Working Group of the German Länder on Water Issues
(Länderarbeitsgemeinschaft Wasser – LAWA)

Principles of pre-emptive groundwater protection with waste recycling and the use of products

Drawn up by the LAWA Working Group on "Groundwater protection with waste recycling and the use of products" and the LAWA Permanent Committee on "Groundwater and Water Supply"

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Summary

This policy paper details the precautionary strategy for the protection of groundwater that has to be considered with the recycling of wastes or the use of products. It should be considered as a basis for the preparation of general regulations. The policy paper should not be used, however, as a direct aid in the assessment of specific measures.

The principles described are to be applied in the assessment of the groundwater-compatibility of waste recycling measures and the use of products, in order to prevent these measures leading to the input of contaminants into groundwater and thus to a detrimental change in its chemical status (in short: contamination). The permissibility of a measure arises, however, only from the joint and conclusive consideration of the results of assessments in different legal areas, in particular soil conservation and waste management.

Contamination of groundwater is not permissible and must be precluded by an appropriate precautionary strategy. The decision on the permissibility of measures therefore depends on awareness of when contamination of groundwater occurs, and is thus precluded when water coming into contact with groundwater is only negligibly contaminated. This is indicated by the insignificance threshold, and where contamination falls short of this threshold the requirements of the amended Drinking Water Ordinance are met and no relevant eco-toxicological effects occur. The result, from the point of view of groundwater protection, is that with the recycling of wastes or the use of products insignificance thresholds have to be observed

- at the latest, in leachate before it comes into contact with groundwater, and
- in groundwater that is in direct contact with the material (contact groundwater).

In order to guarantee the precaution in groundwater protection required under water law, with fills and deposits as well as with the use of construction products that – such as concrete – are emplaced at an unforeseeable proximity to groundwater, insignificance thresholds have to be adhered to not only immediately before leachate passes into groundwater, but already in the unsaturated zone at the lower edge of the fill or in the area of contact of the construction product. This way, concentrations are achieved at the point of transition to groundwater that are sufficiently below the insignificance threshold to satisfy the required precaution.

These demands of groundwater protection must be realized through appropriate demands on materials and requirements concerning the method of emplacement. Substance concentrations in leachate and contact groundwater are influenced, on the one hand, by the release behaviour of the material, which can be determined through appropriate investigation of the material. Where, on the other hand, negligible contaminant loads are released from materials, in addition to compliance with insignificance thresholds, hydro-geological conditions can also be considered as well as the importance of the measure at its particular location from the water-management perspective. It has to be ensured, however, that retention and degradation processes – that reduce concentrations – in the course of the leaching path below emplaced wastes or products are permanently preserved, that accumulation of contaminants in the subsoil is prevented and that the soil's buffer capacity with respect to contaminants is also not exhausted in the long term.

Adherence to the precautionary strategy can prevent a noticeable increase in contaminants in the affected aquifer as a result of recycling measures and the use of products. Insignificance thresholds do not therefore represent a quality goal for groundwater.

1. Motive and objective

A large number of technical regulations have been and continue to be developed to ensure that the recycling of wastes and the use of products take place in an environmentally sound manner. In the development of such control mechanisms, the pre-emptive protection of groundwater is an essential aspect. It is the task of the Working Group of the German *Länder* on Water Issues (*Länderarbeitsgemeinschaft Wasser - (LAWA*) to lay down criteria, which have to be complied with in the preparation of regulations concerning the protection of groundwater.

The principles at issue represent minimum demands of groundwater protection on waste recycling and the use of products. Compliance with these principles sufficiently satisfies the precautionary principle of groundwater protection. Particular demands arising from Ordinances on Water Protection Areas have, however, to be observed.

Concerns of waste management (utility, ban on dilution, no accumulation of pollutants) are not considered, and further legal areas are dealt with only in as much as they touch on groundwater protection. In the application of these principles, it has therefore to be borne in mind that the permissibility of a measure arises, however, only from the joint and conclusive consideration of the results of assessments in different legal areas.

2. Field of application

The principles described in this policy paper are to be applied in the assessment of the groundwater-compatibility of measures involving waste recycling and the use of products, when these measures can lead to the input of contaminants into groundwater and thus result in a detrimental change in its chemical status (that is, the contamination of groundwater).[1] Measures that can result in a detrimental change in the physical or biological status of groundwater are not dealt with.

