NA							NA	NA	4	95.750	35.027	47.000	128.000					
Cu	0.72	3.50	375.00	NA	NA	NA							NA	NA	6	1245.800	655.687	365.000	2064.000			5		
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	2	0.200	ERR	0.200	0.800				*	
Mo	0.28	0.91	125.00	NA	NA	NA							NA	NA	5	6.780	3.397	1.000	22.000				*	D
Ni	1.10	3.70	250.00	NA	NA	NA							NA	NA	4	52.000	5.715	45.000	58.000					
Pb	1.90	8.70	1250.00	NA	NA	NA							NA	NA	5	1013.900	466.101	540.000	1744.000			1		
Sb	0.05	0.43	50.00	NA	NA	NA							NA	NA	5	21.726	8.622	12.814	32.000					
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	5	0.398	0.319	0.100	0.745					D
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	3	12.267	4.244	8.800	17.000					D
V	1.60	32.00	1250.00	NA	NA	NA							NA	NA	5	41.124	38.137	0.100	104.000					D
Zn	3.80	15.00	1250.00	NA	NA	NA							NA	NA	6	1463.800	535.902	1132.400	2408.000			2		
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	NA	NA	NA							NA	NA	2	1838	766	1296	2380					
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	2	216.050		216.050	216.050					
SO4	750.00	22000.00	25000.00	NA	NA	NA							NA	NA	2	12	16	1	23					D
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **gebonden AVI-slak**

identification number: V4038.wk1

06-Jun-94

element	adjusted values products U1	U2	S1	leaching characteristics 64 days diffusiontest in mg/m2 N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	41.0	140.0	750.0	8	1.425	0.046	1.400	1.500							4	10.250	3.775	5.000	13.000					
Ba	600.0	2000.0	15000.0	NA	NA	NA							NA	NA	3	784.000	306.516	576.000	1136.000					
Cd	1.1	3.8	20.0	7	0.100	0.000	0.100	0.200					*		6	4.106	1.155	2.300	4.917					
Co	29.0	95.0	500.0	NA	NA	NA							NA	NA	3	7.267	2.750	4.500	10.000					
Cr	140.0	480.0	2500.0	7	0.971	0.435	0.500	4.300					*	D	4	95.750	35.027	47.000	128.000					
Cu	51.0	170.0	750.0	7	24.000	4.619	16.000	51.000					*		6	1245.800	655.687	365.000	2064.000			4		
Hg	0.4	1.4	10.0	NA	NA	NA							NA	NA	2	0.200	ERR	0.200	0.800				*	
Mo	14.0	48.0	250.0	8	25.125	6.600	15.000	34.000	8						5	6.780	3.397	1.000	22.000				*	D
Ni	50.0	170.0	500.0	7	2.143	0.538	1.400	4.500					*	D	4	52.000	5.715	45.000	58.000					
Pb	120.0	400.0	2500.0	7	1.957	0.331	1.400	4.800					*		5	1013.900	466.101	540.000	1744.000					
Sb	3.7	12.0	100.0	NA	NA	NA							NA	NA	5	21.726	8.622	12.814	32.000					
Se	1.4	4.8	100.0	NA	NA	NA							NA	NA	5	0.398	0.319	0.100	0.745					D
Sn	29.0	95.0	500.0	NA	NA	NA							NA	NA	3	12.267	4.244	8.800	17.000					D
V	230.0	760.0	2500.0	NA	NA	NA							NA	NA	5	41.124	38.137	0.100	104.000					D
Zn	200.0	670.0	2500.0	8	30.375	2.973	28.000	36.000							6	1463.800	535.902	1132.400	2408.000					
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	NA	NA	NA							NA	NA	2	1838	766	1296	2380					
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	NA	NA	NA							NA	NA	2	216.050		216.050	216.050					
SO4	27000.0	80000.0	40000.0	NA	NA	NA							NA	NA	2	12	16	1	23					D
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **lichtgebonden EC-vliegas**

identification number: NV8040.wk1

16-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	1	0.011		0.011	0.011						D	1	24.084		24.084	24.084					
Ba	5.50	58.00	7500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cd	0.03	0.07	10.00	1	0.001		0.001	0.001						D	5	1.184	0.495	0.769	2.007					
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	1.30	12.00	1250.00	1	0.800		0.800	0.800							NA	NA	NA						NA	NA
Cu	0.72	3.50	375.00	NA	NA	NA							NA	NA	5	55.259	22.211	23.415	85.632					
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Mo	0.28	0.91	125.00	NA	NA	NA							NA	NA	5	15.253	4.498	7.359	18.063					D
Ni	1.10	3.70	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Pb	1.90	8.70	1250.00	NA	NA	NA							NA	NA	1	62.886		62.886	62.886					
Sb	0.05	0.43	50.00	NA	NA	NA							NA	NA	5	4.790	1.548	2.074	5.687					
Se	0.04	0.10	50.00	1	0.050		0.050	0.050	1						5	5.191	2.107	2.743	6.958					
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
V	1.60	32.00	1250.00	1	0.200		0.200	0.200							5	130.990	44.423	66.231	169.257					
Zn	3.80	15.00	1250.00	NA	NA	NA							NA	NA	5	146.110	38.700	78.273	169.257					
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	1	6		6	6							1	80		80	80					D
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	1	5.000		5.000	5.000							4	244.185	274.942	80.280	2274.600				*	
SO4	750.00	22000.00	25000.00	1	210		210	210						D	3	2	3	1	23				*	D
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **lichtgebonden EC-vliegas**

identification number: V4040.wk1

06-Jun-94

element	adjusted values products U1	U2	S1	leaching characteristics N	64 days diffusiontest in mg/m2 mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition N	aqua regia in mg/kg mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	41.0	140.0	750.0	NA	NA	NA							NA	NA	1	24.084		24.084	24.084					
Ba	600.0	2000.0	15000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cd	1.1	3.8	20.0	NA	NA	NA							NA	NA	5	1.184	0.495	0.769	2.007					
Co	29.0	95.0	500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	140.0	480.0	2500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cu	51.0	170.0	750.0	NA	NA	NA							NA	NA	5	55.259	22.211	23.415	85.632					
Hg	0.4	1.4	10.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Mo	14.0	48.0	250.0	NA	NA	NA							NA	NA	5	15.253	4.498	7.359	18.063					D
Ni	50.0	170.0	500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Pb	120.0	400.0	2500.0	NA	NA	NA							NA	NA	1	62.886		62.886	62.886					
Sb	3.7	12.0	100.0	NA	NA	NA							NA	NA	5	4.790	1.548	2.074	5.687					
Se	1.4	4.8	100.0	NA	NA	NA							NA	NA	5	5.191	2.107	2.743	6.958					
Sn	29.0	95.0	500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
V	230.0	760.0	2500.0	NA	NA	NA							NA	NA	5	130.990	44.423	66.231	169.257					
Zn	200.0	670.0	2500.0	NA	NA	NA							NA	NA	5	146.110	38.700	78.273	169.257					
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	NA	NA	NA							NA	NA	1	80		80	80					D
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	NA	NA	NA							NA	NA	4	244.185	274.942	80.280	2274.600				•	
SO4	27000.0	80000.0	40000.0	NA	NA	NA							NA	NA	3	2	3	1	23				•	D
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **betongranulaat**

identification number: NV8042.wk1

16-Dec-93

adjusted values granular materials				leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	9	0.044	0.016	0.002	0.050							13	5.923	1.410	3.988	8.700	0.761	0.104			D
Ba	5.50	58.00	7500.00	8	1.619	2.193	0.100	35.000	1				•		11	108.081	57.910	52.000	1227.000	2.074	0.380		•	
Cd	0.03	0.07	10.00	9	0.034	0.024	0.001	0.050	6						12	0.235	0.100	0.079	1.000	-0.620	0.278		•	D
Co	0.42	2.50	250.00	7	0.090	0.026	0.030	0.100							7	4.429	2.915	0.500	26.000				•	
Cr	1.30	12.00	1250.00	8	0.101	0.004	0.100	0.140					•		13	168.486	150.754	30.000	459.000	2.069	0.389			
Cu	0.72	3.50	375.00	8	0.099	0.010	0.078	0.390					•		13	17.148	6.795	7.000	31.000	1.204	0.169			
Hg	0.02	0.08	5.00	6	0.002		0.002	0.002							9	0.198	0.192	0.012	1.300	-0.844	0.632		•	
Mo	0.28	0.91	125.00	9	0.094	0.018	0.046	0.100							9	1.094	0.718	0.500	19.000	0.082	0.506		•	D
Ni	1.10	3.70	250.00	9	0.091	0.027	0.018	0.100						D	12	56.673	41.355	22.000	136.000	1.660	0.288			
Pb	1.90	8.70	1250.00	9	0.078	0.035	0.013	0.100						D	12	8.169	10.602	0.500	50.000	0.517	0.817		•	D
Sb	0.05	0.43	50.00	7	0.043	0.018	0.002	0.050	6						12	0.670	0.661	0.250	2.000	-0.325	0.353			D
Se	0.04	0.10	50.00	7	0.044	0.016	0.008	0.050	6						10	0.316	0.270	0.030	2.000	-0.594	0.548		•	D
Sn	0.27	2.40	250.00	8	0.100		0.100	0.100						D	9	2.883	3.040	0.500	35.000	0.333	0.652		•	D
V	1.60	32.00	1250.00	6	0.100	ERR	0.100	0.110					•		11	29.617	7.007	19.000	41.000	1.460	0.109			D
Zn	3.80	15.00	1250.00	9	0.185	0.179	0.061	0.500							12	72.681	37.850	34.000	211.000	1.852	0.247		•	
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	4	157	67	96	252							2	304		304	304					D
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	2	177.840	19.346	164.160	191.520					
SO4	750.00	22000.00	25000.00	3	89	18	75	275					•	D	2	2360	175	2236	2484					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

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Building material: **betongranulaat**

identification number: PACN8042.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
Benzeen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ethylbenz.	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Tolueen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Xylenen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Fenolen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-fenol	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Arom.(tot)	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Naf	*************	1000000.00	5.00	NA	NA	NA							NA	NA	7	0.174	0.105	0.050	1.030					D
Ph	*************	1000000.00	20.00	NA	NA	NA							NA	NA	8	1.271	0.700	0.470	2.200					D
An	*************	1000000.00	10.00	NA	NA	NA							NA	NA	8	0.293	0.264	0.050	0.730					D
Fla	*************	1000000.00	35.00	NA	NA	NA							NA	NA	8	1.804	1.001	0.790	3.030					
Chr	*************	1000000.00	10.00	NA	NA	NA							NA	NA	8	0.744	0.590	0.080	1.590					D
BaA	*************	1000000.00	50.00	NA	NA	NA							NA	NA	8	0.659	0.487	0.100	1.190					D
BaP	*************	1000000.00	10.00	NA	NA	NA							NA	NA	8	0.463	0.352	0.100	1.060					D
BkF	*************	1000000.00	50.00	NA	NA	NA							NA	NA	8	0.125	0.054	0.040	0.200					D
IP	*************	1000000.00	50.00	NA	NA	NA							NA	NA	8	0.373	0.305	0.080	0.970					D
BPe	*************	1000000.00	50.00	NA	NA	NA							NA	NA	8	0.329	0.232	0	1					D
PAK10(tot)	*************	1000000.00	75.00	NA	NA	NA							NA	NA	8	6.461	3.882	2.050	11.720					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **betongranulaat**

identification number: PCBN8042.wk1

17-Dec-93

adjusted values granular materials				leaching characteristics				L/S=10 columntest in mg/kg							composition				aqua regia in mg/kg					
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-118	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-138	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	2	0.200		0.200	0.200					D
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	1	340.000		340.000	340.000			1		
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **metselwerkgranulaat**

identification number: NV8043.wk1

16-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	4	0.041	0.020	0.011	0.051							7	7.766	1.199	5.500	12.586				*	
Ba	5.50	58.00	7500.00	4	0.199	0.103	0.100	0.330						D	7	126.793	56.807	65.000	215.232					
Cd	0.03	0.07	10.00	3	0.002	0.001	0.001	0.050	1				*	D	7	0.310	0.116	0.182	1.000				*	D
Co	0.42	2.50	250.00	2	0.060	0.057	0.019	0.100							3	10.000	7.937	4.000	19.000					
Cr	1.30	12.00	1250.00	4	0.180	0.073	0.100	0.270							8	82.716	59.476	18.000	170.000					
Cu	0.72	3.50	375.00	4	0.113	0.013	0.100	0.130							8	18.197	9.059	8.000	34.000					
Hg	0.02	0.08	5.00	1	0.002		0.002	0.002							4	0.089	0.103	0.006	1.100				*	D
Mo	0.28	0.91	125.00	4	0.107	0.037	0.066	0.156							5	1.465	1.023	0.500	3.000					D
Ni	1.10	3.70	250.00	4	0.079	0.043	0.015	0.100						D	8	28.169	17.589	8.000	57.000					
Pb	1.90	8.70	1250.00	4	0.052	0.037	0.011	0.100						D	7	41.542	35.363	0.500	192.736				*	
Sb	0.05	0.43	50.00	2	0.035	0.021	0.020	0.050	1						7	1.027	0.714	0.250	2.000					
Se	0.04	0.10	50.00	2	0.029	0.030	0.008	0.050	1						6	0.657	0.743	0.030	2.000					D
Sn	0.27	2.40	250.00	3	0.100	0.000	0.100	0.100						D	5	4.030	3.665	0.500	8.000					D
V	1.60	32.00	1250.00	2	0.215	0.163	0.100	0.330							7	27.105	12.751	14.000	50.707					D
Zn	3.80	15.00	1250.00	3	0.096	0.006	0.089	0.500					*	D	8	166.885	63.497	70.000	230.432					
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	3	106	22	85	128							2	304		304	304					D
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	2	109.440	64.488	63.840	155.040					
SO4	750.00	22000.00	25000.00	2	376	50	340	2781	1				*	D	2	1318	794	757	1879					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **metselwerkgranulaat**

identification number: PACN8043.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
Benzeen	************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ethylbenz.	************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Tolueen	************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Xylenen	************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Fenolen	************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-fenol	************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Arom.(tot)	************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Naf	************	1000000.00	5.00	NA	NA	NA							NA	NA	3	0.260	0.168	0.130	0.450					D
Ph	************	1000000.00	20.00	NA	NA	NA							NA	NA	3	1.613	1.495	0.450	3.300					D
An	************	1000000.00	10.00	NA	NA	NA							NA	NA	3	0.233	0.206	0.040	0.450					D
Fla	************	1000000.00	35.00	NA	NA	NA							NA	NA	2	1.165	0.092	1.100	4.900				*	
Chr	************	1000000.00	10.00	NA	NA	NA							NA	NA	3	0.800	0.614	0.350	1.500					D
BaA	************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.405	0.078	0.350	1.800				*	D
BaP	************	1000000.00	10.00	NA	NA	NA							NA	NA	2	0.280	0.028	0.260	1.600				*	D
BkF	************	1000000.00	50.00	NA	NA	NA							NA	NA	3	0.453	0.564	0.060	1.100					D
IP	************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.215	0.049	0.180	1.300				*	D
BPe	************	1000000.00	50.00	NA	NA	NA							NA	NA	3	0.520	0.507	0	1					D
PAK10(tot)	************	1000000.00	75.00	NA	NA	NA							NA	NA	2	4.060	0.382	3.790	17.250				*	
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **metselwerkgranulaat**

identification number: PCBN8043.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-118	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-138	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	2	0.300		0.300	0.300					D
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	1	350.000		350.000	350.000			1		
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

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Building material: **menggranulaat**

identification number: NV8044.wk1

16-Dec-93

adjusted values granular materials				leaching characteristics				L/S=10 columntest in mg/kg							composition				aqua regia in mg/kg					
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	8	0.010	0.017	0.001	0.099					•	D	31	8.468	2.266	3.400	12.000	0.909	0.139			
Ba	5.50	58.00	7500.00	25	1.070	1.625	0.090	26.500	2		-0.294	0.650	•		25	103.800	37.886	35.000	310.000	2.007	0.188		•	
Cd	0.03	0.07	10.00	12	0.002	0.001	0.001	0.050	1		-2.716	0.475	•	D	30	0.528	0.471	0.100	3.400	-0.402	0.400		•	D
Co	0.42	2.50	250.00	2	0.084	0.023	0.067	0.100							19	9.789	1.475	4.000	12.000	0.983	0.094			
Cr	1.30	12.00	1250.00	25	0.139	0.122	0.019	0.700			-0.997	0.443	•		30	164.767	213.469	17.000	1000.000	1.900	0.585		•	
Cu	0.72	3.50	375.00	25	0.103	0.083	0.037	0.430			-1.056	0.310	•		31	18.155	10.166	7.000	46.000	1.203	0.217			
Hg	0.02	0.08	5.00	1	0.002		0.002	0.002							23	0.197	0.084	0.100	1.200	-0.699	0.224		•	
Mo	0.28	0.91	125.00	8	0.239	0.261	0.032	2.800	3	1			•		30	7.067	9.573	0.500	50.000	0.651	0.453		•	D
Ni	1.10	3.70	250.00	25	0.047	0.041	0.020	0.230			-1.403	0.322	•	D	30	55.667	73.934	10.000	430.000	1.499	0.510	2	•	
Pb	1.90	8.70	1250.00	25	0.044	0.019	0.010	6.400	1		-1.327	0.506	•	D	30	39.050	26.722	0.500	160.000	1.496	0.431		•	
Sb	0.05	0.43	50.00	18	0.021	0.002	0.020	0.050	1		-1.669	0.098	•		18	0.514	0.130	0.250	1.700	-0.276	0.171		•	D
Se	0.04	0.10	50.00	2	0.031	0.027	0.012	0.050	1						19	2.303	0.604	0.250	2.500	0.324	0.242			
Sn	0.27	2.40	250.00	1	0.100		0.100	0.100						D	18	6.167	1.414	0.500	6.500	0.751	0.263			D
V	1.60	32.00	1250.00	21	0.165	0.089	0.100	5.000	1		-0.753	0.365	•		21	60.143	102.299	20.000	830.000	1.622	0.444		•	
Zn	3.80	15.00	1250.00	26	0.392	0.161	0.100	0.520			-0.464	0.259			31	96.935	39.800	46.000	205.000	1.955	0.164			
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	NA	NA	NA							NA	NA	4	500	0	500	700				•	
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	750.00	22000.00	25000.00	22	301	548	50	2966	2		2.293	0.460	•	D	22	3991	1219	1100	6000	3.575	0.169			
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **menggranulaat**

identification number: PACN8044.wk1

17-Dec-93

adjusted values granular materials | leaching characteristics L/S=10 columntest in mg/kg | composition aqua regia in mg/kg

element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
Benzeen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ethylbenz.	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Tolueen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Xylenen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Fenolen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-fenol	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Arom.(tot)	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Naf	*************	1000000.00	5.00	NA	NA	NA							NA	NA	4	0.250	0.100	0.100	1.800				•	D
Ph	*************	1000000.00	20.00	NA	NA	NA							NA	NA	6	2.382	0.448	1.690	2.800					D
An	*************	1000000.00	10.00	NA	NA	NA							NA	NA	6	0.570	0.229	0.300	0.800					D
Fla	*************	1000000.00	35.00	NA	NA	NA							NA	NA	6	3.418	0.844	1.910	4.500					
Chr	*************	1000000.00	10.00	NA	NA	NA							NA	NA	6	1.155	0.352	0.800	1.600					D
BaA	*************	1000000.00	50.00	NA	NA	NA							NA	NA	6	1.235	0.386	0.810	1.800					D
BaP	*************	1000000.00	10.00	NA	NA	NA							NA	NA	6	0.912	0.477	0.070	1.400					D
BkF	*************	1000000.00	50.00	NA	NA	NA							NA	NA	6	0.527	0.270	0.060	0.800					D
IP	*************	1000000.00	50.00	NA	NA	NA							NA	NA	6	0.668	0.271	0.410	1.100					D
BPe	*************	1000000.00	50.00	NA	NA	NA							NA	NA	6	0.553	0.237	0	1					D
PAK10(tot)	*************	1000000.00	75.00	NA	NA	NA							NA	NA	21	13.693	12.797	0.830	73.000	0.993	0.475		•	
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **menggranulaat**
identification number: PCBN8044.wk1

