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ABSTRACT

Evaluation of the environmental compatibility of cement grouts

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According to the principal paper „Principles for the impact of building products on soil and groundwater" (Grundsätze zur Bewertung der Auswirkung von Bauprodukten auf Boden und Grundwasser) the environmental compatibility of building materials has to be controlled for a technical approval. For cement grouts the inverse percolation test by Schössner has been selected as a testing method. However, a disproportionally high amount of substances is washed out in this test. This was already observed in previous projects and therefore a tank test for fresh concrete has been suggested as an alternative. So far no agreement on the testing of cement grouts has been reached in the responsible committees. Therefore further comparative tests were carried out in this project and the data base was increased to cover the range of commercial products in Germany.

In collaboration with two industrial partners 30 cement grouts were classified in 4 frame formulations according to their composition and application. Based on the total content of trace elements and heavy metals and on the results of batch tests for the leaching behaviour the choice was narrowed down to five products. For the leaching tests the cement grouts were mixed with sand to simulate the blending with the native soil. In addition mixtures with gravel were tested to find out whether it is possible to evaluate the cement grouts in analogy to the chapter "Concrete constituents and concrete" (Betonausgangsstoffe und Beton), but that approach was not feasible.

The selected products were tested with different leaching procedures. The harmonised European tank test, the so-called DSLT (dynamic surface leaching test), the fresh concrete tank test with subsequent DSLT and the percolation test by Schössner were used. As a new alternative the DSLT was used with a very short pre storage time in order to measure the leaching at an early age.

Because of the varying sample ages or rather the different degrees of reaction at the beginning of the test, the results of the various leaching tests are systematically different. Another factor is the flow velocity in the percolation test by Schössner. Since the test is started before the setting of the cement grout, part of the material was washed out.

For some parameters the release in the DSLT is approximately the same as in the fresh concrete tank test with subsequent DSLT, if the DSLT is started immediately after demoulding (e. g. for barium and vanadium). Other parameters, like chromium, are intensively leached during the first hours so that it is recommendable to consider the fresh phase with an extrapolation.

In addition to the experimental tests, transport simulations in the groundwater were carried out, using a specific model area, a high-pressure injection, to find out from which release exceedances of the threshold values for groundwater may occur. The derived permissible release for chromium was adhered in most cases, only one product showed a high release. For vanadium the permissible release was often exceeded. In this case the interaction with the soil should be considered to get a more realistic evaluation. At the moment the leaching of vanadium is not considered by the DIBt.

For the evaluation concept for cement grouts a leaching test has to be officially specified. The DSLT with minimal pre-storage is recommended, but the fresh phase should be considered using a parameter specific extrapolation. Furthermore it has to be decided, if one model, e. g. the high-pressure injection blanket, can be used for the different use scenarios of cement grouts.

Further need for research exists concerning the interactions of the leached substances with the soil. For the modelling parameter specific sorption coefficients have to be selected. Since sorption strongly depends on the pH, the buffering of the pH in the aquifer is of major importance. The impact of the buffer capacity should be estimated from literature data or maybe geochemically modelled. Thus the section, in which the pH changes, could be specified more precisely. The increase in pH is also important for the mobilisation of humic substances from the native soil. Humic substances are difficult to manage in the water treatment and they can mobilise heavy metals in the form of dissolved organic complexes.