Measures that can lead to contamination of groundwater include the recycling of wastes and the use of products such as

- mineral wastes from industrial processes (slag, ash) and from building activities (rubble),
- excavated earth, dredged material, soil from soil treatment plants,
- organic wastes,
- construction products (asphalt, concrete, injection materials), auxiliary construction material,

when they are used in areas of relevance to groundwater, such as

- road construction,
- landscaping, recultivation, agriculture,
- filling of dry and wet excavations, open-cast mines and underground cavities,
- civil and underground engineering, with the exception of the underground mining of mineral resources,
- structural foundations,

[1] These principles are to be similarly applied with comparable measures for the disposal of wastes; for example, with non-compacted inert waste landfills in accordance with the EU Landfill Directive.

- subsoil compaction.

Areas of operation of relevance to groundwater also include mining measures for the recycling of non-mining wastes above ground (dumps) or below ground (backfill). Due to the particular circumstances of these cases, appropriate standards and, in particular, existing technical regulations are to be given priority.

The term "fill", as used below, describes the filling of open pits (excavations) that arise in the mining of non-metallic minerals, and includes such sites as are approved as open-cast mines under the Federal Mining Act (*Bundesberggesetz*), but that do not boast specific mining features. They do not include lignite mines. Measures are described below as deposits that involve similar quantities of material per unit of area as in the filling of excavations. Deposits do not include the small-scale emplacement and depositing of material in and on the ground, or the spreading of material for the preparation of a rootable layer.

3. Fundamentals of water law

The recycling of wastes and the use of products can have detrimental effects on the status of groundwater, in particular when these wastes or products contain contaminants that are released into groundwater. According to Article 1a of the Federal Water Act (*Wasserhaushaltsgesetz*), water bodies have to be managed in such a way that the interests of the general public are served and avoidable impairment of their ecological functions precluded (Paragraph 1). Furthermore, care has to be taken as necessitated by circumstances to prevent contamination of water or other detrimental change in its properties (Paragraph 2). These principles have to be considered within the scope of permit-free activities and uses requiring permits.

In this connection, waste recycling and the use of products can qualify as uses under the terms of Article 3 of the Federal Water Act. According to Article 2 of the Act, the use of water bodies is subject to official permission. At the same time, a distinction is made between solid and liquid/muddy wastes and products:

- The use of solid wastes and products is to be assessed according to Article 3, paragraph 2, no. 2 of the Federal Water Act, according to which measures that are likely to bring about a lasting or not inconsiderable detrimental change in the physical (not dealt with here), chemical or biological (not dealt with here) status of the water body are considered to be uses (so-called false uses). Their permissibility is governed by Article 6 of the Federal Water Act. Article 34, paragraph 2 of the Act is not directly applied, since the recycling of wastes and the use of products involves neither storing nor depositing in the sense of this provision. Article 34 as a whole has to be considered as a fundamental material provision of the Federal Water Act in the case of activities other than those mentioned in Article 34. This makes clear that "uncontaminated groundwater" is in every case to be considered an important matter of public concern.

  Article 3, paragraph 6 of the Groundwater Ordinance (*Grundwasserverordnung*) takes up this point and makes clear that measures not expressly mentioned in Article 3 (for example, recycling) can be regarded as uses requiring permission according to Article 3, paragraph 2, no. 2 of the Federal Water Act, if they can result in the input of List 1 contaminants. A permit can only be granted if contamination of groundwater or other detrimental change in its status is not to be

feared. This provision is to be applied to List ll substances by way of Article 4, paragraph 2 of the Groundwater Ordinance.

As far as the question of the necessity of permission for measures of waste recycling and the use of products is concerned, Article 3, paragraph 2, no. 2 of the Federal Water Act has to be observed. It needs to be known whether a measure is likely to bring about contamination of groundwater (in the sense of "lasting and not inconsiderable detrimental change in its chemical status"). The question of permissibility is governed by Article 34 of the Federal Water Act.