17-Dec-93

	adjusted values granular materials			leaching characteristics L/S=10 columntest in mg/kg											composition aqua regia in mg/kg									
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-118	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-138	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	1	0.300		0.300	0.300					D
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	16	121.875	73.595	50.000	380.000	2.047	0.287	3	•	
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **menggranulaat (gecertificeerd)**

identification number: NV8mg01.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	NA	NA	NA							NA	NA	15	10.000		10.000	10.000	1.000				
Ba	5.50	58.00	7500.00	15	0.319	0.214	0.120	0.770			-0.582	0.279			15	99.333	34.541	35.000	170.000	1.970	0.164			
Cd	0.03	0.07	10.00	3	0.002		0.002	0.002						D	14	0.200	ERR	0.200	3.400	-0.617	0.318		•	D
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	15	10.000		10.000	10.000	1.000				
Cr	1.30	12.00	1250.00	15	0.076	0.048	0.019	0.160			-1.222	0.331			14	26.571	6.173	17.000	66.000	1.441	0.143		•	
Cu	0.72	3.50	375.00	15	0.063	0.028	0.037	0.130			-1.240	0.176		D	14	14.207	4.075	8.400	30.000	1.158	0.152		•	
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	15	0.200	0.000	0.200	0.200	-0.699				
Mo	0.28	0.91	125.00	NA	NA	NA							NA	NA	15	2.500		2.500	2.500	0.398	0.000			D
Ni	1.10	3.70	250.00	15	0.026	0.008	0.020	0.044			-1.608	0.122		D	15	12.867	2.232	10.000	17.000	1.103	0.075			
Pb	1.90	8.70	1250.00	15	0.050	0.000	0.050	0.050			-1.301			D	14	44.357	30.247	22.000	160.000	1.625	0.268		•	
Sb	0.05	0.43	50.00	15	0.020		0.020	0.020			-1.699				14	0.529	0.120	0.300	1.700	-0.254	0.168		•	D
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	15	2.500		2.500	2.500	0.398	0.000			
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	15	6.500		6.500	6.500	0.813				D
V	1.60	32.00	1250.00	14	0.141	0.058	0.120	0.440			-0.835	0.174	•		14	26.714	8.870	20.000	210.000	1.471	0.262		•	D
Zn	3.80	15.00	1250.00	15	0.496	0.011	0.470	0.510			-0.305	0.010			14	87.357	23.906	46.000	200.000	1.951	0.153		•	
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	750.00	22000.00	25000.00	14	364	683	52	2966	2		2.348	0.520	•	D	15	4113	983	2300	5600	3.602	0.109			
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

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Building material: **menggranulaat (gecertificeerd)**

identification number: PACN8mg1.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
Benzeen	************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ethylbenz.	************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Tolueen	************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Xylenen	************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Fenolen	************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-fenol	************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Arom.(tot)	************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Naf	************	1000000.00	5.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ph	************	1000000.00	20.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
An	************	1000000.00	10.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Fla	************	1000000.00	35.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Chr	************	1000000.00	10.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
BaA	************	1000000.00	50.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
BaP	************	1000000.00	10.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
BkF	************	1000000.00	50.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
IP	************	1000000.00	50.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
BPe	************	1000000.00	50.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PAK10(tot)	************	1000000.00	75.00	NA	NA	NA							NA	NA	14	12.274	10.504	0.830	54.000	0.950	0.506			
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

RIVM
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Building material: **menggranulaat (gecertificeerd)**

identification number: PCBN8mg1.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-118	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-138	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	14	117.857	78.169	50.000	380.000	2.029	0.303	3		
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **menggranulaat (niet gecertificeerd)**

identification number: NV8mg02.wk1

17-Dec-93

element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
	adjusted values granular materials			leaching characteristics L/S=10 columntest in mg/kg											composition aqua regia in mg/kg									
As	0.88	7.00	375.00	8	0.010	0.017	0.001	0.099					*	D	16	7.031	2.392	3.400	12.000	0.823	0.149			
Ba	5.50	58.00	7500.00	10	2.197	2.150	0.090	26.500	2		0.100	0.808	*		10	110.500	43.457	53.000	310.000	2.058	0.213		*	
Cd	0.03	0.07	10.00	9	0.002	0.001	0.001	0.050	1		-2.721	0.549	*	D	16	0.816	0.490	0.100	2.000	-0.201	0.370			
Co	0.42	2.50	250.00	2	0.084	0.023	0.067	0.100							4	9.000	3.464	4.000	12.000					
Cr	1.30	12.00	1250.00	10	0.233	0.141	0.030	0.700			-0.690	0.395	*		16	344.063	286.024	27.000	1000.000	2.330	0.508			
Cu	0.72	3.50	375.00	11	0.189	0.124	0.068	0.430			-0.805	0.276			16	20.869	12.670	7.000	46.000	1.246	0.262			
Hg	0.02	0.08	5.00	1	0.002		0.002	0.002							8	0.193	0.149	0.100	1.200				*	
Mo	0.28	0.91	125.00	8	0.239	0.261	0.032	2.800	3	1			*		16	14.031	15.081	0.500	50.000	0.889	0.535			D
Ni	1.10	3.70	250.00	11	0.093	0.065	0.030	0.230			-1.124	0.299		D	15	98.467	85.981	14.000	430.000	1.871	0.460	2	*	
Pb	1.90	8.70	1250.00	10	0.036	0.029	0.010	6.400	1		-1.362	0.798	*	D	15	30.233	16.683	0.500	97.000	1.376	0.523		*	
Sb	0.05	0.43	50.00	4	0.030	0.014	0.020	0.050	1						4	0.463	0.170	0.250	0.600					D
Se	0.04	0.10	50.00	2	0.031	0.027	0.012	0.050	1						4	1.563	1.125	0.250	2.500					D
Sn	0.27	2.40	250.00	1	0.100		0.100	0.100						D	3	4.500	3.464	0.500	6.500					D
V	1.60	32.00	1250.00	6	0.175	0.079	0.100	5.000	1				*		6	113.167	175.105	30.000	830.000				*	
Zn	3.80	15.00	1250.00	11	0.251	0.163	0.100	0.520			-0.682	0.277			15	91.800	33.925	48.000	205.000	1.960	0.178		*	
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	NA	NA	NA							NA	NA	4	500	ERR	500	700				*	
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	750.00	22000.00	25000.00	8	189	106	50	360						D	7	3729	1682	1100	6000					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **menggranulaat (niet gecertificeerd)**

identification number: PACN8mg2.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
Benzeen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ethylbenz.	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Tolueen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Xylenen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Fenolen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-fenol	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Arom.(tot)	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Naf	*************	1000000.00	5.00	NA	NA	NA							NA	NA	4	0.250	0.100	0.100	1.800					D
Ph	*************	1000000.00	20.00	NA	NA	NA							NA	NA	6	2.382	0.448	1.690	2.800					D
An	*************	1000000.00	10.00	NA	NA	NA							NA	NA	6	0.570	0.229	0.300	0.800					D
Fla	*************	1000000.00	35.00	NA	NA	NA							NA	NA	6	3.418	0.844	1.910	4.500					
Chr	*************	1000000.00	10.00	NA	NA	NA							NA	NA	6	1.155	0.352	0.800	1.600					D
BaA	*************	1000000.00	50.00	NA	NA	NA							NA	NA	6	1.235	0.386	0.810	1.800					D
BaP	*************	1000000.00	10.00	NA	NA	NA							NA	NA	6	0.912	0.477	0.070	1.400					D
BkF	*************	1000000.00	50.00	NA	NA	NA							NA	NA	6	0.527	0.270	0.060	0.800					D
IP	*************	1000000.00	50.00	NA	NA	NA							NA	NA	6	0.668	0.271	0.410	1.100					D
BPe	*************	1000000.00	50.00	NA	NA	NA							NA	NA	6	0.553	0.237	0	1					D
PAK10(tot)	*************	1000000.00	75.00	NA	NA	NA							NA	NA	6	10.287	4.869	3.100	73.000					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **menggranulaat (niet gecertificeerd)**

identification number: PCBN8mg2.wk1

17-Dec-93

adjusted values granular materials				leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-118	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-138	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	1	0.300		0.300	0.300					D
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	2	150.000		150.000	150.000					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **zeefzand**

identification number: NV8045.wk1

16-Dec-93

	adjusted values granular materials			leaching characteristics				L/S=10 columntest in mg/kg							composition				aqua regia in mg/kg					
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	12	0.082	0.049	0.050	0.180			-1.149	0.229			30	8.697	3.984	5.000	37.000	0.931	0.191		•	
Ba	5.50	58.00	7500.00	8	0.100	0.000	0.100	0.220					•	D	10	125.664	58.348	50.000	540.000	2.112	0.298		•	
Cd	0.03	0.07	10.00	9	0.045	0.016	0.001	0.050	8						31	0.786	0.636	0.250	3.700	-0.173	0.300		•	D
Co	0.42	2.50	250.00	9	0.091	0.027	0.020	0.100							10	4.500	2.900	0.500	7.300	0.460	0.530			
Cr	1.30	12.00	1250.00	18	0.118	0.064	0.030	0.560			-0.944	0.279	•		32	90.503	121.673	12.768	418.000	1.649	0.491			
Cu	0.72	3.50	375.00	19	0.282	0.205	0.100	0.650			-0.660	0.319			31	24.497	22.085	5.500	253.000	1.316	0.348		•	
Hg	0.02	0.08	5.00	18	0.001	0.001	0.000	0.002			-3.005	0.356			31	0.194	0.269	0.012	0.910	-1.082	0.564			
Mo	0.28	0.91	125.00	9	0.100		0.100	0.100							10	4.319	4.249	0.500	47.000	0.465	0.690		•	D
Ni	1.10	3.70	250.00	9	0.094	0.019	0.042	0.100						D	13	60.113	48.709	5.472	145.000	1.624	0.414			
Pb	1.90	8.70	1250.00	8	0.089	0.031	0.012	0.550					•	D	50	70.779	68.940	0.500	500.000	1.575	0.720		•	
Sb	0.05	0.43	50.00	8	0.050		0.050	0.100	9				•		10	0.673	0.873	0.250	6.000	-0.271	0.508		•	D
Se	0.04	0.10	50.00	9	0.046	0.011	0.018	0.050	8						10	0.360	0.232	0.250	0.800	-0.501	0.213			D
Sn	0.27	2.40	250.00	8	0.100		0.100	0.100						D	10	3.250	3.609	0.500	30.400	0.285	0.696		•	D
V	1.60	32.00	1250.00	8	0.100	ERR	0.100	1.400					•		10	28.700	5.100	20.000	36.000	1.451	0.080			D
Zn	3.80	15.00	1250.00	8	0.100		0.100	0.200					•	D	49	167.400	129.015	42.560	810.000	2.140	0.306		•	
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	3	306	239	124	576							NA	NA	NA						NA	NA
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	750.00	22000.00	25000.00	3	455	350	71	755	1					D	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **zeefzand**
identification number: PACN8045.wk1
17-Dec-93

element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
	adjusted values granular materials			leaching characteristics L/S=10 columntest in mg/kg											composition aqua regia in mg/kg									
Benzeen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	14	0.013	0.016	0.005	0.100	-2.015	0.443		*	D
Ethylbenz.	*************	1000000.00	1.25	NA	NA	NA							NA	NA	15	0.133	0.125	0.030	0.390	-1.025	0.353			
Tolueen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	14	0.071	0.066	0.005	0.310	-1.234	0.421		*	D
Xylenen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	14	0.456	0.509	0.050	2.500	-0.513	0.522	4	*	D
Fenolen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-fenol	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Arom.(tot)	*************	1000000.00	1.25	NA	NA	NA							NA	NA	15	0.830	0.826	0.090	2.650	-0.277	0.430	4		
Naf	*************	1000000.00	5.00	NA	NA	NA							NA	NA	134	0.872	1.626	0.020	9.900	-0.675	0.766	7	*	D
Ph	*************	1000000.00	20.00	NA	NA	NA							NA	NA	134	5.353	6.201	0.050	67.000	0.514	0.480	6	*	
An	*************	1000000.00	10.00	NA	NA	NA							NA	NA	134	1.418	2.001	0.050	18.000	-0.099	0.473	3	*	D
Fla	*************	1000000.00	35.00	NA	NA	NA							NA	NA	133	9.674	10.900	0.120	140.000	0.808	0.432	6	*	
Chr	*************	1000000.00	10.00	NA	NA	NA							NA	NA	134	3.683	3.432	0.050	43.000	0.422	0.401	8	*	
BaA	*************	1000000.00	50.00	NA	NA	NA							NA	NA	134	3.969	3.952	0.050	44.000	0.434	0.427		*	D
BaP	*************	1000000.00	10.00	NA	NA	NA							NA	NA	137	3.110	3.175	0.050	40.000	0.335	0.413	4	*	D
BkF	*************	1000000.00	50.00	NA	NA	NA							NA	NA	134	1.620	1.714	0.020	17.000	0.033	0.442		*	D
IP	*************	1000000.00	50.00	NA	NA	NA							NA	NA	134	2.581	3.272	0.060	20.000	0.201	0.440		*	D
BPe	*************	1000000.00	50.00	NA	NA	NA							NA	NA	132	2.259	3.023	0	20	0.133	0.445		*	D
PAK10(tot)	*************	1000000.00	75.00	NA	NA	NA							NA	NA	134	34.357	35.926	0.630	414.000	1.369	0.414	19	*	
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

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Building material: **zeefzand**

identification number: PCBN8045.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	2	0.500		0.500	0.500					D
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	2	0.500		0.500	0.500					
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	2	0.500		0.500	0.500					D
PCB-118	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	2	0.500		0.500	0.500					D
PCB-138	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	2	0.500		0.500	0.500					D
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	2	0.500		0.500	0.500					D
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	2	0.500		0.500	0.500					
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	2	3.000		3.000	3.000			2		D
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	76	1.681	1.499		38.000	ERR	ERR	7	*	D
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	41	565.395	990.544	32.000	6383.000	2.522	0.506	26	*	
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **recycling brekerzand**

identification number: NV8046.wk1

16-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	1	0.030		0.030	0.030							21	9.409	1.270	6.080	10.000	0.969	0.067			
Ba	5.50	58.00	7500.00	16	0.327	0.210	0.120	1.500			-0.511	0.299	•		17	117.882	40.695	40.000	190.000	2.043	0.170			
Cd	0.03	0.07	10.00	10	0.003	0.001	0.002	0.010			-2.539	0.199	•	D	36	0.787	0.598	0.200	2.000	-0.249	0.378			D
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	17	10.000		10.000	10.000	1.000				
Cr	1.30	12.00	1250.00	17	0.128	0.083	0.030	0.410			-0.933	0.284	•		36	38.191	24.571	10.000	181.000	1.522	0.292		•	
Cu	0.72	3.50	375.00	17	0.245	0.125	0.070	1.140	1		-0.623	0.276	•		35	22.187	10.273	10.000	62.000	1.319	0.201		•	
Hg	0.02	0.08	5.00	3	0.001	0.000	0.001	0.001						D	18	0.217	0.038	0.200	0.300	-0.670	0.068			
Mo	0.28	0.91	125.00	2	0.120	0.057	0.080	0.160							16	2.525	0.100	2.500	4.300	0.416	0.058		•	D
Ni	1.10	3.70	250.00	18	0.079	0.041	0.020	0.160			-1.171	0.269		D	37	16.713	8.033	7.000	36.000	1.178	0.196			
Pb	1.90	8.70	1250.00	17	0.065	0.039	0.050	0.200			-1.199	0.210	•	D	35	100.120	84.259	31.000	580.000	1.930	0.302		•	
Sb	0.05	0.43	50.00	17	0.020		0.020	0.020			-1.699				16	0.806	0.286	0.500	1.800	-0.094	0.161		•	D
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	17	2.500		2.500	2.500	0.398	0.000			
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	17	6.500		6.500	6.500	0.813				D
V	1.60	32.00	1250.00	16	0.456	0.363	0.120	3.800	1		-0.431	0.458	•		16	63.125	120.098	24.000	750.000	1.648	0.451		•	
Zn	3.80	15.00	1250.00	18	0.473	0.094	0.100	0.510			-0.344	0.164			36	168.542	67.566	73.000	300.000	2.192	0.179			
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	1	190		190	190							2	102	76	48	155					D
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	750.00	22000.00	25000.00	17	1178	1105	144	6142	8		2.936	0.461	•	D	19	5807	1664	2800	9200	3.746	0.133			
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **recycling brekerzand**
identification number: PACN8046.wk1
17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
Benzeen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ethylbenz.	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Tolueen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Xylenen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Fenolen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-fenol	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Arom.(tot)	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Naf	*************	1000000.00	5.00	NA	NA	NA							NA	NA	2	4.475	6.258	0.050	8.900			1		D
Ph	*************	1000000.00	20.00	NA	NA	NA							NA	NA	2	6.950	7.142	1.900	340.000			1	*	
An	*************	1000000.00	10.00	NA	NA	NA							NA	NA	2	1.300	1.414	0.300	24.000			1	*	D
Fla	*************	1000000.00	35.00	NA	NA	NA							NA	NA	2	14.000	16.971	2.000	370.000			1	*	
Chr	*************	1000000.00	10.00	NA	NA	NA							NA	NA	3	24.533	34.412	0.800	64.000			1		
BaA	*************	1000000.00	50.00	NA	NA	NA							NA	NA	3	30.933	44.464	0.800	82.000			1		D
BaP	*************	1000000.00	10.00	NA	NA	NA							NA	NA	3	26.900	37.614	0.700	70.000			1		D
BkF	*************	1000000.00	50.00	NA	NA	NA							NA	NA	3	15.200	21.611	0.400	40.000					D
IP	*************	1000000.00	50.00	NA	NA	NA							NA	NA	3	16.933	23.619	0.500	44.000					D
BPe	*************	1000000.00	50.00	NA	NA	NA							NA	NA	3	12.233	17.229	0	32					D
PAK10(tot)	*************	1000000.00	75.00	NA	NA	NA							NA	NA	18	45.658	69.743	4.200	1074.900	1.402	0.663	4	*	
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **recycling brekerzand**

identification number: PCBN8046.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-118	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-138	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	34	306.765	242.521	50.000	2400.000	2.383	0.394	16		
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