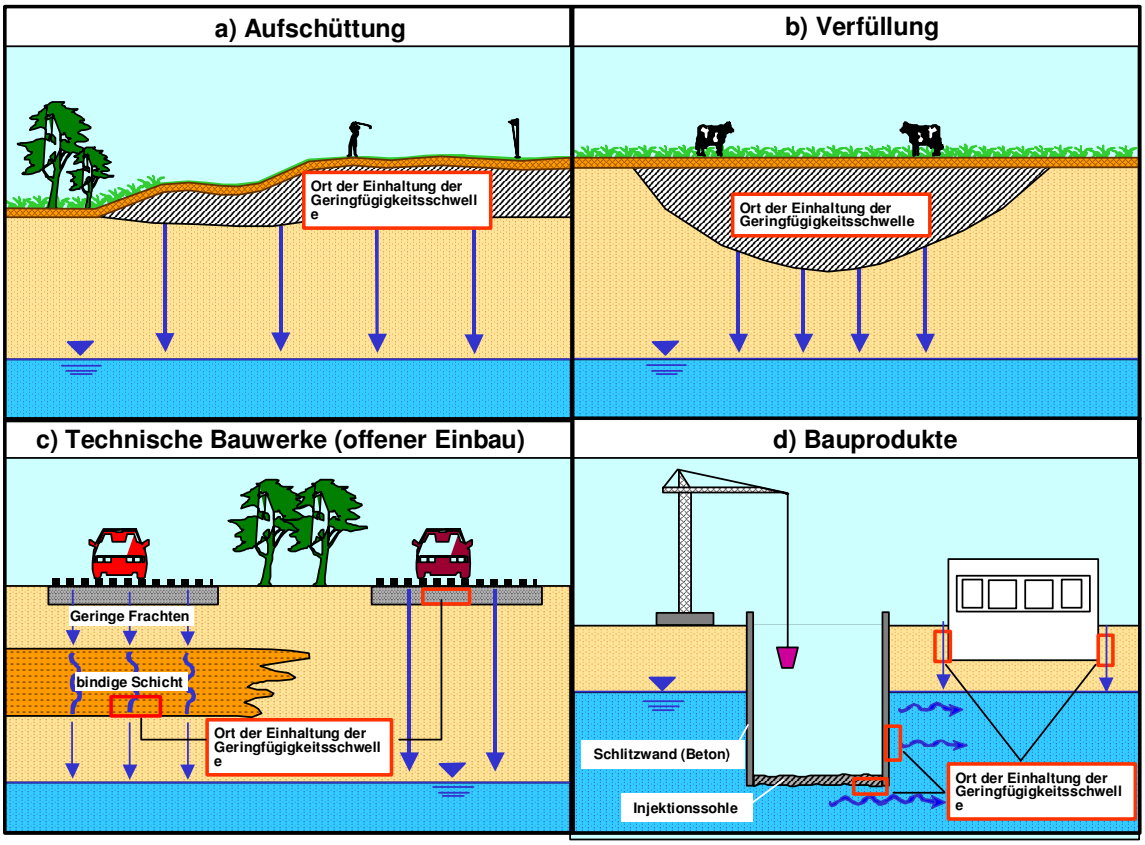
- The use of liquid or muddy wastes or products (for example, injection materials) can be assessed as the direct discharge of substances into groundwater (uses according to Article 3, Paragraph 1, No. 5 of the Federal Water Act). These measures require a permit according to Article 7 of the Federal Water Act. The conditions for the granting of a permit arise in particular from Article 6 and Article 34, paragraph 1 of the Federal Water Act, which, with regard to water protection, supersedes Article 6. Article 34, paragraph 1, on the other hand, is defined for substances covered by the Groundwater Ordinance by the instructions contained therein. According to Article 3, paragraph 1, sentence 1 of the Groundwater Ordinance, the discharge of substances in List 1 of the Annex to the Groundwater Ordinance is not permissible. An exception is only allowed when List 1 substances can enter groundwater in such a small quantity and concentration that impairment of groundwater quality is ruled out both at present and in the future (Article 3, paragraph 3, Groundwater Ordinance). The discharge of substances from List ll of the Annex to the Groundwater Ordinance may only be permitted when harmful contamination of groundwater or other detrimental change in its properties is not to be expected. For substances not covered by the regulations of the Groundwater Ordinance, Article 34, paragraph 1 of the Federal Water Act is to be applied without further concretization.