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Building material:				bouw- en sloopafval ongedefinieerd																				
identification number:				NV8047.wk1																				
16-Dec-93				leaching characteristics				L/S=10 columntest in mg/kg							composition				aqua regia in mg/kg					
	adjusted values granular materials																							
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	6	0.016	0.010	0.001	0.032						D	22	8.127	2.472	4.000	17.632	0.906	0.151		*	
Ba	5.50	58.00	7500.00	NA	NA	NA							NA	NA	2	22.648	1.935	21.280	24.016					
Cd	0.03	0.07	10.00	6	0.006	0.005	0.001	0.012							24	0.684	0.269	0.100	2.797	-0.180	0.250		*	D
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	2	8.238	1.419	7.235	9.242					
Cr	1.30	12.00	1250.00	14	0.181	0.181	0.006	1.600	1		-0.909	0.621	*		24	45.659	34.698	8.000	280.000	1.610	0.316		*	
Cu	0.72	3.50	375.00	16	0.169	0.092	0.030	0.320			-0.856	0.306			24	10.917	4.640	3.000	32.832	1.021	0.213		*	
Hg	0.02	0.08	5.00	15	0.001	0.000	0.000	0.001			-3.290	0.183		D	22	0.033	0.065	0.012	0.500	-1.634	0.417		*	D
Mo	0.28	0.91	125.00	5	0.270	0.293	0.042	0.600	2						2	4.590	1.075	3.830	5.350					D
Ni	1.10	3.70	250.00	5	0.023	0.016	0.010	0.050						D	5	15.677	7.803	8.000	27.360					
Pb	1.90	8.70	1250.00	6	0.033	0.019	0.010	0.050						D	42	23.143	17.971	5.200	127.680	1.296	0.294		*	
Sb	0.05	0.43	50.00	NA	NA	NA							NA	NA	2	2.371	0.516	2.006	2.736					
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	2	3.101	0.946	2.432	3.770					
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
V	1.60	32.00	1250.00	NA	NA	NA							NA	NA	2	57.456	7.309	52.288	62.624					
Zn	3.80	15.00	1250.00	6	0.228	0.211	0.060	0.500							42	69.244	50.042	28.000	626.240	1.799	0.266		*	
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	5	120	82	50	250							NA	NA	NA						NA	NA
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	750.00	22000.00	25000.00	5	626	632	140	1500	2					D	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **bouw- en sloopafval ongedefinieerd**

identification number: PACN8047.wk1

17-Dec-93

adjusted values granular materials				leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
Benzeen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ethylbenz.	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Tolueen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Xylenen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Fenolen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-fenol	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Arom.(tot)	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Naf	*************	1000000.00	5.00	NA	NA	NA							NA	NA	66	0.245	0.344	0.050	11.000	-0.805	0.438	1	*	D
Ph	*************	1000000.00	20.00	NA	NA	NA							NA	NA	66	2.918	7.776	0.050	145.000	-0.344	0.839	4	*	D
An	*************	1000000.00	10.00	NA	NA	NA							NA	NA	66	1.091	3.632	0.010	33.000	-0.677	0.699	4	*	D
Fla	*************	1000000.00	35.00	NA	NA	NA							NA	NA	66	16.381	72.990	0.050	675.000	-0.103	1.025	6	*	
Chr	*************	1000000.00	10.00	NA	NA	NA							NA	NA	66	8.750	48.491	0.020	545.000	-0.377	0.924	7	*	
BaA	*************	1000000.00	50.00	NA	NA	NA							NA	NA	66	7.319	36.136	0.020	425.000	-0.334	0.945	2	*	D
BaP	*************	1000000.00	10.00	NA	NA	NA							NA	NA	66	2.937	10.004	0.020	225.000	-0.473	0.848	5	*	D
BkF	*************	1000000.00	50.00	NA	NA	NA							NA	NA	66	3.010	13.955	0.010	220.000	-0.568	0.826	2	*	D
IP	*************	1000000.00	50.00	NA	NA	NA							NA	NA	66	2.848	9.377	0.020	120.000	-0.463	0.857	2	*	D
BPe	*************	1000000.00	50.00	NA	NA	NA							NA	NA	66	2.734	8.723	0	105	-0.473	0.862	2	*	D
PAK10(tot)	*************	1000000.00	75.00	NA	NA	NA							NA	NA	67	49.558	209.577	0.055	2367.000	0.613	0.910	6	*	
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

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Building material: **bouw- en sloopafval ongedefinieerd**

identification number: PCBN8047.wk1

17-Dec-93

adjusted values granular materials				leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-118	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-138	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	12	0.339	0.189	0.100	4.300	-0.448	0.413	1	*	D
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	13	460.000	383.080	100.000	3100.000	2.581	0.455	8	*	
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **rookgasontzwavelingsgips**

identification number: NV8048.wk1

17-Dec-93

	adjusted values granular materials			leaching characteristics				L/S=10 columntest in mg/kg							composition				aqua regia in mg/kg					
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	NA	NA	NA	0.000	0.000	0	0	0.000	0.000	NA	NA	1	0.405	0.000	0.405	0.405	0.000	0.000	0		D
Ba	5.50	58.00	7500.00	NA	NA	NA	0.000	0.000	0	0	0.000	0.000	NA	NA	NA	NA	NA	0.000	0.000	0.000	0.000	0	NA	NA
Cd	0.03	0.07	10.00	NA	NA	NA	0.000	0.000	0	0	0.000	0.000	NA	NA	1	0.675	0.000	0.675	0.675	0.000	0.000	0		D
Co	0.42	2.50	250.00	NA	NA	NA	0.000	0.000	0	0	0.000	0.000	NA	NA	NA	NA	NA	0.000	0.000	0.000	0.000	0	NA	NA
Cr	1.30	12.00	1250.00	NA	NA	NA	0.000	0.000	0	0	0.000	0.000	NA	NA	1	7.088	0.000	7.088	7.088	0.000	0.000	0		
Cu	0.72	3.50	375.00	NA	NA	NA	0.000	0.000	0	0	0.000	0.000	NA	NA	1	4.388	0.000	4.388	4.388	0.000	0.000	0		D
Hg	0.02	0.08	5.00	NA	NA	NA	0.000	0.000	0	0	0.000	0.000	NA	NA	1	0.155	0.000	0.155	0.155	0.000	0.000	0		
Mo	0.28	0.91	125.00	NA	NA	NA	0.000	0.000	0	0	0.000	0.000	NA	NA	1	20.250	0.000	20.250	20.250	0.000	0.000	0		D
Ni	1.10	3.70	250.00	NA	NA	NA	0.000	0.000	0	0	0.000	0.000	NA	NA	1	3.375	0.000	3.375	3.375	0.000	0.000	0		D
Pb	1.90	8.70	1250.00	NA	NA	NA	0.000	0.000	0	0	0.000	0.000	NA	NA	1	6.750	0.000	6.750	6.750	0.000	0.000	0		D
Sb	0.05	0.43	50.00	NA	NA	NA	0.000	0.000	0	0	0.000	0.000	NA	NA	1	2.700	0.000	2.700	2.700	0.000	0.000	0		
Se	0.04	0.10	50.00	NA	NA	NA	0.000	0.000	0	0	0.000	0.000	NA	NA	1	5.400	0.000	5.400	5.400	0.000	0.000	0		
Sn	0.27	2.40	250.00	NA	NA	NA	0.000	0.000	0	0	0.000	0.000	NA	NA	NA	NA	NA	0.000	0.000	0.000	0.000	0	NA	NA
V	1.60	32.00	1250.00	NA	NA	NA	0.000	0.000	0	0	0.000	0.000	NA	NA	1	121.500	0.000	121.500	121.500	0.000	0.000	0		
Zn	3.80	15.00	1250.00	NA	NA	NA	0.000	0.000	0	0	0.000	0.000	NA	NA	1	8.438	0.000	8.438	8.438	0.000	0.000	0		D
Br	2.90	4.10	500.00	NA	NA	NA	0.000	0.000	0	0	0.000	0.000	NA	NA	NA	NA	NA	0.000	0.000	0.000	0.000	0	NA	NA
Cl	600.00	8800.00	5000.00	NA	NA	NA	0	0	0	0	0.000	0.000	NA	NA	1	2700	0	2700	2700	0.000	0.000	0		
CN-comp	0.07	0.38	125.00	NA	NA	NA	0.000	0.000	0	0	0.000	0.000	NA	NA	NA	NA	NA	0.000	0.000	0.000	0.000	0	NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA	0.000	0.000	0	0	0.000	0.000	NA	NA	NA	NA	NA	0.000	0.000	0.000	0.000	0	NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA	0.000	0.000	0	0	0.000	0.000	NA	NA	NA	NA	NA	0.000	0.000	0.000	0.000	0	NA	NA
SO4	750.00	22000.00	25000.00	NA	NA	NA	0	0	0	0	0.000	0.000	NA	NA	NA	NA	NA	0	0	0.000	0.000	0	NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

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Building material: **fosforzuurgips**

identification number: NV8049.wk1

16-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	2	0.445	0.219	0.290	0.600							8	1.839	1.264	0.439	3.962					D
Ba	5.50	58.00	7500.00	NA	NA	NA							NA	NA	3	17.550	14.804	4.725	33.750					
Cd	0.03	0.07	10.00	2	2.250	0.071	2.200	2.300	2	2					7	2.044	0.787	1.350	5.738				*	
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	3	0.428	0.372	0.068	0.810					D
Cr	1.30	12.00	1250.00	NA	NA	NA							NA	NA	4	6.126	1.666	4.253	8.100					D
Cu	0.72	3.50	375.00	2	0.565	0.049	0.530	0.600							5	3.362	1.063	2.160	4.725					D
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	3	0.025	0.031	0.007	0.540				*	D
Mo	0.28	0.91	125.00	2	0.455	0.488	0.110	0.800	1						5	6.075	6.527	0.675	13.500					D
Ni	1.10	3.70	250.00	NA	NA	NA							NA	NA	4	5.366	3.574	2.295	10.125					
Pb	1.90	8.70	1250.00	2	0.370	0.325	0.140	0.600							3	5.850	1.559	4.050	24.975				*	D
Sb	0.05	0.43	50.00	2	0.006	0.006	0.001	0.010						D	4	0.316	0.307	0.034	0.675					D
Se	0.04	0.10	50.00	2	1.160	1.612	0.020	2.300	1	1					4	0.945	0.468	0.540	1.350					D
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
V	1.60	32.00	1250.00	2	0.600	0.141	0.500	0.700							4	2.666	0.883	1.553	40.500				*	D
Zn	3.80	15.00	1250.00	2	3.300	2.404	1.600	5.000	1						8	12.833	6.054	2.768	18.900					D
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	1	0.338		0.338	0.338					D
Cl	600.00	8800.00	5000.00	NA	NA	NA							NA	NA	1	146		146	146					D
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	2	680.000	395.980	400.000	960.000	2	2					1	8640.000		8640.000	8640.000			1		
SO4	750.00	22000.00	25000.00	2	13500	2121	12000	15000	2						1	432000		432000	432000			1		
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **mijnsteen**

identification number: NV8050.wk1

17-Dec-93

adjusted values granular materials				leaching characteristics			L/S=10 columntest in mg/kg								composition			aqua regia in mg/kg						
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	17	0.105	0.071	0.011	0.550	0	0	-1.053	0.416	•		58	13.694	13.665	2.000	70.000	0.983	0.395	0	•	
Ba	5.50	58.00	7500.00	17	0.438	0.629	0.010	3.700	0	0	-0.767	0.836	•		30	179.173	89.711	4.000	520.000	2.169	0.403	0	•	
Cd	0.03	0.07	10.00	20	0.003	0.003	0.001	0.014	0	0	-2.747	0.418	•	D	56	0.841	0.368	0.000	5.500	ERR	ERR	0	•	
Co	0.42	2.50	250.00	NA	NA	NA	0.000	0.000	0	0	0.000	0.000	NA	NA	7	7.015	2.705	2.112	8.976	0.000	0.000	0		
Cr	1.30	12.00	1250.00	20	0.047	0.074	0.005	0.800	0	0	-1.731	0.711	•	D	56	50.589	45.438	5.000	405.000	1.593	0.361	0	•	
Cu	0.72	3.50	375.00	21	0.034	0.033	0.005	0.100	0	0	-1.682	0.455		D	56	36.396	13.023	2.000	71.280	1.518	0.236	0		
Hg	0.02	0.08	5.00	3	0.002	0.001	0.001	0.002	0	0	0.000	0.000			19	0.141	0.143	0.000	0.410	ERR	ERR	0		
Mo	0.28	0.91	125.00	2	0.100	0.000	0.100	0.100	0	0	0.000	0.000			9	0.205	0.413	0.000	1.056	0.000	0.000	0		D
Ni	1.10	3.70	250.00	20	0.025	0.030	0.001	0.260	0	0	-1.799	0.577	•	D	57	45.282	25.929	1.000	220.000	1.584	0.352	0	•	
Pb	1.90	8.70	1250.00	16	0.030	0.049	0.010	0.300	0	0	-1.708	0.501	•	D	58	24.194	21.449	0.000	120.000	ERR	ERR	0	•	
Sb	0.05	0.43	50.00	NA	NA	NA	0.000	0.000	0	0	0.000	0.000	NA	NA	4	1.529	0.549	0.966	2.000	0.000	0.000	0		
Se	0.04	0.10	50.00	NA	NA	NA	0.000	0.000	0	0	0.000	0.000	NA	NA	3	1.256	0.667	0.713	2.000	0.000	0.000	0		D
Sn	0.27	2.40	250.00	2	0.100	0.000	0.100	0.100	0	0	0.000	0.000		D	8	0.132	0.373	0.000	1.584	0.000	0.000	0	•	D
V	1.60	32.00	1250.00	NA	NA	NA	0.000	0.000	0	0	0.000	0.000	NA	NA	3	63.400	44.515	12.000	89.496	0.000	0.000	0		
Zn	3.80	15.00	1250.00	20	0.067	0.022	0.020	2.200	0	0	-1.124	0.368	•	D	58	115.926	104.187	9.000	1560.000	1.982	0.330	1	•	
Br	2.90	4.10	500.00	NA	NA	NA	0.000	0.000	0	0	0.000	0.000	NA	NA	NA	NA	NA	0.000	0.000	0.000	0.000	0	NA	NA
Cl	600.00	8800.00	5000.00	12	309	195	23	540	0	0	2.312	0.513			19	509	251	166	1100	2.656	0.219	0		
CN-comp	0.07	0.38	125.00	NA	NA	NA	0.000	0.000	0	0	0.000	0.000	NA	NA	NA	NA	NA	0.000	0.000	0.000	0.000	0	NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA	0.000	0.000	0	0	0.000	0.000	NA	NA	NA	NA	NA	0.000	0.000	0.000	0.000	0	NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA	0.000	0.000	0	0	0.000	0.000	NA	NA	2	380.424	5.600	376.464	384.384	0.000	0.000	0		
SO4	750.00	22000.00	25000.00	19	213	378	25	1600	3	0	2.089	0.499	•	D	23	637	1642	21	19221	2.414	0.707	0	•	
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **mijnsteen**
identification number: PACN8050.wk1
17-Dec-93

adjusted values granular materials | leaching characteristics L/S=10 columntest in mg/kg | composition aqua regia in mg/kg

element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
Benzeen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	1	0.100		0.100	0.100					D
Ethylbenz.	*************	1000000.00	1.25	NA	NA	NA							NA	NA	1	0.100		0.100	0.100					
Tolueen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	1	0.100		0.100	0.100					D
Xylenen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	1	0.100		0.100	0.100					D
Fenolen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	2	1.450	0.778	0.900	2.000			1		D
Cl-fenol	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Arom.(tot)	*************	1000000.00	1.25	NA	NA	NA							NA	NA	1	0.400		0.400	0.400					
Naf	*************	1000000.00	5.00	NA	NA	NA							NA	NA	26	0.172	0.377	0.050	5.700	-0.947	0.484	1	•	D
Ph	*************	1000000.00	20.00	NA	NA	NA							NA	NA	27	0.429	0.291	0.020	1.050	-0.487	0.376			D
An	*************	1000000.00	10.00	NA	NA	NA							NA	NA	25	0.022	0.017	0.010	0.150	-1.739	0.348		•	D
Fla	*************	1000000.00	35.00	NA	NA	NA							NA	NA	44	0.882	1.095	0.030	5.700	-0.352	0.599		•	D
Chr	*************	1000000.00	10.00	NA	NA	NA							NA	NA	25	0.218	0.218	0.030	0.900	-0.843	0.468		•	D
BaA	*************	1000000.00	50.00	NA	NA	NA							NA	NA	25	0.176	0.171	0.020	1.400	-0.941	0.518		•	D
BaP	*************	1000000.00	10.00	NA	NA	NA							NA	NA	43	0.055	0.047	0.010	0.700	-1.394	0.432		•	D
BkF	*************	1000000.00	50.00	NA	NA	NA							NA	NA	43	0.058	0.058	0.010	0.450	-1.413	0.460		•	D
IP	*************	1000000.00	50.00	NA	NA	NA							NA	NA	43	0.062	0.069	0.010	1.000	-1.347	0.433		•	D
BPe	*************	1000000.00	50.00	NA	NA	NA							NA	NA	42	0.078	0.070	0	1	-1.233	0.421		•	D
PAK10(tot)	*************	1000000.00	75.00	NA	NA	NA							NA	NA	24	2.170	1.633	0.320	9.290	0.249	0.366		•	
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **mijnsteen**

identification number: PCBN8050.wk1

17-Dec-93

adjusted values granular materials

				leaching characteristics L/S=10 columntest in mg/kg											composition aqua regia in mg/kg									
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	51	0.016	0.021	0.010	0.500	-1.890	0.331		•	D
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	51	0.012	0.013	0.010	0.200	-1.947	0.233		•	D
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	51	0.010	0.003	0.010	0.100	-1.972	0.152		•	D
PCB-118	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	29	0.010	0.000	0.010	0.030	-1.984	0.087		•	D
PCB-138	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	51	0.010	0.001	0.010	0.030	-1.987	0.070		•	D
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	51	0.010	0.001	0.010	0.030	-1.987	0.070		•	D
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	51	0.010	0.003	0.010	0.045	-1.978	0.111		•	D
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	26	0.067	0.024	0.060	0.180	-1.175	0.136		•	D
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	1	0.500		0.500	0.500					D
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	5	0.196	0.005	0.190	0.400				•	D
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	2	340.000		340.000	340.000			2		
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **mijnsteen (gesorteerd)**

identification number: NV8ms01.wk1

17-Dec-93

adjusted values granular materials				leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	6	0.117	0.041	0.080	0.180							11	4.193	1.600	2.400	22.000	0.658	0.263		*	D
Ba	5.50	58.00	7500.00	7	0.349	0.481	0.010	2.500					*		9	182.484	68.101	84.480	295.000					
Cd	0.03	0.07	10.00	7	0.001	0.000	0.001	0.002					*	D	10	0.632	0.477		1.000	ERR	ERR			D
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	4	5.808	3.168	2.112	8.448					
Cr	1.30	12.00	1250.00	7	0.009	0.005	0.005	0.170					*	D	10	40.074	20.062	15.312	71.280	1.546	0.243			
Cu	0.72	3.50	375.00	8	0.015	0.011	0.005	0.030						D	9	27.027	10.272	10.560	71.280	1.439	0.248		*	
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	10	0.110	0.137		0.400	ERR	ERR			
Mo	0.28	0.91	125.00	NA	NA	NA							NA	NA	4									D
Ni	1.10	3.70	250.00	7	0.012	0.008	0.001	0.070					*	D	12	29.268	14.082	2.112	50.000	1.367	0.387			
Pb	1.90	8.70	1250.00	5	0.010	ERR	0.010	0.060					*	D	11	15.000	13.601		120.000	ERR	ERR		*	
Sb	0.05	0.43	50.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	4									D
V	1.60	32.00	1250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Zn	3.80	15.00	1250.00	7	0.060	0.000	0.060	2.200					*	D	11	66.999	27.901	20.592	470.000	1.858	0.328		*	
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	4	483	57	400	530							4	276	90	166	375					D
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	750.00	22000.00	25000.00	8	116	57	50	200						D	8	236	231	21	510					D
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