General descriptions of measures (for example, technical regulations or product approvals) are drawn up in agreement with LAWA with the protection of groundwater in mind. They apply only in so far as they are introduced in the respective Federal *Land*, for instance in the form of administrative regulations. Use of solid wastes and products on the basis of such general descriptions of measures does not require approval under Article 3, paragraph 2, no. 2 of the Federal Water Act, as long as this is determined by the respective *Land* and consideration is not required in the particular case. Such a regulation for specifically intended discharge into groundwater is not provided for in the sense of Article 3, paragraph 1, no. 5 of the Federal Water Act.

In addition, direct discharge of contaminants into groundwater, with the exception of particular fields of application, is prohibited under Article 11, paragraph 3j of the EU Water Framework Directive. Such exceptions, which are therefore not directly touched on in the policy paper, include certain mining activities, such as the exploration and production of hydrocarbons or the discharge of natural or liquid gas for the purpose of storage. Moreover, good chemical status of groundwater must be maintained or re-achieved, and a significant and sustained increase in contaminant concentrations as a result of human activities must be reversed and the contamination of groundwater thus gradually decreased (Article 4, paragraph 1b, Water Framework Directive).

4. Protection of groundwater against contamination

In this section, the situation is described where contamination of groundwater does not occur with the use of solid wastes and products (cf. Figure 1).



4.1 Place of assessment

In deciding whether the use of materials results in contamination of groundwater, it is not important whether contamination is remedied in the further course of the flow path or diluted through blending with non-contaminated groundwater. The appropriate place of assessment depends accordingly on the respective circumstances:

- The recycling of wastes and the use of products take place in the unsaturated zone. The place of assessment is the affected upper groundwater layer. Where substance input is by way of leachate, this is the area in which leachate meets with the saturated zone and thus becomes part of groundwater. The highest groundwater level expected in each case is decisive. In order to guarantee groundwater protection as required under water law, but also for the purpose of precautionary soil protection, in the case of fills or deposits leachate must meet corresponding qualitative demands (so-called insignificance thresholds, cf. Section 4.2) already at the lower edge of emplaced materials, and with construction works, through which only low loads can be released, at the lower edge of an existing cohesive layer. That way, when leachate meets up with groundwater, a sufficiently safe gap is created to the possible onset of groundwater contamination.

- The recycling of wastes and the use of products takes place in the saturated zone; groundwater flows through or around the material from which substances are introduced into groundwater. The place of assessment is the area of contact between the material and the flowing groundwater (contact groundwater). This also applies when it can be expected that the waste or product will only be located in the saturated zone at a later point in time; for instance, following a rise in the groundwater table, or with construction products that can be emplaced not only in the saturated but also in the unsaturated zone.

Where recycled waste or an employed product, which does not result in groundwater contamination, nevertheless leads to ambient changes in groundwater (for example, pH value, redox potential, salinity), an increased release of contaminants from subsoil material – from a geogenic or anthropogenic source – can occur in the further flow path. Substances released as a result of changes of ambience – humic substances, for instance – need not result, in the case of transportation in groundwater beyond the direct place of input, in mobilization (for example through complexation) and transportation of geogenic or anthropogenic contaminants. This has to be taken account of in assessments.

Substance inputs or release can be ignored that, on the basis of averaging over a small area, do not result in transgression of insignificance thresholds. Transgression of insignificance thresholds for limited periods of time (see Section 5.2.2) can likewise be accepted when average substance concentrations – observed over a reasonable short period of time – are below insignificance thresholds.

The terms "over a small area" and "reasonable short period of time" cannot be universally defined, but have to be interpreted restrictively. In the preparation of general descriptions of measures, or in a particular case, they must therefore be specified for the respective circumstance and agreed with LAWA.

4.2 Insignificance thresholds

Leachate or contact groundwater can be classified as "changed in its chemical status to only a significant extent" (in a legal sense, uncontaminated) at the place of assessment – that is, before it becomes part of groundwater – in accordance with the benchmark of Article 3, paragraph 1 in connection with Article 3, paragraph 3 of the Groundwater Ordinance when, despite an increase in substance concentration compared to regional background values,

- no relevant ecotoxicological effects occur

and if, in addition,

- the demands of the Drinking Water Ordinance or values derived accordingly are met.