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Building material: **mijnsteen (gesorteerd)**

identification number: PACN8ms1.wk1

17-Dec-93

element	U1 (adjusted values granular materials)	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
Benzeen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ethylbenz.	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Tolueen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Xylenen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Fenolen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-fenol	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Arom.(tot)	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Naf	*************	1000000.00	5.00	NA	NA	NA							NA	NA	1	0.200		0.200	0.200					D
Ph	*************	1000000.00	20.00	NA	NA	NA							NA	NA	1	0.500		0.500	0.500					D
An	*************	1000000.00	10.00	NA	NA	NA							NA	NA	1	0.050		0.050	0.050					D
Fla	*************	1000000.00	35.00	NA	NA	NA							NA	NA	1	0.800		0.800	0.800					D
Chr	*************	1000000.00	10.00	NA	NA	NA							NA	NA	1	0.500		0.500	0.500					D
BaA	*************	1000000.00	50.00	NA	NA	NA							NA	NA	1	0.400		0.400	0.400					D
BaP	*************	1000000.00	10.00	NA	NA	NA							NA	NA	1	0.150		0.150	0.150					D
BkF	*************	1000000.00	50.00	NA	NA	NA							NA	NA	1	0.080		0.080	0.080					D
IP	*************	1000000.00	50.00	NA	NA	NA							NA	NA	1	0.050		0.050	0.050					D
BPe	*************	1000000.00	50.00	NA	NA	NA							NA	NA	1	0.050		0	0					D
PAK10(tot)	*************	1000000.00	75.00	NA	NA	NA							NA	NA	1	2.780		2.780	2.780					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **mijnsteen (gesorteerd)**

identification number: PCBN8ms1.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	1	0.010		0.010	0.010					D
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	1	0.010		0.010	0.010					D
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	1	0.010		0.010	0.010					D
PCB-118	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	1	0.010		0.010	0.010					D
PCB-138	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	1	0.010		0.010	0.010					D
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	1	0.010		0.010	0.010					D
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	1	0.010		0.010	0.010					D
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **mijnsteen (gewassen)**

identification number: NV8ms02.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	NA	NA	NA							NA	NA	12	23.167	20.674	2.000	68.000	1.196	0.434			
Ba	5.50	58.00	7500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cd	0.03	0.07	10.00	NA	NA	NA							NA	NA	12	1.000		1.000	1.000					
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	1.30	12.00	1250.00	NA	NA	NA							NA	NA	11	70.727	34.386	18.000	260.000	1.847	0.293		*	
Cu	0.72	3.50	375.00	NA	NA	NA							NA	NA	12	43.083	6.762	35.000	53.000	1.630	0.067			
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Mo	0.28	0.91	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ni	1.10	3.70	250.00	NA	NA	NA							NA	NA	11	61.545	22.070	35.000	155.000	1.800	0.191		*	
Pb	1.90	8.70	1250.00	NA	NA	NA							NA	NA	12	22.083	6.895	15.000	35.000	1.325	0.133			
Sb	0.05	0.43	50.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
V	1.60	32.00	1250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Zn	3.80	15.00	1250.00	NA	NA	NA							NA	NA	11	80.455	13.374	55.000	170.000	1.927	0.121		*	
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	750.00	22000.00	25000.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **mijnsteen (Nederland)**

identification number: NV8ms03.wk1

17-Dec-93

leaching characteristics — L/S=10 columntest in mg/kg; composition — aqua regia in mg/kg

adjusted values granular materials element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	2	0.050		0.050	0.050							4	8.250	3.096	4.000	11.000					
Ba	5.50	58.00	7500.00	2	0.107		0.107	0.107						D	2	142.500	3.536	140.000	145.000					
Cd	0.03	0.07	10.00	2	0.012	0.002	0.011	0.014							4	1.000		1.000	1.000					
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	1.30	12.00	1250.00	2	0.100		0.100	0.100							4	101.250	72.436	45.000	205.000					
Cu	0.72	3.50	375.00	2	0.100		0.100	0.100							4	35.000	3.464	30.000	38.000					
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	2	0.200		0.200	0.200					
Mo	0.28	0.91	125.00	2	0.100		0.100	0.100							NA	NA	NA						NA	NA
Ni	1.10	3.70	250.00	2	0.100		0.100	0.100						D	3	49.333	7.095	43.000	120.000					
Pb	1.90	8.70	1250.00	2	0.051	0.001	0.050	0.051						D	4	15.000	5.774	10.000	20.000					
Sb	0.05	0.43	50.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Sn	0.27	2.40	250.00	2	0.100		0.100	0.100						D	NA	NA	NA						NA	NA
V	1.60	32.00	1250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Zn	3.80	15.00	1250.00	2	0.100		0.100	0.100						D	4	75.500	19.958	54.000	100.000					
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	2	23	1	23	24							NA	NA	NA						NA	NA
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	750.00	22000.00	25000.00	2	1588	18	1575	1600	2						NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **mijnsteen (Nederland)**

identification number: PACN8ms2.wk1

17-Dec-93

adjusted values granular materials				leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
Benzeen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ethylbenz.	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Tolueen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Xylenen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Fenolen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-fenol	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Arom.(tot)	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Naf	*************	1000000.00	5.00	NA	NA	NA							NA	NA	1	0.100		0.100	0.100					D
Ph	*************	1000000.00	20.00	NA	NA	NA							NA	NA	1	1.050		1.050	1.050					D
An	*************	1000000.00	10.00	NA	NA	NA							NA	NA	1	0.060		0.060	0.060					D
Fla	*************	1000000.00	35.00	NA	NA	NA							NA	NA	4	0.168	0.096	0.070	0.300					D
Chr	*************	1000000.00	10.00	NA	NA	NA							NA	NA	1	0.090		0.090	0.090					D
BaA	*************	1000000.00	50.00	NA	NA	NA							NA	NA	1	0.070		0.070	0.070					D
BaP	*************	1000000.00	10.00	NA	NA	NA							NA	NA	3	0.027	0.006	0.020	0.090					D
BkF	*************	1000000.00	50.00	NA	NA	NA							NA	NA	4	0.028	0.013	0.010	0.040					D
IP	*************	1000000.00	50.00	NA	NA	NA							NA	NA	4	0.028	0.017	0.010	0.050					D
BPe	*************	1000000.00	50.00	NA	NA	NA							NA	NA	4	0.070	0.057	0	0					D
PAK10(tot)	*************	1000000.00	75.00	NA	NA	NA							NA	NA	1	1.900		1.900	1.900					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **mijnsteen (Nederland)**

identification number: PCBN8ms2.wk1

17-Dec-93

element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
	adjusted values granular materials			leaching characteristics L/S=10 columntest in mg/kg											composition aqua regia in mg/kg									
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	3	0.010	0.000	0.010	0.015					D
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	4	0.010		0.010	0.010					D
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	4	0.010		0.010	0.010					D
PCB-118	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-138	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	4	0.010		0.010	0.010					D
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	4	0.010		0.010	0.010					D
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	4	0.010		0.010	0.010					D
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **mijnsteen (overige)**

identification number: NV8ms04.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	9	0.110	0.090	0.011	0.550			-1.063	0.543	•		30	13.837	11.187	2.640	70.000	1.038	0.373		•	
Ba	5.50	58.00	7500.00	7	0.329	0.234	0.050	3.700					•		20	198.391	126.130	4.000	520.000	2.144	0.489			
Cd	0.03	0.07	10.00	11	0.003	0.004	0.001	0.010			-2.741	0.406		D	30	0.826	0.396	0.053	5.500	-0.140	0.373		•	
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	2	8.448	ERR	8.448	8.976				•	
Cr	1.30	12.00	1250.00	10	0.050	0.091	0.005	0.800			-1.704	0.821	•	D	30	32.975	21.472	5.000	405.000	1.466	0.358		•	
Cu	0.72	3.50	375.00	11	0.036	0.030	0.005	0.100			-1.611	0.420		D	30	35.554	13.612	2.000	67.000	1.496	0.278			
Hg	0.02	0.08	5.00	3	0.002	0.001	0.001	0.002							7	0.169	0.173		0.410					
Mo	0.28	0.91	125.00	NA	NA	NA							NA	NA	5	0.370	0.515		1.056					D
Ni	1.10	3.70	250.00	10	0.014	0.010	0.001	0.260			-1.848	0.574	•	D	29	38.960	14.245	1.000	220.000	1.558	0.351		•	
Pb	1.90	8.70	1250.00	8	0.034	0.067	0.010	0.300					•	D	30	26.709	22.383		112.000	ERR	ERR		•	
Sb	0.05	0.43	50.00	NA	NA	NA							NA	NA	4	1.529	0.549	0.966	2.000					
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	3	1.256	0.667	0.713	2.000					D
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	5	0.528	0.747		1.584					D
V	1.60	32.00	1250.00	NA	NA	NA							NA	NA	3	63.400	44.515	12.000	89.496					
Zn	3.80	15.00	1250.00	11	0.065	0.025	0.020	0.120			-1.218	0.192		D	30	138.657	119.981	9.000	1560.000	2.066	0.385	1	•	
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	6	288	155	58	540							15	571	244	264	1100	2.719	0.191			
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	2	380.424	5.600	376.464	384.384					
SO4	750.00	22000.00	25000.00	9	74	38	25	870	1		1.927	0.420	•	D	15	851	2017	30	19221	2.587	0.702		•	
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

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Building material: **mijnsteen (overige)**

identification number: PACN8ms3.wk1

17-Dec-93

element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
	adjusted values granular materials			leaching characteristics L/S=10 columntest in mg/kg											composition aqua regia in mg/kg									
Benzeen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	1	0.100		0.100	0.100					D
Ethylbenz.	*************	1000000.00	1.25	NA	NA	NA							NA	NA	1	0.100		0.100	0.100					
Tolueen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	1	0.100		0.100	0.100					D
Xylenen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	1	0.100		0.100	0.100					D
Fenolen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	2	1.450	0.778	0.900	2.000			1		D
Cl-fenol	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Arom.(tot)	*************	1000000.00	1.25	NA	NA	NA							NA	NA	1	0.400		0.400	0.400					
Naf	*************	1000000.00	5.00	NA	NA	NA							NA	NA	24	0.174	0.392	0.050	5.700	-0.955	0.501	1	•	D
Ph	*************	1000000.00	20.00	NA	NA	NA							NA	NA	25	0.402	0.273	0.020	1.000	-0.515	0.374			D
An	*************	1000000.00	10.00	NA	NA	NA							NA	NA	23	0.019	0.014	0.010	0.150	-1.778	0.332		•	D
Fla	*************	1000000.00	35.00	NA	NA	NA							NA	NA	39	0.957	1.139	0.030	5.700	-0.311	0.610		•	D
Chr	*************	1000000.00	10.00	NA	NA	NA							NA	NA	23	0.212	0.217	0.030	0.900	-0.857	0.473		•	D
BaA	*************	1000000.00	50.00	NA	NA	NA							NA	NA	23	0.170	0.170	0.020	1.400	-0.955	0.526		•	D
BaP	*************	1000000.00	10.00	NA	NA	NA							NA	NA	38	0.053	0.047	0.010	0.700	-1.403	0.443		•	D
BkF	*************	1000000.00	50.00	NA	NA	NA							NA	NA	38	0.061	0.061	0.010	0.450	-1.400	0.477		•	D
IP	*************	1000000.00	50.00	NA	NA	NA							NA	NA	38	0.066	0.072	0.010	1.000	-1.319	0.443		•	D
BPe	*************	1000000.00	50.00	NA	NA	NA							NA	NA	37	0.080	0.072	0	1	-1.228	0.436		•	D
PAK10(tot)	*************	1000000.00	75.00	NA	NA	NA							NA	NA	22	2.154	1.703	0.320	9.290	0.239	0.379		•	
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **mijnsteen (overige)**

identification number: PCBN8ms3.wk1

17-Dec-93

	adjusted values granular materials			leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	46	0.017	0.023	0.010	0.500	-1.882	0.347		*	D
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	46	0.012	0.014	0.010	0.200	-1.941	0.245		*	D
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	46	0.010	0.003	0.010	0.100	-1.969	0.160		*	D
PCB-118	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	28	0.010	ERR	0.010	0.030	-1.984	0.089		*	D
PCB-138	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	46	0.010	0.001	0.010	0.030	-1.986	0.074		*	D
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	46	0.010	0.001	0.010	0.030	-1.986	0.074		*	D
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	46	0.010	0.003	0.010	0.045	-1.976	0.117		*	D
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	26	0.067	0.024	0.060	0.180	-1.175	0.136		*	D
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	1	0.500		0.500	0.500					D
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	5	0.196	0.005	0.190	0.400				*	D
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	2	340.000		340.000	340.000			2		
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material:				EC-vliegas																				
identification number:				NV8052.wk1																				
17-Dec-93				leaching characteristics				L/S=10 columntest in mg/kg							composition				aqua regia in mg/kg					
	adjusted values granular materials																							
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	12	0.263	0.321	0.022	0.987	1		-0.946	0.615			76	41.789	35.221	1.539	208.728	1.486	0.403		*	
Ba	5.50	58.00	7500.00	5	2.166	1.278	0.032	3.200							62	977.349	630.713	300.000	4627.473	2.936	0.247		*	
Cd	0.03	0.07	10.00	17	0.004	0.004	0.000	0.011			-2.861	0.803			72	0.906	0.902	0.067	11.708	-0.224	0.458	1	*	
Co	0.42	2.50	250.00	2	0.018	0.011	0.010	0.025							44	29.229	15.251	3.278	82.956	1.399	0.308		*	
Cr	1.30	12.00	1250.00	17	1.729	1.393	0.160	4.673	9		0.056	0.463			72	87.633	39.069	18.732	280.980	1.902	0.229		*	
Cu	0.72	3.50	375.00	7	0.080	0.101	0.007	0.685					*	D	64	119.466	82.731	30.105	943.290	2.010	0.287	2	*	
Hg	0.02	0.08	5.00	1	0.000		0.000	0.000						D	39	0.174	0.159	0.013	1.338	-0.916	0.460		*	
Mo	0.28	0.91	125.00	16	5.810	5.143	0.350	15.260	16	11	0.459	0.624			57	15.911	11.302	2.208	284.325	1.137	0.334	1	*	D
Ni	1.10	3.70	250.00	10	0.064	0.089	0.010	0.676			-1.357	0.608	*	D	50	51.839	37.061	1.204	228.129	1.564	0.461		*	
Pb	1.90	8.70	1250.00	9	0.051	0.045	0.004	0.109						D	66	56.345	49.616	2.074	220.770	1.570	0.458		*	
Sb	0.05	0.43	50.00	5	0.203	0.182	0.004	0.370	3						61	4.876	3.121	0.535	26.091	0.595	0.344		*	
Se	0.04	0.10	50.00	6	1.335	1.326	0.010	3.700	5	5					59	8.805	8.409	0.736	109.047	0.763	0.474	1	*	
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	14	36.858	48.253	2.676	223.446	1.290	0.648		*	D
V	1.60	32.00	1250.00	9	3.969	2.669	0.350	17.490	9		0.546	0.464	*		65	168.884	75.392	45.492	561.960	2.196	0.203		*	
Zn	3.80	15.00	1250.00	5	0.213	0.135	0.065	1.017					*		74	141.408	119.800	9.366	602.100	1.980	0.452		*	
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	38	2.355	2.194	0.201	14.049	0.227	0.438		*	D
Cl	600.00	8800.00	5000.00	4	17	6	11	25							32	65	81	9	2355	1.643	0.521		*	D
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	3	4.134	2.136	2.894	31.550	1				*		43	73.711	112.738	0.268	488.370	1.318	0.901		*	
SO4	750.00	22000.00	25000.00	6	3088	914	1342	3842	6						17	1909	1458	0	4282	2.671	1.410			
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **EC-vliegas**

identification number: PACN8052.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
Benzeen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ethylbenz.	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Tolueen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Xylenen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Fenolen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-fenol	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Arom.(tot)	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Naf	*************	1000000.00	5.00	NA	NA	NA							NA	NA	2	0.050		0.050	0.050					D
Ph	*************	1000000.00	20.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
An	*************	1000000.00	10.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
Fla	*************	1000000.00	35.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
Chr	*************	1000000.00	10.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
BaA	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
BaP	*************	1000000.00	10.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
BkF	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
IP	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
BPe	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.010		0	0					D
PAK10(tot)	*************	1000000.00	75.00	NA	NA	NA							NA	NA	2	0.140		0.140	0.140					D
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **EC-vliegas**

identification number: PCBN8052.wk1

17-Dec-93

adjusted values granular materials				leaching characteristics L/S=10 columntest in mg/kg											composition aqua regia in mg/kg									
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-118	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-138	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

RIVM
research for
man and environment

BASIS
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Building material: **EC-bodemas**

identification number: NV8053.wk1

17-Dec-93

adjusted values granular materials				leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	61	0.106	0.096	0.002	0.520			-1.151	0.478	*		87	5.463	6.019	0.600	34.100	0.535	0.441		*	D
Ba	5.50	58.00	7500.00	54	2.857	2.396	0.200	14.800	8		0.334	0.378	*		78	543.040	393.199	48.000	1214.350	2.564	0.431			
Cd	0.03	0.07	10.00	61	0.004	0.009	0.000	0.050	3		-2.858	0.548	*	D	87	0.123	0.167	0.010	12.144	-1.115	0.481	1	*	D
Co	0.42	2.50	250.00	57	0.030	0.034	0.001	0.700	1		-1.762	0.524	*		84	20.217	15.763	2.400	60.345	1.128	0.428			
Cr	1.30	12.00	1250.00	61	0.024	0.030	0.001	0.240			-1.830	0.448	*	D	88	112.095	112.912	4.500	350.150	1.630	0.704			
Cu	0.72	3.50	375.00	61	0.053	0.099	0.010	0.740	1		-1.550	0.492	*	D	87	36.459	32.024	5.500	864.200	1.421	0.409	1	*	
Hg	0.02	0.08	5.00	54	0.003	0.001	0.002	0.005			-2.553	0.151			81	0.226	0.053	0.007	0.300	-0.668	0.191			
Mo	0.28	0.91	125.00	56	0.144	0.135	0.010	0.500	7		-1.028	0.419			73	3.114	3.594	0.420	20.860	0.298	0.425		*	D
Ni	1.10	3.70	250.00	61	0.097	0.134	0.005	1.200	1		-1.364	0.594	*	D	88	49.963	34.259	6.700	141.550	1.567	0.367			
Pb	1.90	8.70	1250.00	61	0.055	0.131	0.008	0.680			-1.679	0.493	*	D	86	20.761	10.425	3.000	61.090	1.261	0.255		*	
Sb	0.05	0.43	50.00	46	0.016	0.007	0.002	0.100	1		-1.833	0.246	*		76	1.923	2.349	0.200	12.665	-0.031	0.562		*	
Se	0.04	0.10	50.00	57	0.045	0.040	0.008	0.250	24	5	-1.480	0.376	*		84	1.786	3.888	0.037	26.820	-0.048	0.521		*	D
Sn	0.27	2.40	250.00	53	0.024	0.010	0.010	0.050			-1.667	0.193		D	80	18.099	131.966	0.200	2249.900	0.008	0.710	2	*	D
V	1.60	32.00	1250.00	58	0.395	0.618	0.040	6.800	4		-0.631	0.473	*		88	86.615	72.658	9.100	275.650	1.728	0.466			
Zn	3.80	15.00	1250.00	60	0.307	0.392	0.066	2.800			-0.642	0.333	*		87	42.791	35.752	6.200	208.600	1.479	0.402		*	
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	3	0.447		0.447	1.773				*	D
Cl	600.00	8800.00	5000.00	4	149	140	26	350							8	254	163	45	1974				*	D
CN-comp	0.07	0.38	125.00	3	0.100	0.000	0.100	0.100	3						NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	3	0.100	0.000	0.100	0.100	3	3					NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	4	1.492	0.891	0.500	2.666							4	35.946	2.608	32.035	37.250					
SO4	750.00	22000.00	25000.00	56	398	409	2	3150	8		2.418	0.497	*	D	44	1324	2081	112	17200	2.858	0.496		*	
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

RIVM
research for
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database

Building material: **EC-bodemas**

identification number: PACN8053.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
Benzeen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ethylbenz.	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Tolueen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Xylenen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Fenolen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-fenol	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Arom.(tot)	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Naf	*************	1000000.00	5.00	NA	NA	NA							NA	NA	2	0.050		0.050	0.050					D
Ph	*************	1000000.00	20.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
An	*************	1000000.00	10.00	NA	NA	NA							NA	NA	5	0.010		0.010	0.010					D
Fla	*************	1000000.00	35.00	NA	NA	NA							NA	NA	4	0.010	ERR	0.010	0.020					D
Chr	*************	1000000.00	10.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
BaA	*************	1000000.00	50.00	NA	NA	NA							NA	NA	5	0.010		0.010	0.010					D
BaP	*************	1000000.00	10.00	NA	NA	NA							NA	NA	5	0.010		0.010	0.010					D
BkF	*************	1000000.00	50.00	NA	NA	NA							NA	NA	5	0.010		0.010	0.010					D
IP	*************	1000000.00	50.00	NA	NA	NA							NA	NA	5	0.010		0.010	0.010					D
BPe	*************	1000000.00	50.00	NA	NA	NA							NA	NA	5	0.010		0	0					D
PAK10(tot)	*************	1000000.00	75.00	NA	NA	NA							NA	NA	2	0.140		0.140	0.140					D
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

RIVM
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Building material: **EC-bodemas**

identification number: PCBN8053.wk1

17-Dec-93

	adjusted values granular materials			leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-118	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-138	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **EC-bodemas (gecertificeerd)**

identification number: NV8eb01.wk1

17-Dec-93

adjusted values granular materials				leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	13	0.054	0.047	0.002	0.158			-1.511	0.575			9	1.456	1.037	0.600	7.450	0.158	0.362		*	D
Ba	5.50	58.00	7500.00	9	5.056	4.816	0.500	14.800	3						7	307.929	378.633	50.000	931.250					
Cd	0.03	0.07	10.00	12	0.001	0.001	0.000	0.012			-2.951	0.475	*	D	10	0.086	0.057	0.020	0.149	-1.198	0.389			D
Co	0.42	2.50	250.00	12	0.043	0.039	0.003	0.100			-1.653	0.613			10	16.085	14.942	2.400	41.720	0.993	0.481			
Cr	1.30	12.00	1250.00	12	0.013	0.013	0.001	0.070			-2.006	0.488	*	D	10	67.825	70.306	4.900	171.350	1.434	0.705			
Cu	0.72	3.50	375.00	12	0.056	0.028	0.010	0.170			-1.271	0.289	*	D	10	37.529	42.554	6.500	119.200	1.324	0.481			
Hg	0.02	0.08	5.00	9	0.003	0.002	0.002	0.005							7	0.207	0.011	0.200	0.224					
Mo	0.28	0.91	125.00	13	0.160	0.171	0.010	0.500	2		-1.043	0.507			8	1.213	0.912	0.420	2.980					D
Ni	1.10	3.70	250.00	13	0.132	0.105	0.010	0.350			-1.080	0.501		D	10	41.666	32.772	6.700	89.400	1.453	0.430			
Pb	1.90	8.70	1250.00	12	0.019	0.008	0.008	0.050			-1.734	0.232	*	D	10	17.962	12.220	4.900	43.210	1.160	0.309			
Sb	0.05	0.43	50.00	7	0.010	ERR	0.010	0.018					*		8	2.112	2.570	0.250	5.215					
Se	0.04	0.10	50.00	11	0.037	0.019	0.010	0.170	6	1	-1.432	0.325	*		9	1.664	1.648	0.400	9.685	0.137	0.490		*	D
Sn	0.27	2.40	250.00	10	0.015	0.005	0.010	0.020			-1.849	0.159		D	10	0.590	0.494	0.200	1.490	-0.341	0.313			D
V	1.60	32.00	1250.00	13	0.603	1.048	0.040	3.000	2		-0.639	0.560			10	82.830	80.702	9.100	249.575	1.672	0.526			
Zn	3.80	15.00	1250.00	12	0.390	0.271	0.150	2.800			-0.412	0.356	*		10	35.740	33.198	6.200	96.850	1.322	0.505			
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	1	26		26	26							NA	NA	NA						NA	NA
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	1	2.666		2.666	2.666							NA	NA	NA						NA	NA
SO4	750.00	22000.00	25000.00	12	112	46	49	190			2.010	0.196		D	5	340	225	120	700					D
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **EC-bodemas (niet gecertificeerd)**

identification number: NV8eb02.wk1

17-Dec-93

adjusted values granular materials				leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	48	0.120	0.101	0.012	0.520			-1.055	0.405	•		77	5.905	6.224	0.600	34.100	0.583	0.428		•	D
Ba	5.50	58.00	7500.00	45	2.507	1.841	0.200	10.800	5		0.302	0.351	•		71	566.220	389.493	48.000	1214.350	2.600	0.408			
Cd	0.03	0.07	10.00	48	0.004	0.010	0.000	0.050	3		-2.833	0.568	•	D	77	0.128	0.176	0.010	12.144	-1.105	0.493	1	•	D
Co	0.42	2.50	250.00	45	0.026	0.032	0.001	0.700	1		-1.790	0.502	•		74	20.775	15.885	2.700	60.345	1.146	0.420			
Cr	1.30	12.00	1250.00	48	0.025	0.032	0.004	0.240			-1.784	0.430	•	D	78	117.771	116.361	4.500	350.150	1.655	0.705			
Cu	0.72	3.50	375.00	48	0.050	0.110	0.010	0.740	1		-1.624	0.510	•	D	77	36.320	30.755	5.500	864.200	1.433	0.401	1	•	
Hg	0.02	0.08	5.00	45	0.003	0.001	0.002	0.005			-2.559	0.139			74	0.228	0.055	0.007	0.300	-0.667	0.199			
Mo	0.28	0.91	125.00	42	0.130	0.112	0.020	0.500	5		-1.024	0.396	•		65	3.348	3.733	0.500	20.860	0.335	0.425		•	D
Ni	1.10	3.70	250.00	48	0.087	0.140	0.005	1.200	1		-1.440	0.598	•	D	78	51.026	34.503	8.700	141.550	1.582	0.358			
Pb	1.90	8.70	1250.00	48	0.064	0.147	0.009	0.680			-1.665	0.543	•	D	76	21.130	10.201	3.000	61.090	1.274	0.246		•	
Sb	0.05	0.43	50.00	38	0.017	0.007	0.002	0.100	1		-1.806	0.259	•		68	1.900	2.342	0.200	12.665	-0.022	0.552		•	
Se	0.04	0.10	50.00	45	0.044	0.040	0.008	0.250	18	4	-1.493	0.390	•		74	1.694	4.003	0.037	26.820	-0.073	0.523		•	D
Sn	0.27	2.40	250.00	43	0.026	0.010	0.010	0.050			-1.624	0.177		D	70	20.600	141.025	0.200	2249.900	0.057	0.738	2	•	D
V	1.60	32.00	1250.00	45	0.335	0.424	0.050	6.800	2		-0.629	0.452	•		78	87.100	72.121	9.800	275.650	1.735	0.461			
Zn	3.80	15.00	1250.00	47	0.244	0.296	0.066	2.300			-0.704	0.301	•		77	43.707	36.173	6.800	208.600	1.500	0.387		•	
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	3	0.447		0.447	1.773				•	D
Cl	600.00	8800.00	5000.00	2	110	14	100	350					•		8	254	163	45	1974				•	D
CN-comp	0.07	0.38	125.00	3	0.100	0.000	0.100	0.100	3						NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	3	0.100	0.000	0.100	0.100	3	3					NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	3	1.100	0.520	0.500	1.400							4	35.946	2.608	32.035	37.250					
SO4	750.00	22000.00	25000.00	44	477	430	2	3150	8		2.527	0.497	•	D	39	1450	2180	112	17200	2.908	0.496		•	
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

RIVM
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Building material: **wervelbedvliegas**

identification number: NV8054.wk1

17-Dec-93

	adjusted values granular materials			leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	1	0.012		0.012	0.012						D	4	26.770	13.275	8.951	39.500					
Ba	5.50	58.00	7500.00	1	3.680		3.680	3.680							3	187.976	38.240	147.695	223.781					
Cd	0.03	0.07	10.00	NA	NA	NA							NA	NA	3	0.416	0.113	0.291	0.510					D
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	2	12.912	10.222	5.684	20.140					
Cr	1.30	12.00	1250.00	2	0.076	0.081	0.019	0.133							4	74.938	59.553	24.500	161.122					
Cu	0.72	3.50	375.00	1	0.430		0.430	0.430							3	37.315	24.973	8.951	56.000					
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	2	0.222	0.003	0.220	0.224					
Mo	0.28	0.91	125.00	1	2.820		2.820	2.820	1	1					2	9.623	0.949	8.951	10.294					D
Ni	1.10	3.70	250.00	NA	NA	NA							NA	NA	1	58.183		58.183	58.183					
Pb	1.90	8.70	1250.00	1	0.036		0.036	0.036						D	3	38.263	34.399	2.900	71.610					
Sb	0.05	0.43	50.00	1	0.026		0.026	0.026							4	2.592	0.579	2.000	3.133					
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	2	1.992	1.551	0.895	3.088					D
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
V	1.60	32.00	1250.00	NA	NA	NA							NA	NA	2	91.750	15.824	80.561	102.939					
Zn	3.80	15.00	1250.00	1	0.160		0.160	0.160							2	63.554	13.925	53.707	268.537					
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	2	1.678	1.424	0.671	2.685					D
Cl	600.00	8800.00	5000.00	NA	NA	NA							NA	NA	1	707		707	707					
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	2	378.189	471.545	44.756	711.622					
SO4	750.00	22000.00	25000.00	NA	NA	NA							NA	NA	1	895		895	895					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **wervelbedbodemas**

identification number: NV8055.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	NA	NA	NA							NA	NA	3	26.398	23.056	7.674	52.150					
Ba	5.50	58.00	7500.00	NA	NA	NA							NA	NA	3	191.217	96.083	111.750	298.000					
Cd	0.03	0.07	10.00	NA	NA	NA							NA	NA	2	0.745		0.745	0.745					D
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	1	19.296		19.296	19.296					
Cr	1.30	12.00	1250.00	NA	NA	NA							NA	NA	3	57.862	37.520	14.900	84.185					
Cu	0.72	3.50	375.00	NA	NA	NA							NA	NA	2	40.975	5.268	37.250	44.700					
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Mo	0.28	0.91	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ni	1.10	3.70	250.00	NA	NA	NA							NA	NA	1	74.500		74.500	74.500					
Pb	1.90	8.70	1250.00	NA	NA	NA							NA	NA	2	33.525	15.804	22.350	44.700					
Sb	0.05	0.43	50.00	NA	NA	NA							NA	NA	3	1.043	0.394	0.745	1.490					
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	2	1.118	0.527	0.745	1.490					D
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
V	1.60	32.00	1250.00	NA	NA	NA							NA	NA	2	52.150	52.679	14.900	89.400					
Zn	3.80	15.00	1250.00	NA	NA	NA							NA	NA	2	55.875	36.876	29.800	81.950					
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	1	4.098		4.098	4.098					D
Cl	600.00	8800.00	5000.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	2	260.750	158.038	149.000	372.500					
SO4	750.00	22000.00	25000.00	NA	NA	NA							NA	NA	2	7450		7450	7450					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

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Building material: vergassingsbodemas

identification number: NV8056.wk1

17-Dec-93

adjusted values granular materials				leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	4	0.012	0.011	0.001	0.027						D	5	4.154	3.881	1.401	115.475				*	D
Ba	5.50	58.00	7500.00	4	0.037	0.033	0.010	0.083						D	6	574.271	388.462	238.400	1162.200					
Cd	0.03	0.07	10.00	4	0.000	0.000		0.001						D	4	0.019	0.037		0.745				*	D
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	1	8.568		8.568	8.568					
Cr	1.30	12.00	1250.00	NA	NA	NA							NA	NA	5	113.687	23.008	87.910	248.830				*	
Cu	0.72	3.50	375.00	3	0.007	0.009		0.082					*	D	5	73.159	43.147	26.075	117.710					
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	4	0.007	0.006		0.015					D
Mo	0.28	0.91	125.00	3		ERR		0.028					*	D	5	10.877	5.284	5.215	17.135					D
Ni	1.10	3.70	250.00	NA	NA	NA							NA	NA	5	80.162	87.304	2.980	184.760					
Pb	1.90	8.70	1250.00	3	0.003	0.003		0.037					*	D	4	0.931	1.862		59.600				*	D
Sb	0.05	0.43	50.00	NA	NA	NA							NA	NA	5	1.036	0.581	0.238	10.281				*	
Se	0.04	0.10	50.00	3	0.000	0.000		0.042					*	D	1	0.745		0.745	0.745					D
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	3				1.639				*	D
V	1.60	32.00	1250.00	4	0.030	0.040		0.086						D	5	150.788	108.803	46.190	320.350					
Zn	3.80	15.00	1250.00	NA	NA	NA							NA	NA	6	21.853	29.672		67.050					
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	1	0.447		0.447	0.447					D
Cl	600.00	8800.00	5000.00	2	3	5		7						D	NA	NA	NA						NA	NA
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	3	0.345	0.015	0.330	7.800					*	D	4	50.287	26.075	37.250	745.000				*	
SO4	750.00	22000.00	25000.00	4	56	57	7	107						D	1	745		745	745					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

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APPENDIX A.

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Building material: **vergassingsvliegas**

identification number: NV8058.wk1

17-Dec-93

adjusted values granular materials				leaching characteristics				L/S=10 columntest in mg/kg							composition				aqua regia in mg/kg					
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	1	0.142		0.142	0.142							3	50.599	39.102	19.000	94.329					
Ba	5.50	58.00	7500.00	1	0.103		0.103	0.103						D	1	167.250		167.250	167.250					
Cd	0.03	0.07	10.00	1										D	2	1.338	ERR	1.338	4.817				•	
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	2	20.739	14.192	10.704	30.774					
Cr	1.30	12.00	1250.00	NA	NA	NA							NA	NA	3	84.294	29.791	51.513	109.716					
Cu	0.72	3.50	375.00	1	0.003		0.003	0.003						D	3	30.551	7.369	22.077	35.457					
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	3	0.060	0.012	0.047	0.067					D
Mo	0.28	0.91	125.00	1	0.245		0.245	0.245							2	13.380	ERR	13.380	20.739				•	D
Ni	1.10	3.70	250.00	NA	NA	NA							NA	NA	3	163.459	91.510	58.872	228.798					
Pb	1.90	8.70	1250.00	1										D	3	26.983	20.968	9.366	50.175					
Sb	0.05	0.43	50.00	NA	NA	NA							NA	NA	3	2.810	1.688	1.271	4.616					
Se	0.04	0.10	50.00	1	0.042		0.042	0.042							2	0.903	0.331	0.669	1.137					D
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	1									D
V	1.60	32.00	1250.00	1	0.230		0.230	0.230							2	66.900	0.000	66.900	120.420				•	
Zn	3.80	15.00	1250.00	NA	NA	NA							NA	NA	2	34.454	16.557	22.746	307.740				•	
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	1	195		195	195							NA	NA	NA						NA	NA
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	1	4.750		4.750	4.750							1	280.980		280.980	280.980					
SO4	750.00	22000.00	25000.00	1	143		143	143						D	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

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Building material: **AVI-slak**

identification number: NV8059.wk1

17-Dec-93

adjusted values granular materials				leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	71	0.014	0.017	0.005	0.235			-2.022	0.382	*	D	169	5.982	6.762	0.500	65.560	0.605	0.386		*	D
Ba	5.50	58.00	7500.00	16	0.913	0.581	0.270	2.047			-0.135	0.309			115	919.257	434.314	340.000	3792.050	2.934	0.177		*	
Cd	0.03	0.07	10.00	71	0.004	0.006	0.001	0.040	2		-2.649	0.431	*	D	169	4.821	4.559	0.100	52.150	0.539	0.390	17	*	
Co	0.42	2.50	250.00	3	0.022	0.007	0.015	0.029							105	11.198	6.409	4.000	68.242	1.016	0.192		*	
Cr	1.30	12.00	1250.00	69	0.090	0.083	0.008	0.680			-1.206	0.433	*		169	187.604	88.985	53.000	2741.600	2.237	0.216	1	*	
Cu	0.72	3.50	375.00	73	4.153	2.825	0.191	14.031	66	41	0.498	0.386	*		172	1591.018	968.391	12.000	7748.000	3.129	0.294	170	*	
Hg	0.02	0.08	5.00	6	0.001	0.000	0.001	0.001						D	20	0.252	0.294	0.022	3.978	-0.738	0.510		*	
Mo	0.28	0.91	125.00	71	1.856	1.677	0.070	9.722	69	45	0.109	0.425	*		160	35.412	21.381	1.490	476.055	1.411	0.431	1	*	
Ni	1.10	3.70	250.00	70	0.114	0.082	0.013	0.477			-1.050	0.355	*	D	164	123.256	94.413	22.000	1010.000	2.020	0.259	9	*	
Pb	1.90	8.70	1250.00	73	0.619	1.186	0.010	9.200	7	1	-0.740	0.743	*		164	1232.050	633.967	35.000	5500.000	3.034	0.267	63	*	
Sb	0.05	0.43	50.00	49	0.110	0.090	0.006	0.900	42	2	-1.063	0.388	*		154	25.594	87.507	1.000	1100.000	0.826	0.699	9	*	
Se	0.04	0.10	50.00	7	0.006	0.002	0.005	0.028					*	D	108	0.982	1.401	0.100	15.198	-0.157	0.328		*	D
Sn	0.27	2.40	250.00	10	0.081	0.035	0.042	2.559	1	1	-0.992	0.504	*	D	101	161.668	61.915	8.000	380.000	2.163	0.262	9	*	
V	1.60	32.00	1250.00	12	0.218	0.146	0.048	0.530			-0.765	0.332			112	59.622	25.000	0.100	130.000	1.720	0.316			
Zn	3.80	15.00	1250.00	71	0.408	0.555	0.060	4.653	1		-0.616	0.457	*		172	1992.513	833.992	550.000	7673.500	3.268	0.180	145	*	
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	9	17.923	21.661	2.436	426.140	1.128	0.738		*	D
Cl	600.00	8800.00	5000.00	8	1740	578	845	2412	8						109	1549	921	360	18104	3.130	0.272	2	*	
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	3	1.000		1.000	1.000					
F-tot	13.00	100.00	4500.00	2	1.900	0.566	1.500	2.300							11	372.328	318.963	50.000	987.000	2.425	0.394			
SO4	750.00	22000.00	25000.00	11	5695	2734	2011	10805	11		3.703	0.235			12	3402	2982	826	9418	3.375	0.386			
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

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Building material: **AVI-slak**

identification number: PACN8059.wk1

17-Dec-93

element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
	adjusted values granular materials			leaching characteristics L/S=10 columntest in mg/kg											composition aqua regia in mg/kg									
Benzeen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ethylbenz.	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Tolueen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Xylenen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Fenolen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-fenol	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Arom.(tot)	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Naf	*************	1000000.00	5.00	NA	NA	NA							NA	NA	17	0.059	0.046	0.010	0.150	-1.361	0.367			D
Ph	*************	1000000.00	20.00	NA	NA	NA							NA	NA	17	0.317	0.263	0.015	0.750	-0.732	0.545			D
An	*************	1000000.00	10.00	NA	NA	NA							NA	NA	17	0.045	0.054	0.005	0.150	-1.727	0.618			D
Fla	*************	1000000.00	35.00	NA	NA	NA							NA	NA	17	0.594	0.686	0.030	2.100	-0.538	0.578			D
Chr	*************	1000000.00	10.00	NA	NA	NA							NA	NA	17	0.251	0.268	0.010	0.800	-0.828	0.493			D
BaA	*************	1000000.00	50.00	NA	NA	NA							NA	NA	16	0.173	0.219	0.010	0.900	-0.967	0.551			D
BaP	*************	1000000.00	10.00	NA	NA	NA							NA	NA	17	0.151	0.226	0.005	0.700	-1.216	0.604			D
BkF	*************	1000000.00	50.00	NA	NA	NA							NA	NA	17	0.096	0.129	0.010	0.400	-1.309	0.493			D
IP	*************	1000000.00	50.00	NA	NA	NA							NA	NA	17	0.119	0.124	0.010	0.400	-1.160	0.495			D
BPe	*************	1000000.00	50.00	NA	NA	NA							NA	NA	17	0.126	0.130	0	0	-1.136	0.491			D
PAK10(tot)	*************	1000000.00	75.00	NA	NA	NA							NA	NA	18	1.861	2.019	0.008	6.400	-0.057	0.694			
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **AVI-slak**

identification number: PCBN8059.wk1

17-Dec-93

element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
	adjusted values granular materials			leaching characteristics L/S=10 columntest in mg/kg											composition aqua regia in mg/kg									
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-118	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-138	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	11	1.300	0.767	0.500	2.800	0.041	0.270			D
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	11	0.111	0.017	0.094	0.148	-0.959	0.064			D
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