The term "insignificance threshold" is used to describe concentration values that meet these conditions. The test values of the Federal Soil Protection Ordinance count as insignificance thresholds with regard to numerical values for the path from soil to groundwater, in so far as individual contaminants are regulated in the Ordinance. Examination and possible extrapolation of insignificance thresholds are required according to the criteria of water law. In the case of relevant substances that are not listed, insignificance thresholds must be laid down on the basis of the above-defined criteria.[2]

[2] On account of the decision passed at the 26th ACK, revision and supplementation of values is currently being under-

With insignificance thresholds it is not intended to set a quality goal for groundwater, but rather that a groundwater status be maintained that is largely unaffected by human activity. This objective is achieved by applying insignificance thresholds not directly to groundwater, but rather to contact groundwater or leachate before it reaches groundwater. Where insignificance thresholds are adhered to at this point, a groundwater status ensues that, depending on the local situation, lies between "naturally pure" and "in a legal sense, uncontaminated". The application of the concept of insignificance thresholds may not lead to a noticeable deterioration in groundwater status and a significant increase in substance concentrations. Because insignificance thresholds already have to be observed in the case of fills or deposits at the lower edge of the material, and in the case of construction works with negligible loads, at the lower edge of a cohesive layer, the additional safety required under water law is achieved in the sense of a precautionary strategy.

Where regional geogenic background values in groundwater transgress insignificance thresholds, the authorities responsible for these regions can lay down values in exceptional cases (for example, for the recycling of excavated earth from the same region) that, at most, may correspond with such regional concentrations.

5. Implications for the recycling of wastes and the use of products

In the assessment of materials (wastes and products) with regard to recycling and product use, the important thing is to prevent the development of risks to groundwater. It is therefore obvious that the certainty of predictions assumes particular importance in recycling and the use of products.

The requirement for compliance with insignificance threshold values results, as a rule, in demands on the emplacement of wastes or products. These are realized, for example, by way of eluate concentrations that have to be met in the waste or product, by shifting the place of adherence to insignificance thresholds, or by the assignment of suitable construction methods as well as local hydrogeological and water management characteristics. The result can be the exclusion of certain materials. Through limitations on contaminant concentrations in leachate or contact groundwater and in the eluate of emplaced wastes and products, before mixing with groundwater unaffected by the measure a detrimental change in its properties is therefore already precluded.
With fills and deposits, on account of the large masses that have to be emplaced, the continuous burden and large overall loads, insignificance thresholds have to be complied with – as an additional element of preventative groundwater protection – not directly before the passing of leachate into groundwater, but already at the lower edge of the material. That way, the demands of pre-emptive soil protection are also taken into account. This requirement also applies to permeable construction products that are emplaced above the upper groundwater layer, since, in the worst-case scenario, it has to be assumed that the construction product is emplaced at a site without retention capacity. With construction products that are emplaced not only in the saturated but also in the unsaturated zone, assessment must be directed at the place of emplacement with a direct effect on groundwater. Contact groundwater is therefore of particular importance.

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taken by the LAWA sub-committee on "test values.“

5.1 General matters concerning the assessment of measures

Recycling or the use of materials is permissible, with groundwater protection in mind, when particularly critical materials or methods of emplacement are excluded or restricted, and when it can be ensured that insignificance thresholds are observed

- with fills and deposits, in leachate at the lower edge of the measure, or
- with construction works with negligible loads, in leachate at the lower edge of a cohesive layer but still in the unsaturated zone, or
- with construction products in groundwater that is in direct contact with the material (contact groundwater).

Short-term transgression of the insignificance threshold over a small area – in the sense of comments made in Section 4.1 and in references made in Sections 5.2 and 5.3 – can be permissible.

In assessing the permissibility of measures, expected substance concentrations in leachate or contact groundwater are predicted and compared with the insignificance threshold.

This can take place

- with defined standard cases (for example, material and construction method), during the drawing up of general descriptions of measures (for instance, assistance from the Federal/*Länder* Working Group on Soil Protection (*LABO*) in enforcing Article 12 of the Federal Soil Protection Ordinance, "demands on the recycling of mineral wastes – technical regulations" of the Working Group of the German *Länder* on Waste Issues *LAGA)*, Report No. 20, or product approvals), or
- through the responsible water authority in individual cases that are not dealt with here.