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Building material: **AVI-vliegas**

identification number: NV8060.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	15	0.033	0.020	0.006	0.060			-1.586	0.332			77	21.813	16.386	0.669	310.416	1.214	0.429		•	
Ba	5.50	58.00	7500.00	7	3.306	1.161	2.081	5.135							65	2320.594	932.771	430.000	4400.000	3.325	0.201			
Cd	0.03	0.07	10.00	16	2.392	2.453	0.020	19.500	16	16	0.152	0.725	•		79	173.647	93.642	0.669	749.280	2.153	0.387	79	•	
Co	0.42	2.50	250.00	1	0.093		0.093	0.093							61	18.144	7.464	8.000	86.970	1.239	0.183		•	
Cr	1.30	12.00	1250.00	15	0.164	0.151	0.049	0.853			-0.851	0.368	•		77	202.592	91.265	50.844	1719.330	2.284	0.202	1	•	
Cu	0.72	3.50	375.00	15	0.241	0.286	0.049	1.665	2		-0.727	0.443	•		78	612.469	248.139	84.294	2100.660	2.762	0.185	74	•	
Hg	0.02	0.08	5.00	3	0.001	0.001		0.001						D	15	2.544	2.006	0.094	11.000	0.299	0.478	4	•	
Mo	0.28	0.91	125.00	15	5.459	1.848	3.015	8.548	15	15	0.713	0.153			66	49.246	26.106	4.014	1030.260	1.640	0.333	3	•	
Ni	1.10	3.70	250.00	16	1.057	1.319	0.029	3.108	6		-0.577	0.828			71	105.328	66.850	40.140	375.978	1.972	0.222	7	•	
Pb	1.90	8.70	1250.00	15	56.353	78.789	0.200	415.400	12	10	1.219	1.026	•		72	4580.457	2050.720	63.555	9000.000	3.596	0.302	69		
Sb	0.05	0.43	50.00	7	0.045	0.043	0.002	0.103	3						67	93.646	136.152	2.208	3465.420	1.742	0.495	32	•	
Se	0.04	0.10	50.00	7	0.403	0.541	0.018	1.372	4	4					64	11.121	6.384	1.137	34.387	0.948	0.359		•	
Sn	0.27	2.40	250.00	6	0.239	0.109	0.130	0.377	2						57	529.296	187.320	200.000	900.000	2.695	0.163	54		
V	1.60	32.00	1250.00	6	0.052	0.003	0.049	0.070					•		67	84.363	38.235	3.345	175.000	1.849	0.321			
Zn	3.80	15.00	1250.00	17	18.894	13.122	0.200	42.081	13	12	0.983	0.729			80	**********	5688.725	247.530	**********	4.013	0.326	78		
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	6	191.241	267.375	1.519	2562.270			2	•	
Cl	600.00	8800.00	5000.00	14	38873	15151	572	56190	13	13	4.474	0.508			65	30975	19771	510	112745	4.317	0.561	58	•	
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	5	1184.793	326.387	620.000	3600.000				•	
SO4	750.00	22000.00	25000.00	14	16656	5582	4628	27396	14	1	4.190	0.190			8	19679	19303	4200	46339			3		
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **AVI-vliegas**

identification number: PACN8060.wk1

17-Dec-93

adjusted values granular materials

element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
				leaching characteristics			L/S=10 columntest in mg/kg								composition			aqua regia in mg/kg						
Benzeen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ethylbenz.	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Tolueen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Xylenen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Fenolen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-fenol	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Arom.(tot)	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Naf	*************	1000000.00	5.00	NA	NA	NA							NA	NA	12	0.109	0.132	0.010	0.400	-1.257	0.551			D
Ph	*************	1000000.00	20.00	NA	NA	NA							NA	NA	11	0.078	0.069	0.010	0.350	-1.227	0.501		*	D
An	*************	1000000.00	10.00	NA	NA	NA							NA	NA	12	0.006	0.002	0.005	0.010	-2.226	0.136			D
Fla	*************	1000000.00	35.00	NA	NA	NA							NA	NA	12	0.035	0.042	0.001	0.300	-1.651	0.650		*	D
Chr	*************	1000000.00	10.00	NA	NA	NA							NA	NA	11	0.018	0.025	0.005	0.280	-1.867	0.580		*	D
BaA	*************	1000000.00	50.00	NA	NA	NA							NA	NA	11	0.017	0.016	0.005	0.090	-1.859	0.440		*	D
BaP	*************	1000000.00	10.00	NA	NA	NA							NA	NA	12	0.007	0.005	0.001	0.035	-2.174	0.368		*	D
BkF	*************	1000000.00	50.00	NA	NA	NA							NA	NA	13	0.014	0.014	0.001	0.040	-2.063	0.443			D
IP	*************	1000000.00	50.00	NA	NA	NA							NA	NA	12	0.011	0.016	0.001	0.095	-2.090	0.510		*	D
BPe	*************	1000000.00	50.00	NA	NA	NA							NA	NA	12	0.011	0.015	0	0	-2.037	0.563		*	D
PAK10(tot)	*************	1000000.00	75.00	NA	NA	NA							NA	NA	11	0.297	0.223	0.105	1.640	-0.556	0.373		*	D
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

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Building material: **AVI-vliegas**

identification number: PCBN8060.wk1

17-Dec-93

element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
	adjusted values granular materials			leaching characteristics L/S=10 columntest in mg/kg											composition aqua regia in mg/kg									
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-118	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-138	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	1	0.100		0.100	0.100					D
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	10	0.740	0.280	0.500	1.300	-0.156	0.152			D
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	10	0.125	0.018	0.096	0.143	-0.909	0.066			D
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **hoogovenstukslak**

identification number: NV8061.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	7	0.019	0.034	0.002	0.650					*	D	8	0.433	0.352	0.149	2.310				*	D
Ba	5.50	58.00	7500.00	2	75.500	81.317	18.000	133.000	2	1					6	605.230	165.904	350.000	1400.000				*	
Cd	0.03	0.07	10.00	7	0.002	0.003	0.001	0.022					*	D	9	0.236	0.368	0.011	1.000					D
Co	0.42	2.50	250.00	2	0.011	0.011	0.003	0.019						D	5	2.948	1.531	0.291	4.000					D
Cr	1.30	12.00	1250.00	8	0.052	0.041	0.001	0.120						D	8	63.559	51.941	16.000	140.000					
Cu	0.72	3.50	375.00	8	0.054	0.041	0.011	0.130						D	9	4.889	4.104	1.000	12.144					D
Hg	0.02	0.08	5.00	2	0.000	0.000	0.001	0.026	1				*	D	4	0.053	0.055	0.003	0.100					D
Mo	0.28	0.91	125.00	6	0.032	0.031	0.002	0.200					*	D	7	3.983	3.789	0.745	149.000			1	*	D
Ni	1.10	3.70	250.00	7	0.031	0.036	0.005	0.175					*	D	7	22.930	49.989	1.000	218.285				*	
Pb	1.90	8.70	1250.00	7	0.023	0.017	0.010	0.095					*	D	7	3.596	3.833	0.745	33.003				*	D
Sb	0.05	0.43	50.00	2	0.006	0.005	0.002	0.010							6	0.580	0.736	0.037	5.215				*	D
Se	0.04	0.10	50.00	2	0.051	0.055	0.012	0.090	1						6	1.592	0.488	0.800	32.780				*	D
Sn	0.27	2.40	250.00	1	0.010		0.010	0.010						D	5	25.022	31.973	0.373	74.500					D
V	1.60	32.00	1250.00	5	0.249	0.350	0.004	3.445	1				*		9	200.783	187.430	3.000	541.000					
Zn	3.80	15.00	1250.00	8	0.116	0.067	0.030	0.230						D	8	7.471	6.498	1.000	33.525				*	D
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	1	3.725		3.725	3.725					D
Cl	600.00	8800.00	5000.00	5	361	230	50	624	1						1	373		373	373					D
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	1	3.770		3.770	3.770							1	465.625		465.625	465.625					
SO4	750.00	22000.00	25000.00	5	704	734	160	7400	2				*	D	1	13025		13025	13025					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

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Building material: **hoogovenstukslak**

identification number: V4061.wk1

06-Jun-94

element	adjusted values products U1	U2	S1	leaching characteristics 64 days diffusiontest in mg/m2 N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	41.0	140.0	750.0	3										D	8	0.433	0.352	0.149	2.310				*	D
Ba	600.0	2000.0	15000.0	3	199.667	136.214	44.000	297.000							6	605.230	165.904	350.000	1400.000				*	
Cd	1.1	3.8	20.0	3										D	9	0.236	0.368	0.011	1.000					D
Co	29.0	95.0	500.0	NA	NA	NA							NA	NA	5	2.948	1.531	0.291	4.000					D
Cr	140.0	480.0	2500.0	3	11.333	4.041	7.000	15.000							8	63.559	51.941	16.000	140.000					
Cu	51.0	170.0	750.0	3	2.667	1.528	1.000	4.000							9	4.889	4.104	1.000	12.144					D
Hg	0.4	1.4	10.0	NA	NA	NA							NA	NA	4	0.053	0.055	0.003	0.100					D
Mo	14.0	48.0	250.0	3										D	7	3.983	3.789	0.745	149.000				*	D
Ni	50.0	170.0	500.0	2	-0.000	ERR		11.000					*	D	7	22.930	49.989	1.000	218.285				*	
Pb	120.0	400.0	2500.0	3										D	7	3.596	3.833	0.745	33.003				*	D
Sb	3.7	12.0	100.0	NA	NA	NA							NA	NA	6	0.580	0.736	0.037	5.215				*	D
Se	1.4	4.8	100.0	NA	NA	NA							NA	NA	6	1.592	0.488	0.800	32.780				*	D
Sn	29.0	95.0	500.0	NA	NA	NA							NA	NA	5	25.022	31.973	0.373	74.500					D
V	230.0	760.0	2500.0	3	10.333	5.686	4.000	15.000							9	200.783	187.430	3.000	541.000					
Zn	200.0	670.0	2500.0	3	27.000	16.093	12.000	44.000							8	7.471	6.498	1.000	33.525				*	D
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	1	3.725		3.725	3.725					D
Cl	18000.0	54000.0	1000000.0	NA	NA	NA							NA	NA	1	373		373	373					D
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	NA	NA	NA							NA	NA	1	465.625		465.625	465.625					
SO4	27000.0	80000.0	40000.0	3	24213	12851	12012	37628	1						1	13025		13025	13025					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

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Building material: **hoogovenstukslak**

identification number: PACN8061.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
Benzeen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ethylbenz.	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Tolueen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Xylenen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Fenolen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	1	0.500		0.500	0.500					D
Cl-fenol	*************	1000000.00	1.25	NA	NA	NA							NA	NA	1	1.000		1.000	1.000					D
Arom.(tot)	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Naf	*************	1000000.00	5.00	NA	NA	NA							NA	NA	4	0.065	0.044	0.010	0.100					D
Ph	*************	1000000.00	20.00	NA	NA	NA							NA	NA	4	0.158	0.116	0.040	0.300					D
An	*************	1000000.00	10.00	NA	NA	NA							NA	NA	4	0.045	0.044	0.010	0.100					D
Fla	*************	1000000.00	35.00	NA	NA	NA							NA	NA	3	0.073	0.025	0.050	0.300				•	D
Chr	*************	1000000.00	10.00	NA	NA	NA							NA	NA	4	0.063	0.043	0.020	0.100					D
BaA	*************	1000000.00	50.00	NA	NA	NA							NA	NA	4	0.058	0.043	0.020	0.100					D
BaP	*************	1000000.00	10.00	NA	NA	NA							NA	NA	4	0.078	0.085	0.020	0.200					D
BkF	*************	1000000.00	50.00	NA	NA	NA							NA	NA	3	0.023	0.015	0.010	0.200				•	D
IP	*************	1000000.00	50.00	NA	NA	NA							NA	NA	3	0.037	0.015	0.020	0.200				•	D
BPe	*************	1000000.00	50.00	NA	NA	NA							NA	NA	4	0.085	0.081	0	0					D
PAK10(tot)	*************	1000000.00	75.00	NA	NA	NA							NA	NA	4	0.825	0.618	0.270	1.600					D
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

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Building material: **hoogovenstukslak**

identification number: PCBN8061.wk1

17-Dec-93

	adjusted values granular materials			leaching characteristics L/S=10 columntest in mg/kg											composition aqua regia in mg/kg									
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	1	0.050		0.050	0.050					D
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	1	0.050		0.050	0.050					D
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	1	0.050		0.050	0.050					D
PCB-118	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	1	0.050		0.050	0.050					D
PCB-138	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	1	0.050		0.050	0.050					D
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	1	0.050		0.050	0.050					D
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	1	0.050		0.050	0.050					D
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	1	0.300		0.300	0.300					D
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	2	0.250	0.212	0.100	0.400					D
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	1	2.250		2.250	2.250			1		D
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	1	1.700		1.700	1.700			1		
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	1	0.800		0.800	0.800					D
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **hoogovenschuimslak**

identification number: NV8062.wk1

17-Dec-93

adjusted values granular materials				leaching characteristics			L/S=10 columntest in mg/kg								composition			aqua regia in mg/kg						
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	3	0.002	0.000	0.002	0.002					*	D	4	0.175	0.050	0.100	1.700				*	D
Ba	5.50	58.00	7500.00	2	2.650	0.071	2.600	2.700							3	435.000	25.000	410.000	460.000					
Cd	0.03	0.07	10.00	4	0.006	0.005	0.001	0.010							5	0.640	0.493	0.100	1.000					D
Co	0.42	2.50	250.00	1	0.016		0.016	0.016							2	7.000	4.243	4.000	10.000					
Cr	1.30	12.00	1250.00	3	0.030	0.000	0.030	0.260					*	D	5	41.200	25.626	13.000	77.000					
Cu	0.72	3.50	375.00	4	0.029	0.012	0.020	0.046						D	5	1.800	0.837	1.000	3.000					D
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	3	0.100	0.000	0.100	0.100					
Mo	0.28	0.91	125.00	2	0.021	0.001	0.020	0.022						D	4	4.000	2.309	2.000	6.000					D
Ni	1.10	3.70	250.00	4	0.053	0.036	0.012	0.100						D	5	13.800	9.176	1.000	26.000					
Pb	1.90	8.70	1250.00	4	0.055	0.052	0.010	0.100						D	4	6.750	6.946	1.000	157.500				*	D
Sb	0.05	0.43	50.00	1	0.002		0.002	0.002						D	2	0.200		0.200	0.200					D
Se	0.04	0.10	50.00	1	0.011		0.011	0.011						D	2	0.800		0.800	0.800					D
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	2	8.000		8.000	8.000					D
V	1.60	32.00	1250.00	2	0.550	0.467	0.220	0.880							2	15.500	0.707	15.000	26.000				*	D
Zn	3.80	15.00	1250.00	4	0.056	0.060	0.010	0.140						D	4	3.250	0.957	2.000	8.500				*	D
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	NA	NA	NA							NA	NA	1	500		500	500					
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	750.00	22000.00	25000.00	1	590		590	590						D	1	2100		2100	2100					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **hoogovenschuimslak**

identification number: PACN8062.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
Benzeen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ethylbenz.	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Tolueen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Xylenen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Fenolen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-fenol	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Arom.(tot)	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Naf	*************	1000000.00	5.00	NA	NA	NA							NA	NA	2	0.050		0.050	0.050					D
Ph	*************	1000000.00	20.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
An	*************	1000000.00	10.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
Fla	*************	1000000.00	35.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
Chr	*************	1000000.00	10.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
BaA	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
BaP	*************	1000000.00	10.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
BkF	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
IP	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
BPe	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.010		0	0					D
PAK10(tot)	*************	1000000.00	75.00	NA	NA	NA							NA	NA	2	0.140		0.140	0.140					D
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **hoogovenschuimslak**

identification number: PCBN8062.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-118	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-138	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **gegranuleerde hoogovenslak**

identification number: NV8063.wk1

17-Dec-93

adjusted values granular materials				leaching characteristics L/S=10 columntest in mg/kg											composition aqua regia in mg/kg									
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	1	0.002		0.002	0.002						D	2	0.200		0.200	0.200					D
Ba	5.50	58.00	7500.00	1	1.100		1.100	1.100							2	530.000	169.706	410.000	650.000					
Cd	0.03	0.07	10.00	1	0.002		0.002	0.002						D	2	0.100		0.100	0.100					D
Co	0.42	2.50	250.00	1	0.010		0.010	0.010						D	2	4.500	2.121	3.000	6.000					
Cr	1.30	12.00	1250.00	1	0.150		0.150	0.150							2	26.500	2.121	25.000	28.000					
Cu	0.72	3.50	375.00	1	0.030		0.030	0.030						D	2	1.000		1.000	1.000					D
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	2	0.100		0.100	0.100					
Mo	0.28	0.91	125.00	1	0.021		0.021	0.021						D	2	2.000		2.000	2.000					D
Ni	1.10	3.70	250.00	1	0.012		0.012	0.012						D	2	1.000		1.000	1.000					D
Pb	1.90	8.70	1250.00	1	0.590		0.590	0.590							2	1.000		1.000	1.000					D
Sb	0.05	0.43	50.00	1	0.002		0.002	0.002						D	2	0.200		0.200	0.200					D
Se	0.04	0.10	50.00	1	0.008		0.008	0.008						D	2	2.250	0.636	1.800	2.700					
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	2	8.000		8.000	8.000					D
V	1.60	32.00	1250.00	1	0.085		0.085	0.085							2	34.500	21.920	19.000	50.000					D
Zn	3.80	15.00	1250.00	1	0.060		0.060	0.060						D	2	1.000		1.000	1.000					D
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	750.00	22000.00	25000.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

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Building material: **gegranuleerde hoogovenslak**

identification number: PACN8063.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
Benzeen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ethylbenz.	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Tolueen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Xylenen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Fenolen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-fenol	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Arom.(tot)	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Naf	*************	1000000.00	5.00	NA	NA	NA							NA	NA	2	0.050		0.050	0.050					D
Ph	*************	1000000.00	20.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
An	*************	1000000.00	10.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
Fla	*************	1000000.00	35.00	NA	NA	NA							NA	NA	2	0.015	0.007	0.010	0.020					D
Chr	*************	1000000.00	10.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
BaA	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
BaP	*************	1000000.00	10.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
BkF	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
IP	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
BPe	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.010		0	0					D
PAK10(tot)	*************	1000000.00	75.00	NA	NA	NA							NA	NA	2	0.145	0.007	0.140	0.150					D
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **gegranuleerde hoogovenslak**

identification number: PCBN8063.wk1

17-Dec-93

	adjusted values granular materials			leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-118	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-138	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **hoogovenslakkenzand**

identification number: NV8064.wk1

17-Dec-93

adjusted values granular materials				leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	2	0.011	0.013	0.002	0.020						D	4	3.857	3.963	0.200	8.000					D
Ba	5.50	58.00	7500.00	1	0.090		0.090	0.090						D	4	390.988	240.821	178.000	721.905					
Cd	0.03	0.07	10.00	2	0.006	0.006	0.001	0.010							3	0.052	0.039	0.007	1.000				*	D
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	1.30	12.00	1250.00	2	0.043	0.046	0.010	0.075						D	4	10.215	4.006	5.960	14.900					
Cu	0.72	3.50	375.00	2	0.014	0.013	0.005	0.023						D	3	1.327	0.797	0.745	8.000				*	D
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	2	0.026	0.016	0.015	0.037					D
Mo	0.28	0.91	125.00	2	0.020	0.000	0.020	0.020						D	2	0.559	0.263	0.373	6.000				*	D
Ni	1.10	3.70	250.00	2	0.015	0.007	0.010	0.020						D	4	7.230	2.152	4.098	9.000					
Pb	1.90	8.70	1250.00	2	0.041	0.029	0.020	0.061						D	4	10.656	7.349	0.745	17.880					
Sb	0.05	0.43	50.00	NA	NA	NA							NA	NA	2	0.346	0.068	0.298	2.000				*	D
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	1	2.980		2.980	2.980					
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	2	1.490	1.054	0.745	2.235					D
V	1.60	32.00	1250.00	2	0.191	0.087	0.130	0.253							4	18.855	17.936	3.725	43.694					D
Zn	3.80	15.00	1250.00	2	0.122	0.030	0.100	0.143						D	4	21.572	15.243	0.745	35.000					
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	1	211		211	211							2	373		373	373					D
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	2	297.255	238.111	128.885	465.625					
SO4	750.00	22000.00	25000.00	2	151	97	83	220						D	2	11339	15751	201	22476					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: jarosiet-eindslak

identification number: NV8065.wk1

17-Dec-93

	adjusted values granular materials			leaching characteristics				L/S=10 columntest in mg/kg							composition				aqua regia in mg/kg					
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	1	0.070		0.070	0.070							14	44.068	41.321	0.820	112.495	1.223	0.792			
Ba	5.50	58.00	7500.00	1	69.820		69.820	69.820	1	1					14	6045.625	4568.305	1981.700	***********	3.695	0.269	2		
Cd	0.03	0.07	10.00	1	0.020		0.020	0.020							11	0.286	0.262	0.075	1.200	-0.675	0.489		*	D
Co	0.42	2.50	250.00	1	0.020		0.020	0.020							12	67.968	15.426	46.190	89.400	1.822	0.101			
Cr	1.30	12.00	1250.00	1	0.020		0.020	0.020						D	14	***********	***********	722.650	***********	3.919	0.572	13		
Cu	0.72	3.50	375.00	1	0.030		0.030	0.030						D	13	2993.531	1196.716	2510.650	7748.000	3.487	0.163	14	*	
Hg	0.02	0.08	5.00	1	0.020		0.020	0.020	1						5	0.569	0.485	0.050	1.000					
Mo	0.28	0.91	125.00	1	20.550		20.550	20.550	1	1					9	70.504	85.511	28.310	454.450	1.808	0.407	2	*	
Ni	1.10	3.70	250.00	1	0.040		0.040	0.040						D	12	315.146	93.466	111.750	430.000	2.475	0.161	9		
Pb	1.90	8.70	1250.00	1	0.020		0.020	0.020						D	14	126.780	57.591	37.250	220.000	2.046	0.253			
Sb	0.05	0.43	50.00	1	0.470		0.470	0.470	1	1					21	114.323	41.661	44.700	290.550	2.048	0.191	21	*	
Se	0.04	0.10	50.00	1	0.020		0.020	0.020							5	1.498	0.500	1.000	2.000					D
Sn	0.27	2.40	250.00	1	0.010		0.010	0.010						D	3	37.423	12.307	27.000	51.000					D
V	1.60	32.00	1250.00	1	0.030		0.030	0.030						D	4	85.408	33.840	47.680	130.000					
Zn	3.80	15.00	1250.00	1	0.420		0.420	0.420							12	2537.104	910.058	570.000	3866.550	3.364	0.224	11		
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	750.00	22000.00	25000.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **LD-staalslak**

identification number: NV8066.wk1

17-Dec-93

adjusted values granular materials				leaching characteristics L/S=10 columntest in mg/kg											composition aqua regia in mg/kg									
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	8	0.005	0.007	0.002	0.055					•	D	21	1.110	0.697	0.200	2.700	-0.049	0.311			D
Ba	5.50	58.00	7500.00	13	1.782	0.797	0.900	3.600			0.215	0.179			14	115.138	69.975	33.525	353.000	2.034	0.271		•	
Cd	0.03	0.07	10.00	8	0.001	0.001	0.000	0.015					•	D	22	0.686	0.427	0.037	1.000	-0.360	0.521			D
Co	0.42	2.50	250.00	6	0.018	0.007	0.010	0.027							2	16.000	5.657	12.000	20.000					
Cr	1.30	12.00	1250.00	14	0.087	0.095	0.003	0.280			-1.431	0.709			23	953.892	439.256	370.000	3700.000	2.965	0.227	5	•	
Cu	0.72	3.50	375.00	9	0.042	0.049	0.002	0.280			-1.572	0.677	•	D	23	12.803	7.846	1.000	100.000	1.045	0.413		•	
Hg	0.02	0.08	5.00	1	0.014		0.014	0.014							5	0.071	0.038	0.007	0.100					D
Mo	0.28	0.91	125.00	9	0.071	0.055	0.028	0.180							5	5.118	3.751	1.118	66.000				•	D
Ni	1.10	3.70	250.00	9	0.075	0.137	0.001	0.350						D	21	181.440	107.282	0.500	415.000	1.975	0.833	4		
Pb	1.90	8.70	1250.00	9	0.040	0.066	0.010	1.380			-1.480	0.701	•	D	24	12.700	9.204	0.500	30.000	0.895	0.547			
Sb	0.05	0.43	50.00	5	0.001	0.001	0.001	0.002						D	3	0.210	0.018	0.200	2.000				•	D
Se	0.04	0.10	50.00	2	0.009	0.001	0.008	0.010						D	4	0.965	0.735	0.261	2.000					D
Sn	0.27	2.40	250.00	4	0.030	0.000	0.030	0.110					•	D	3	9.163	8.316	1.490	18.000					D
V	1.60	32.00	1250.00	14	0.301	0.221	0.029	0.629			-0.707	0.482			14	3292.163	1390.566	1452.750	5662.000	3.478	0.197	14		
Zn	3.80	15.00	1250.00	12	0.192	0.132	0.068	0.428			-0.814	0.306			21	29.064	15.312	9.685	105.000	1.433	0.266		•	
Br	2.90	4.10	500.00	7	6.699	4.886	0.103	13.300	6	5					NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	12	1164	1282	44	3884	6		2.674	0.705			1	373		373	373					D
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	12	7.473	6.840	0.870	17.000	4		0.667	0.466			8	247.433	191.388	18.625	3143.900				•	
SO4	750.00	22000.00	25000.00	10	73	96	4	498			1.493	0.829	•	D	8	4065	1547	1700	6035					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **LD-staalslak**

identification number: V4066.wk1

06-Jun-94

element	adjusted values products U1	U2	S1	leaching characteristics 64 days diffusiontest in mg/m2 N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	41.0	140.0	750.0	1	0.274		0.274	0.274						D	21	1.110	0.697	0.200	2.700	-0.049	0.311			D
Ba	600.0	2000.0	15000.0	6	7.011	4.965	3.000	257.400					*		14	115.138	69.975	33.525	353.000	2.034	0.271		*	
Cd	1.1	3.8	20.0	1	0.130		0.130	0.130							22	0.686	0.427	0.037	1.000	-0.360	0.521			D
Co	29.0	95.0	500.0	NA	NA	NA							NA	NA	2	16.000	5.657	12.000	20.000					
Cr	140.0	480.0	2500.0	2	3.194	2.396	1.500	4.889							23	953.892	439.256	370.000	3700.000	2.965	0.227	1	*	
Cu	51.0	170.0	750.0	2	1.752	0.351	1.504	2.000							23	12.803	7.846	1.000	100.000	1.045	0.413		*	
Hg	0.4	1.4	10.0	1	0.027		0.027	0.027						D	5	0.071	0.038	0.007	0.100					D
Mo	14.0	48.0	250.0	1	10.393		10.393	10.393							5	5.118	3.751	1.118	66.000				*	D
Ni	50.0	170.0	500.0	2	0.976	0.317	0.752	1.200						D	21	181.440	107.282	0.500	415.000	1.975	0.833			
Pb	120.0	400.0	2500.0	1	0.547		0.547	0.547						D	24	12.700	9.204	0.500	30.000	0.895	0.547			
Sb	3.7	12.0	100.0	NA	NA	NA							NA	NA	3	0.210	0.018	0.200	2.000				*	D
Se	1.4	4.8	100.0	NA	NA	NA							NA	NA	4	0.965	0.735	0.261	2.000					D
Sn	29.0	95.0	500.0	NA	NA	NA							NA	NA	3	9.163	8.316	1.490	18.000					D
V	230.0	760.0	2500.0	6	101.185	70.686	24.000	193.000							14	3292.163	1390.566	1452.750	5662.000	3.478	0.197	8		
Zn	200.0	670.0	2500.0	1	3.966		3.966	3.966						D	21	29.064	15.312	9.685	105.000	1.433	0.266		*	
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	NA	NA	NA							NA	NA	1	373		373	373					D
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	5	16.400	9.263	7.000	726.154					*		8	247.433	191.388	18.625	3143.900				*	
SO4	27000.0	80000.0	40000.0	5	213	136	100	143156	1	1			*	D	8	4065	1547	1700	6035					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: LD-staalslak

identification number: PACN8066.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
Benzeen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ethylbenz.	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Tolueen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Xylenen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Fenolen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-fenol	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Arom.(tot)	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Naf	*************	1000000.00	5.00	NA	NA	NA							NA	NA	2	0.050		0.050	0.050					D
Ph	*************	1000000.00	20.00	NA	NA	NA							NA	NA	2	0.040	0.014	0.030	0.050					D
An	*************	1000000.00	10.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
Fla	*************	1000000.00	35.00	NA	NA	NA							NA	NA	2	0.060	0.014	0.050	0.070					D
Chr	*************	1000000.00	10.00	NA	NA	NA							NA	NA	2	0.025	0.007	0.020	0.030					D
BaA	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.015	0.007	0.010	0.020					D
BaP	*************	1000000.00	10.00	NA	NA	NA							NA	NA	2	0.015	0.007	0.010	0.020					D
BkF	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.015	0.007	0.010	0.020					D
IP	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.015	0.007	0.010	0.020					D
BPe	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.025	0.007	0	0					D
PAK10(tot)	*************	1000000.00	75.00	NA	NA	NA							NA	NA	2	0.270	0.071	0.220	0.320					D
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

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Building material: **LD-staalslak**

identification number: PCBN8066.wk1

17-Dec-93

adjusted values granular materials				leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-118	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-138	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **fosforslak**

identification number: NV8067.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	7	0.013	0.009	0.002	0.020						D	11	0.449	0.318	0.001	2.608	-0.537	0.859		•	D
Ba	5.50	58.00	7500.00	2	0.255	0.134	0.160	0.350							7	127.033	31.845	62.580	1162.200				•	
Cd	0.03	0.07	10.00	4	0.004	0.004	0.001	0.010						D	12	0.472	0.454	0.000	1.300	-0.774	1.092			D
Co	0.42	2.50	250.00	2	0.010	0.009	0.003	0.016						D	4	5.612	4.272	3.000	68.000				•	
Cr	1.30	12.00	1250.00	4	0.057	0.065	0.001	0.140						D	10	48.137	23.326	26.075	96.000	1.642	0.190			
Cu	0.72	3.50	375.00	4	0.067	0.078	0.005	0.180						D	10	9.189	8.155	2.980	84.000	0.931	0.466		•	
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	4	0.070	0.044	0.007	0.100					D
Mo	0.28	0.91	125.00	7	0.039	0.023	0.010	0.070						D	8	9.453	15.644	0.007	149.000			1	•	D
Ni	1.10	3.70	250.00	4	0.014	0.005	0.010	0.021						D	10	15.974	17.276	1.490	51.000	0.966	0.499			
Pb	1.90	8.70	1250.00	3	0.019	0.010	0.010	0.095					•	D	10	6.140	5.785	0.027	32.035	0.545	0.838		•	D
Sb	0.05	0.43	50.00	2	0.006	0.006	0.002	0.010							7	0.678	0.753	0.052	5.215				•	D
Se	0.04	0.10	50.00	2	0.016	0.006	0.012	0.020							7	0.940	0.636	0.001	17.880				•	D
Sn	0.27	2.40	250.00	1	0.010		0.010	0.010						D	4	4.279	4.299	0.373	74.500				•	D
V	1.60	32.00	1250.00	5	0.213	0.135	0.071	0.430							9	21.620	22.084	0.037	140.000	1.071	0.980		•	D
Zn	3.80	15.00	1250.00	7	0.123	0.044	0.061	0.200						D	10	18.750	11.740	3.000	65.560	1.235	0.373		•	D
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	1	4.470		4.470	4.470					D
Cl	600.00	8800.00	5000.00	1	237		237	237							1	432		432	432					D
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	1	19.030		19.030	19.030	1						3	**********	5183.507	**********	**********			3		
SO4	750.00	22000.00	25000.00	3	831	486	330	1300	2					D	2	8574	1800	7301	9847					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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fosforslak

Building material: fosforslak
identification number: V4067.wk1

06-Jun-94

element	adjusted values products U1	U2	S1	leaching characteristics 64 days diffusiontest in mg/m2 N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	41.0	140.0	750.0	1	0.000		0.000	0.000						D	11	0.449	0.318	0.001	2.608	-0.537	0.859		*	D
Ba	600.0	2000.0	15000.0	NA	NA	NA							NA	NA	7	127.033	31.845	62.580	1162.200				*	
Cd	1.1	3.8	20.0	1	0.001		0.001	0.001						D	12	0.472	0.454	0.000	1.300	-0.774	1.092			D
Co	29.0	95.0	500.0	NA	NA	NA							NA	NA	4	5.612	4.272	3.000	68.000				*	
Cr	140.0	480.0	2500.0	NA	NA	NA							NA	NA	10	48.137	23.326	26.075	96.000	1.642	0.190			
Cu	51.0	170.0	750.0	1	0.001		0.001	0.001						D	10	9.189	8.155	2.980	84.000	0.931	0.466		*	
Hg	0.4	1.4	10.0	NA	NA	NA							NA	NA	4	0.070	0.044	0.007	0.100					D
Mo	14.0	48.0	250.0	NA	NA	NA							NA	NA	8	9.453	15.644	0.007	149.000				*	D
Ni	50.0	170.0	500.0	NA	NA	NA							NA	NA	10	15.974	17.276	1.490	51.000	0.966	0.499			
Pb	120.0	400.0	2500.0	1	0.005		0.005	0.005						D	10	6.140	5.785	0.027	32.035	0.545	0.838		*	D
Sb	3.7	12.0	100.0	NA	NA	NA							NA	NA	7	0.678	0.753	0.052	5.215				*	D
Se	1.4	4.8	100.0	NA	NA	NA							NA	NA	7	0.940	0.636	0.001	17.880				*	D
Sn	29.0	95.0	500.0	NA	NA	NA							NA	NA	4	4.279	4.299	0.373	74.500				*	D
V	230.0	760.0	2500.0	1	0.051		0.051	0.051						D	9	21.620	22.084	0.037	140.000	1.071	0.980		*	D
Zn	200.0	670.0	2500.0	1	0.063		0.063	0.063						D	10	18.750	11.740	3.000	65.560	1.235	0.373		*	D
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	1	4.470		4.470	4.470					D
Cl	18000.0	54000.0	1000000.0	NA	NA	NA							NA	NA	1	432		432	432					D
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	1	74.100		74.100	74.100							3	**********	5183.507	**********	**********			3		
SO4	27000.0	80000.0	40000.0	1	101		101	101						D	2	8574	1800	7301	9847					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **fosforslak**

identification number: PACN8067.wk1

17-Dec-93

	adjusted values granular materials			leaching characteristics				L/S=10 columntest in mg/kg							composition				aqua regia in mg/kg					
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
Benzeen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ethylbenz.	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Tolueen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Xylenen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Fenolen	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-fenol	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Arom.(tot)	*************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Naf	*************	1000000.00	5.00	NA	NA	NA							NA	NA	2	0.050		0.050	0.050					D
Ph	*************	1000000.00	20.00	NA	NA	NA							NA	NA	2	0.020	0.014	0.010	0.030					D
An	*************	1000000.00	10.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
Fla	*************	1000000.00	35.00	NA	NA	NA							NA	NA	2	0.015	0.007	0.010	0.020					D
Chr	*************	1000000.00	10.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
BaA	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
BaP	*************	1000000.00	10.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
BkF	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
IP	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.010		0.010	0.010					D
BPe	*************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.010		0	0					D
PAK10(tot)	*************	1000000.00	75.00	NA	NA	NA							NA	NA	2	0.155	0.021	0.140	0.170					D
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **fosforslak**

identification number: PCBN8067.wk1

17-Dec-93

element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
	adjusted values granular materials			leaching characteristics L/S=10 columntest in mg/kg											composition aqua regia in mg/kg									
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-118	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-138	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **ELO-slak**

identification number: NV8068.wk1

17-Dec-93

adjusted values granular materials				leaching characteristics		L/S=10 columntest in mg/kg									composition		aqua regia in mg/kg							
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	4	0.003	0.002	0.001	0.005						D	13	4.232	3.568	1.118	50.000	0.567	0.487		*	D
Ba	5.50	58.00	7500.00	3	10.817	4.827	6.450	16.000	3						8	146.250	79.316	100.000	640.000				*	
Cd	0.03	0.07	10.00	4	0.001		0.001	0.001						D	14	0.770	0.269	0.100	1.000	-0.166	0.275			D
Co	0.42	2.50	250.00	1	0.030		0.030	0.030							4	26.250	27.097	3.000	65.000					
Cr	1.30	12.00	1250.00	3	0.146	0.078	0.071	2.600	1				*		14	4375.571	2840.620	1359.625	9100.000	3.548	0.301	14		
Cu	0.72	3.50	375.00	4	0.058	0.041	0.012	0.100						D	14	80.488	50.419	24.585	190.000	1.812	0.312			
Hg	0.02	0.08	5.00	2	0.000	0.000		0.001						D	9	0.064	0.034	0.020	0.400	-1.169	0.365		*	D
Mo	0.28	0.91	125.00	4	3.199	2.376	0.294	6.100	4	3					9	77.068	83.554	6.000	740.000	1.756	0.637	3	*	
Ni	1.10	3.70	250.00	4	0.021	0.014	0.010	0.040						D	14	1267.378	1339.794	42.465	3700.000	2.614	0.823	8		
Pb	1.90	8.70	1250.00	4	0.175	0.145	0.010	0.320							14	35.232	24.132	7.450	70.000	1.413	0.383			
Sb	0.05	0.43	50.00	1	0.002		0.002	0.002						D	3	1.700	1.044	0.500	50.000				*	
Se	0.04	0.10	50.00	1	0.018		0.018	0.018							3	9.267	9.400	2.500	100.000			1	*	
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	4	9.000	1.155	8.000	10.000					D
V	1.60	32.00	1250.00	2	0.162	0.167	0.044	0.280							8	393.531	169.949	130.000	543.850					
Zn	3.80	15.00	1250.00	4	0.153	0.068	0.091	0.230							14	162.983	147.330	39.000	470.000	2.029	0.424			
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	1	50		50	50							1	500		500	500					
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	2	34.500	13.435	25.000	44.000					D
SO4	750.00	22000.00	25000.00	NA	NA	NA							NA	NA	1	25		25	25					D
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **ELO-slak**

identification number: PACN8068.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
Benzeen	************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ethylbenz.	************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Tolueen	************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Xylenen	************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Fenolen	************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-fenol	************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Arom.(tot)	************	1000000.00	1.25	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Naf	************	1000000.00	5.00	NA	NA	NA							NA	NA	2	0.050		0.050	0.050					D
Ph	************	1000000.00	20.00	NA	NA	NA							NA	NA	2	0.080	0.099	0.010	0.150					D
An	************	1000000.00	10.00	NA	NA	NA							NA	NA	2	0.015	0.007	0.010	0.020					D
Fla	************	1000000.00	35.00	NA	NA	NA							NA	NA	2	0.080	0.099	0.010	0.150					D
Chr	************	1000000.00	10.00	NA	NA	NA							NA	NA	2	0.050	0.057	0.010	0.090					D
BaA	************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.045	0.049	0.010	0.080					D
BaP	************	1000000.00	10.00	NA	NA	NA							NA	NA	2	0.040	0.042	0.010	0.070					D
BkF	************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.040	0.042	0.010	0.070					D
IP	************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.035	0.035	0.010	0.060					D
BPe	************	1000000.00	50.00	NA	NA	NA							NA	NA	2	0.040	0.042	0	0					D
PAK10(tot)	************	1000000.00	75.00	NA	NA	NA							NA	NA	2	0.475	0.474	0.140	0.810					D
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **ELO-slak**

identification number: PCBN8068.wk1

17-Dec-93

	adjusted values granular materials			leaching characteristics				L/S=10 columntest in mg/kg							composition				aqua regia in mg/kg					
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
PCB-28	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-52	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-101	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-118	1000000.0	1000000.0	.0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-138	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-153	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB-180	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
PCB(tot)	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
EOCl(tot)	1000000.0	1000000.0	3.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
OCl-best.mid.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl-vrije bestr.	1000000.0	1000000.0	0.5	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Min.olie	1000000.0	1000000.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **koperslak**