5.2 Prediction of substance concentrations in leachate and contact groundwater

Substance concentrations in leachate and contact groundwater are influenced by the release behaviour of the particular material and the emplacement scenario. Both have therefore to be considered in predictions for leachate.

5.2.1 Release behaviour of materials

Where no general knowledge of the release behaviour of a material exists, it has to be determined through the investigation of representative samples. With the use of materials that react chemically following emplacement (for example, injections), the time-related development of the release behaviour of the components and their reaction products has to be considered.
The release behaviour of the material is normally determined by means of elution tests, which provide an eluate concentration. Significant substance concentrations in leachate or groundwater result only in exceptional cases directly from this eluate concentration. It also has to be noted that different materials, despite identical eluate values, can give rise to differing substance concentrations in leachate or groundwater.
Knowledge of the composition of the material can provide important indications regarding release behaviour; for instance, when ambient changes result in increased solubility. Material of unknown origin must therefore first be characterized through the analysis of its solids contents and, where necessary, through pH saturation analyses.

In selecting a standardized, or at least precisely defined elution process, it is important that the loading of leachate or contact groundwater – also under unfavourable circumstances – can be inferred from the results of analyses, taking account of the emplacement scenario. Since analysis values ascer-

tained in the laboratory are only valid for the "laboratory scenario", they can differ substantially from substance concentrations in leachate or contact groundwater. In laying down reference values (for example, assignment values of "demands on the recycling of mineral wastes – technical regulations" of the "Working Group of the German *Länder* on Waste Issues" [*Länderarbeitsgemeinschaft Abfall, LAGA*], Report No. 20), compliance with which in the eluate also guarantees adherence to the insignificance threshold in leachate and contact groundwater, these deviations must be known and taken into account.

With regard to the suitability of elution processes, a number of pointers are provided below. Here, a distinction is made between materials that are permeable and those that are impermeable to water.

Investigation and assessment of materials permeable to water

- Materials that, on account of their physical properties, can be permeated or infiltrated, are usually investigated with the elution process according to DIN 38414-T4. Due to the particular test conditions, substance concentrations determined in this way are likely to lie below concentrations actually occurring in leachate. With contact groundwater this effect is less clear. In the case of components that are easily soluble in water, the differences are particularly clear. The use of materials containing sulphate and chloride frequently results in substance concentrations in excess of insignificance thresholds when such materials are infiltrated. Depending on levels in the particular material and on the emplacement scenario, the occurrence of leachate with increased substance concentrations can be of limited duration, however, can affect very small areas and can therefore be tolerated. For materials and measures that fall under the provisions of the Soil Protection Ordinance, the investigative procedures mentioned in the Ordinance have to be taken into account.

- The high pH values that occur with alkaline-reacting materials containing alkaline earth oxides and hydroxides (for example, steelworks slag) in eluate are, as a rule, not transferable to in-situ conditions. Through the effects of carbon acid, carbonization combined with a lowering of pH values occurs in the neutral area. As a result, the solubility of amphoteric metals (for example, aluminium) decreases.

- Due to problems with eluate preparation, the assessment of materials that can release lipophilic organic contaminants has been and is currently being undertaken on the basis of analyses of solids. Recent findings indicate, however, that this can lead to errors of judgement. The release of contaminants is mainly determined by the matrix, the substance mixture and the specific contaminated surface. These variables are generally not connected, however, with solids values. Similarly, with such an approach the emplacement scenario can also not be properly considered. Here, column leaching tests are more appropriate. If equilibrium concentration ensues in the eluate from the column, possible substance concentrations in the leachate or contact groundwater can be equated with substance concentrations in the eluate from the column. With conditions of disequilibrium, eluate values (µg/l) have first to be converted, corresponding to the respective test conditions, into rates of release (mass of a contaminant / material mass • time).

  Possible substance concentration in leachate or contact groundwater can be predicted from the rate of release, taking account of the contact time resulting from the emplacement scenario.

  Column leaching tests have up to now only been tried out for a limited selection of substances and matrices. For this reason, solids concentrations can be used for a transitional period for the assessment of release behaviour, so far as appropriate experiences are available.

- In order to avoid the long-term release of contaminants under unfavourable hydro-chemical circumstances, it might be necessary to limit solids concentrations.[3] Long-term release behaviour has always to be borne in mind when the material to be recycled will be a lasting feature of the geosphere (for instance, the compensation of mass deficits in mining and landscaping).