identification number: V4069.wk1

06-Jun-94

adjusted values products				leaching characteristics	64 days diffusiontest in mg/m2										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	41.0	140.0	750.0	5	0.344	0.201	0.140	1.960					*		NA	NA	NA						NA	NA
Ba	600.0	2000.0	15000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cd	1.1	3.8	20.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Co	29.0	95.0	500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	140.0	480.0	2500.0	6	0.010	0.015		0.030						D	NA	NA	NA						NA	NA
Cu	51.0	170.0	750.0	12	177.735	124.280	14.000	430.100	11	5	2.123	0.400			NA	NA	NA						NA	NA
Hg	0.4	1.4	10.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Mo	14.0	48.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Ni	50.0	170.0	500.0	12	7.315	8.202	0.100	25.030			0.523	0.687		D	NA	NA	NA						NA	NA
Pb	120.0	400.0	2500.0	11	22.766	27.084	1.170	160.000	1		1.043	0.765	*		NA	NA	NA						NA	NA
Sb	3.7	12.0	100.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Se	1.4	4.8	100.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Sn	29.0	95.0	500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
V	230.0	760.0	2500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Zn	200.0	670.0	2500.0	12	84.216	96.190	10.020	283.000	2		1.638	0.537			NA	NA	NA						NA	NA
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	27000.0	80000.0	40000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **EC-vliegasgranulaat**

identification number: NV8071.wk1

17-Dec-93

element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
	adjusted values granular materials			leaching characteristics			L/S=10 columntest in mg/kg								composition			aqua regia in mg/kg						
As	0.88	7.00	375.00	4	1.633	0.088	1.520	2.379	5				*		9	30.456	12.430	15.525	53.000					
Ba	5.50	58.00	7500.00	NA	NA	NA							NA	NA	1	859.950		859.950	859.950					
Cd	0.03	0.07	10.00	2	0.001	0.000	0.001	0.001						D	10	0.802	0.171	0.641	1.000	-0.105	0.090			
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	1.30	12.00	1250.00	2	0.191	0.017	0.179	0.202							8	16.538	15.315	4.000	114.750				*	
Cu	0.72	3.50	375.00	NA	NA	NA							NA	NA	2	148.500	52.503	111.375	185.625					
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	1	0.014		0.014	0.014					D
Mo	0.28	0.91	125.00	5	0.505	0.117	0.350	0.650	5						9	5.992	2.172	2.500	37.800	0.829	0.317		*	D
Ni	1.10	3.70	250.00	2	0.073	0.018	0.061	0.086						D	9	48.994	22.911	30.000	165.375	1.713	0.240		*	
Pb	1.90	8.70	1250.00	2	0.008	0.003	0.006	0.010						D	9	27.469	20.944	10.000	125.550	1.402	0.400		*	
Sb	0.05	0.43	50.00	2	0.030	0.000	0.030	0.030							9	1.007	0.675	0.338	6.480	0.026	0.357		*	
Se	0.04	0.10	50.00	2	0.080		0.080	0.080	2						8	2.513	0.521	2.025	4.523				*	
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	1	4.050		4.050	4.050					D
V	1.60	32.00	1250.00	2	0.895	0.215	0.743	1.047							9	81.219	65.012	10.000	1093.500	1.886	0.568		*	
Zn	3.80	15.00	1250.00	5	0.106	0.009	0.100	0.120						D	9	60.975	45.432	16.000	1620.000	1.817	0.596	1	*	
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	NA	NA	NA							NA	NA	1	338		338	338					D
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	1	81.000		81.000	81.000					
SO4	750.00	22000.00	25000.00	NA	NA	NA							NA	NA	1	552		552	552					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **EC-vliegasgranulaat**

identification number: V4071.wk1

06-Jun-94

element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
	adjusted values products			leaching characteristics 64 days diffusiontest in mg/m2											composition aqua regia in mg/kg									
As	41.0	140.0	750.0	1	60.800		60.800	60.800	1						9	30.456	12.430	15.525	53.000					
Ba	600.0	2000.0	15000.0	1	33.800		33.800	33.800							1	859.950		859.950	859.950					
Cd	1.1	3.8	20.0	1	0.040		0.040	0.040						D	10	0.802	0.171	0.641	1.000	-0.105	0.090			
Co	29.0	95.0	500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	140.0	480.0	2500.0	1	4.060		4.060	4.060							8	16.538	15.315	4.000	114.750				•	
Cu	51.0	170.0	750.0	1	1.760		1.760	1.760							2	148.500	52.503	111.375	185.625					
Hg	0.4	1.4	10.0	NA	NA	NA							NA	NA	1	0.014		0.014	0.014					D
Mo	14.0	48.0	250.0	1	14.300		14.300	14.300	1						9	5.992	2.172	2.500	37.800	0.829	0.317		•	D
Ni	50.0	170.0	500.0	1	20.290		20.290	20.290							9	48.994	22.911	30.000	165.375	1.713	0.240		•	
Pb	120.0	400.0	2500.0	1	0.490		0.490	0.490						D	9	27.469	20.944	10.000	125.550	1.402	0.400		•	
Sb	3.7	12.0	100.0	1	1.350		1.350	1.350							9	1.007	0.675	0.338	6.480	0.026	0.357		•	
Se	1.4	4.8	100.0	1	1.300		1.300	1.300							8	2.513	0.521	2.025	4.523				•	
Sn	29.0	95.0	500.0	1	40.570		40.570	40.570	1					D	1	4.050		4.050	4.050					D
V	230.0	760.0	2500.0	1	19.200		19.200	19.200							9	81.219	65.012	10.000	1093.500	1.886	0.568		•	
Zn	200.0	670.0	2500.0	1	5.130		5.130	5.130							9	60.975	45.432	16.000	1620.000	1.817	0.596		•	
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	1	28		28	28						D	1	338		338	338					D
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	1	29.560		29.560	29.560							1	81.000		81.000	81.000					
SO4	27000.0	80000.0	40000.0	1	3317		3317	3317						D	1	552		552	552					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **geexpandeerd kleigranulaat**

identification number: NV8072.wk1

17-Dec-93

adjusted values granular materials				leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	NA	NA	NA							NA	NA	6	22.409	5.669	15.728	29.000					
Ba	5.50	58.00	7500.00	NA	NA	NA							NA	NA	7	91.386	78.077	27.000	203.850					
Cd	0.03	0.07	10.00	NA	NA	NA							NA	NA	6	0.967	0.360	0.500	1.350					
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	5	24.400	4.219	18.000	29.000					
Cr	1.30	12.00	1250.00	NA	NA	NA							NA	NA	7	59.343	45.437	25.000	124.200					
Cu	0.72	3.50	375.00	NA	NA	NA							NA	NA	7	56.036	16.096	37.125	76.000					
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	2	0.007		0.007	0.007					D
Mo	0.28	0.91	125.00	NA	NA	NA							NA	NA	5	4.630	1.381	3.000	6.075					D
Ni	1.10	3.70	250.00	NA	NA	NA							NA	NA	7	48.236	7.476	36.000	58.000					
Pb	1.90	8.70	1250.00	NA	NA	NA							NA	NA	6	123.242	128.127	23.000	288.225					
Sb	0.05	0.43	50.00	NA	NA	NA							NA	NA	5	1.396	0.521	0.800	2.000					
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	6	1.462	0.599	0.400	2.200					D
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	4	2.975	1.464	1.500	20.000					D
V	1.60	32.00	1250.00	NA	NA	NA							NA	NA	6	80.425	60.945	26.000	157.275					
Zn	3.80	15.00	1250.00	NA	NA	NA							NA	NA	7	264.843	269.319	67.000	657.450					
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	NA	NA	NA							NA	NA	2	338		338	338					D
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	4	235.000	227.548	31.000	432.000					
SO4	750.00	22000.00	25000.00	NA	NA	NA							NA	NA	4	22415	6339	16929	28200			2		
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

APPENDIX A.

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Building material: **geexpandeerd kleigranulaat**

identification number: V4072.wk1

06-Jun-94

	adjusted values products			leaching characteristics	64 days diffusiontest in mg/m2										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	41.0	140.0	750.0	2	0.425	0.021	0.410	0.440							6	22.409	5.669	15.728	29.000					
Ba	600.0	2000.0	15000.0	2	2.540	0.198	2.400	2.680							7	91.386	78.077	27.000	203.850					
Cd	1.1	3.8	20.0	2	0.110		0.110	0.110							6	0.967	0.360	0.500	1.350					
Co	29.0	95.0	500.0	NA	NA	NA							NA	NA	5	24.400	4.219	18.000	29.000					
Cr	140.0	480.0	2500.0	2	2.950	0.212	2.800	3.100							7	59.343	45.437	25.000	124.200					
Cu	51.0	170.0	750.0	2	3.250	0.212	3.100	3.400							7	56.036	16.096	37.125	76.000					
Hg	0.4	1.4	10.0	NA	NA	NA							NA	NA	2	0.007		0.007	0.007					D
Mo	14.0	48.0	250.0	2	0.305	0.021	0.290	0.320						D	5	4.630	1.381	3.000	6.075					D
Ni	50.0	170.0	500.0	2	19.170	1.655	18.000	20.340							7	48.236	7.476	36.000	58.000					
Pb	120.0	400.0	2500.0	2	1.600	0.283	1.400	1.800							6	123.242	128.127	23.000	288.225					
Sb	3.7	12.0	100.0	2	0.086	0.008	0.080	0.091						D	5	1.396	0.521	0.800	2.000					
Se	1.4	4.8	100.0	2	0.031	0.001	0.030	0.031						D	6	1.462	0.599	0.400	2.200					D
Sn	29.0	95.0	500.0	2	29.510	2.135	28.000	31.020	1					D	4	2.975	1.464	1.500	20.000					D
V	230.0	760.0	2500.0	2	0.134	0.006	0.130	0.138						D	6	80.425	60.945	26.000	157.275					
Zn	200.0	670.0	2500.0	2	11.200	0.283	11.000	11.400							7	264.843	269.319	67.000	657.450					
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	2	261	4	258	264						D	2	338		338	338					D
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	2	42.630	3.719	40.000	45.260							4	235.000	227.548	31.000	432.000					
SO4	27000.0	80000.0	40000.0	2	7593	403	7308	7878							4	22415	6339	16929	28200					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **hydraulisch gebonden EC-vliegasgranulaat**
identification number: NV8073.wk1
17-Dec-93

adjusted values granular materials				leaching characteristics	L/S=10 columntest in mg/kg										composition	aqua regia in mg/kg								
element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	NA	NA	NA							NA	NA	1	32.400		32.400	32.400					
Ba	5.50	58.00	7500.00	NA	NA	NA							NA	NA	1	1208.250		1208.250	1208.250					
Cd	0.03	0.07	10.00	NA	NA	NA							NA	NA	2	18.293	24.915	0.675	35.910			1		
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	1	24.300		24.300	24.300					
Cr	1.30	12.00	1250.00	NA	NA	NA							NA	NA	1	282.825		282.825	282.825					
Cu	0.72	3.50	375.00	NA	NA	NA							NA	NA	2	131.963	134.120	37.125	226.800					
Hg	0.02	0.08	5.00	NA	NA	NA							NA	NA	1	0.203		0.203	0.203					
Mo	0.28	0.91	125.00	NA	NA	NA							NA	NA	2	32.738	27.206	13.500	51.975					D
Ni	1.10	3.70	250.00	NA	NA	NA							NA	NA	2	93.150	24.819	75.600	110.700					
Pb	1.90	8.70	1250.00	NA	NA	NA							NA	NA	2	490.050	666.307	18.900	961.200					
Sb	0.05	0.43	50.00	NA	NA	NA							NA	NA	2	52.481	73.742	0.338	104.625			1		
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	1	7.223		7.223	7.223					
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	1	164.700		164.700	164.700					
V	1.60	32.00	1250.00	NA	NA	NA							NA	NA	2	69.525	31.502	47.250	91.800					
Zn	3.80	15.00	1250.00	NA	NA	NA							NA	NA	2	19.983	25.197	2.167	37.800					D
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	NA	NA	NA							NA	NA	1	7358		7358	7358			1		
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	750.00	22000.00	25000.00	NA	NA	NA							NA	NA	1	22950		22950	22950					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

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APPENDIX A.

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Building material: **hydraulisch gebonden EC-vliegasgranulaat**

identification number: V4073.wk1

06-Jun-94

element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
	adjusted values products			leaching characteristics 64 days diffusiontest in mg/m2											composition aqua regia in mg/kg									
As	41.0	140.0	750.0	NA	NA	NA							NA	NA	1	32.400		32.400	32.400					
Ba	600.0	2000.0	15000.0	NA	NA	NA							NA	NA	1	1208.250		1208.250	1208.250					
Cd	1.1	3.8	20.0	NA	NA	NA							NA	NA	2	18.293	24.915	0.675	35.910			1		
Co	29.0	95.0	500.0	NA	NA	NA							NA	NA	1	24.300		24.300	24.300					
Cr	140.0	480.0	2500.0	NA	NA	NA							NA	NA	1	282.825		282.825	282.825					
Cu	51.0	170.0	750.0	NA	NA	NA							NA	NA	2	131.963	134.120	37.125	226.800					
Hg	0.4	1.4	10.0	NA	NA	NA							NA	NA	1	0.203		0.203	0.203					
Mo	14.0	48.0	250.0	NA	NA	NA							NA	NA	2	32.738	27.206	13.500	51.975					D
Ni	50.0	170.0	500.0	NA	NA	NA							NA	NA	2	93.150	24.819	75.600	110.700					
Pb	120.0	400.0	2500.0	NA	NA	NA							NA	NA	2	490.050	666.307	18.900	961.200					
Sb	3.7	12.0	100.0	NA	NA	NA							NA	NA	2	52.481	73.742	0.338	104.625			1		
Se	1.4	4.8	100.0	NA	NA	NA							NA	NA	1	7.223		7.223	7.223					
Sn	29.0	95.0	500.0	NA	NA	NA							NA	NA	1	164.700		164.700	164.700					
V	230.0	760.0	2500.0	NA	NA	NA							NA	NA	2	69.525	31.502	47.250	91.800					
Zn	200.0	670.0	2500.0	NA	NA	NA							NA	NA	2	19.983	25.197	2.167	37.800					D
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	NA	NA	NA							NA	NA	1	7358		7358	7358					
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
SO4	27000.0	80000.0	40000.0	NA	NA	NA							NA	NA	1	22950		22950	22950					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

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Building material: **poreuze metselbaksteen met EC-vliegas**

identification number: NV8pm01.wk1

17-Dec-93

element	adjusted values granular materials U1	U2	S1	leaching characteristics L/S=10 columntest in mg/kg N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	composition aqua regia in mg/kg N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
As	0.88	7.00	375.00	2	0.931	0.310	0.712	1.150	1						3	26.483	4.261	21.668	29.768					
Ba	5.50	58.00	7500.00	NA	NA	NA							NA	NA	3	576.675	41.116	529.200	600.750					
Cd	0.03	0.07	10.00	2	0.010		0.010	0.010							3	0.459	0.089	0.365	0.540					D
Co	0.42	2.50	250.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	1.30	12.00	1250.00	2	0.054	0.001	0.054	0.055						D	3	113.850	9.578	105.300	124.200					
Cu	0.72	3.50	375.00	2	0.200		0.200	0.200							3	66.375	13.522	53.325	80.325					
Hg	0.02	0.08	5.00	2	0.000	0.000	0.000	0.000						D	2	0.007	0.000	0.007	0.014				•	D
Mo	0.28	0.91	125.00	2	2.175	0.347	1.929	2.420	2	2					3	5.400	0.675	4.725	6.075					D
Ni	1.10	3.70	250.00	2	1.008	0.011	1.000	1.016							3	61.650	1.699	60.075	63.450					
Pb	1.90	8.70	1250.00	2	0.500		0.500	0.500							3	45.675	5.414	40.500	51.300					
Sb	0.05	0.43	50.00	NA	NA	NA							NA	NA	2	6.851	2.721	4.928	49.478				•	
Se	0.04	0.10	50.00	NA	NA	NA							NA	NA	3	1.508	0.439	1.080	1.958					D
Sn	0.27	2.40	250.00	NA	NA	NA							NA	NA	3	4.050	0.675	3.375	4.725					D
V	1.60	32.00	1250.00	2	2.239	0.198	2.099	2.379	2						3	156.375	15.038	139.050	166.050					
Zn	3.80	15.00	1250.00	2	0.238	0.113	0.158	0.318							3	141.975	16.497	127.575	159.975					
Br	2.90	4.10	500.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	600.00	8800.00	5000.00	2	5		5	5							3	338		338	338					D
CN-comp	0.07	0.38	125.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	0.01	0.08	25.00	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	13.00	100.00	4500.00	NA	NA	NA							NA	NA	3	298.125	30.624	270.000	330.750					
SO4	750.00	22000.00	25000.00	2	7824	2485	6066	9581	2						3	5805	2655	3608	8755					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.

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Building material: **poreuze metselbaksteen met EC-vliegas**

identification number: V4pm01.wk1

18-Dec-93

element	U1	U2	S1	N	mean	sd(n-1)	minimum	maximum	n>U1	n>U2	log(mean)	log(sd(n-1))	outlayer	det.lim.	N	mean	sd(n-1)	minimum	maximum	log(mean)	log(sd(n-1))	n>S1	outlayer	det.lim.
	adjusted values products			leaching characteristics 64 days diffusiontest in mg/m2											composition aqua regia in mg/kg									
As	41.0	140.0	750.0	3	6.857	1.280	5.570	8.130							3	26.483	4.261	21.668	29.768					
Ba	600.0	2000.0	15000.0	3	11.267	0.321	10.900	11.500							3	576.675	41.116	529.200	600.750					
Cd	1.1	3.8	20.0	3	0.046	0.006	0.039	0.051						D	3	0.459	0.089	0.365	0.540					D
Co	29.0	95.0	500.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cr	140.0	480.0	2500.0	3	4.167	0.230	3.930	4.390							3	113.850	9.578	105.300	124.200					
Cu	51.0	170.0	750.0	3	1.495	0.109	1.370	1.570						D	3	66.375	13.522	53.325	80.325					
Hg	0.4	1.4	10.0	NA	NA	NA							NA	NA	2	0.007	0.000	0.007	0.014				•	D
Mo	14.0	48.0	250.0	3	53.667	15.830	36.800	68.200	3	2					3	5.400	0.675	4.725	6.075					D
Ni	50.0	170.0	500.0	3	20.823	1.171	19.620	21.960							3	61.650	1.699	60.075	63.450					
Pb	120.0	400.0	2500.0	2	0.171	0.003	0.169	0.250					•	D	3	45.675	5.414	40.500	51.300					
Sb	3.7	12.0	100.0	2	0.577	0.132	0.484	11.200	1				•		2	6.851	2.721	4.928	49.478				•	
Se	1.4	4.8	100.0	3	0.224	0.064	0.150	0.267						D	3	1.508	0.439	1.080	1.958					D
Sn	29.0	95.0	500.0	3	41.650	2.333	39.250	43.910	3					D	3	4.050	0.675	3.375	4.725					D
V	230.0	760.0	2500.0	3	42.633	26.521	17.300	70.200							3	156.375	15.038	139.050	166.050					
Zn	200.0	670.0	2500.0	3	2.160	1.022	1.180	3.220						D	3	141.975	16.497	127.575	159.975					
Br	29.0	95.0	1000.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
Cl	18000.0	54000.0	1000000.0	3	73	23	46	88						D	3	338		338	338					D
CN-comp	7.1	24.0	250.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
CN-vrij	1.4	4.8	50.0	NA	NA	NA							NA	NA	NA	NA	NA						NA	NA
F-tot	1300.0	4400.0	9000.0	2	76.295	1.860	74.980	103.800					•		3	298.125	30.624	270.000	330.750					
SO4	27000.0	80000.0	40000.0	3	79547	5332	73600	83900	3	2					3	5805	2655	3608	8755					
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

NA: No information available, ERR: standarddeviation zero.