Investigation and assessment of materials impermeable to water

The emplacement of impermeable materials above groundwater is generally irrelevant.

The substance release behaviour of impermeable materials has to be regularly assessed in the case of emplacement in groundwater. Little experience has been made in this respect with appropriate investigative procedures. Of late, tank tests have been proposed. Concentrations in tank test eluate (µg/l), according to the respective test conditions, have first to be converted into release rates (mass of a substance / area • time). Substance concentrations in contact groundwater can then be estimated from release rates for particular scenarios. Substance concentrations in contact groundwater result from release rates, flow velocity in the contact-groundwater boundary layer and the length of the line of contact.

5.2.2 Emplacement scenario

The method of emplacement is unimportant with fills and deposits, since, due to the large masses, expected heavy loads and their permanent nature, retention of contaminants in the soil is not guaranteed and insignificance thresholds have therefore to be observed at the lower edge of the emplacement measure. In other cases, the emplacement scenario influences substance concentrations in leachate and contact groundwater in a variety of ways. From past experience, the following points are of particular importance:

- With permeable constructions in the unsaturated zone it is necessary, under unfavourable circumstances (for example, unexpectedly-high groundwater levels or heavy loads) for insignificance thresholds to be observed – as in the case of fills – already at the point of emplacement. With lower loads, a retaining, groundwater-covering layer – where available – can be used in adherence to the insignificance threshold. Concentration-reducing retention and degradation processes in the course of the leachate path below emplaced waste or construction products can only be considered, however, when, in particular, the ability of the soil to degrade contaminants is maintained in the long term – or can be assumed with sufficient certainty – and only a negligible material change occurs in the subsoil that provides retention. For this purpose, soil-protection assessment standards have to be developed.

- Low rates of release can have the result that solution equilibrium is not achieved with infiltration, permeation or flow round a material. In such cases, leachate and contact-groundwater concentration is influenced by the time material is in contact with water. With infiltration, the contact time depends, among other things, on the layer thickness of the emplaced material. With permeation or flow round a material, the contact time depends on the length of the line of contact and the prevailing flow velocity.

[3] The limitation of solids concentration can be necessary for reasons of waste management..

- With high rates of release, saturation concentration, which might lie above the insignificance threshold, is already reached after a brief period of contact. Here, the duration of leaching is influenced not only by the material-specific total concentration of releasable contaminants, but also by material-specific leaching behaviour as well as layer thickness and the line of contact.

- Where, in the course of use, the surface of a body of material is compacted to decrease the leaching rate, small volume flows of leachate can arise whose substance concentration exceeds the insignificance threshold. This can be tolerated if, on average, substance concentrations in the leachate – viewed over a small area – adhere to the insignificance threshold.

- If contaminants from a flowed-round impermeable body are released at its surface, substance concentrations in the adjoining contact groundwater result from the rate of release and the volume of groundwater that flows in this layer. For assessment, depending on the particular circumstances, average concentrations can be used from a contact area ranging from a few centimetres to a few decimetres.

- Provided that a replenishing of groundwater concentrations up to insignificance thresholds cannot be excluded, as a result of many closely-grouped or extensive contamination sources in the unsaturated zone that themselves comply with insignificance thresholds, area-related or source-related load limitations of relevant contaminants have to be taken into consideration in isolated cases.

- If, in the area of influence of a measure in the saturated zone, further comparable measures are carried out, this has to be considered in determining the applicable emplacement scenario.

In general regulations, or within the scope of isolated decisions, reference is made, as a rule, to particular elution processes (for example, DIN 38414-T4) for the assessment of the release behaviour of material; that is, permissible analysis values are set, compliance with which in the respective case (= emplacement scenario) also guarantees adherence to the insignificance threshold.[4] The development of general regulations only makes sense, however, when standard cases can be accurately defined and, in the choice of elution processes and the laying down of permissible analysis values, special properties of the material can be considered. The result would otherwise be that favourable or unfavourable effects of particular cases could not be considered.

[4] Note: Apart from the assessment of release behaviour, which requires an optimized method of investigation related to the material and the emplacement scenario, the process employed also fulfils the function of an instrument of quality assurance within the framework of the conduct of measures. In this connection, routine processes are therefore preferred.