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SUMMARY

F 7039

Evaluation of the Environmental Compatibility of Building Materials for Sealings and Groutings

Project no. ZP 52-5-20.47-1212/06

In this research project proposals for concepts for the evaluation of the environmental compatibility of building materials for sealings and groutings have been developed. The concepts shall be used for technical approvals. The evaluation is based on two different leaching tests: a tank test with several stages for sealings and an inverse column test for groutings. In both experiments concentrations of pollutants are determined in the eluats at different time steps, but these concentrations are not equal to the concentrations of groundwater in contact with these building materials. Therefore it is necessary to calculate leaching rates from the experimental data. Using these leaching rates the concentrations in the groundwater are simulated numerically. Building materials for sealings and groutings are used for different applications. This was to be considered in the evaluation concepts. Therefore different model scenarios were developed for the simulations. Table 1 summarise the considered building materials and the scenarios.

Table 1: Summary of the model scenarios

Building material		Construction			Contact to the ground water
		type	dimensions	sealed area	
1		2	3	4	5
Sea-lings	bituminous sealings	building	ground area: 10 x 10 m²	outer walls	depth of immersion: 2 m
	unsaturated polyester resins	sewer pipe	diameter: 1,2 m length: 100 m	whole pipe (inliner)	damaged joints
Grou-tings	acrylate gel	building	ground area: 20 x 40 m²	outer walls	depth of immersion e: 10 m
	cement suspensions	grouting base	20 x 40 m²	base	20 x 40 m²
	polyurethanes	sewer pipe	diameter: 1,2 m length: 40 m	joints / pipe couplings	injected joints

The conductivity of the soil was chosen to be $k_f = 10^{-4}$ m/s, the effective porosity $n_e = 0.1$ and the ground water gradient $i = 10^{-3}$. Generally the longitudinal dispersivity was 3 m, only for the bituminous sealings 1 m was chosen because of the smaller dimensions of the building. The diffusion coefficients in the groundwater were chosen specifically for the different substances. Decay and retardation were neglected.

The immissions calculated from the leaching tests were applied at the surface of the building materials in each model scenario. Since the sealings are leached in water, the immissions were adapted to the circumstances in the water saturated soil. In the inverse column test the groutings are injected in the watersaturated soil, therefore no adaptation was needed.

The calculated ground water concentrations were averaged over a contact layer of 2 m or in an area of 2 x 2 m² at the location of the highest concentrations. Afterwards an averaging over a time period of 6 month was carried out. These mean concentration in the contact layer have to fulfil the existing limit values for ground water (GFS: Geringfügigkeitsschwellen) or if necessary equivalently derived values. The transport simulation shall not be carried out for every single technical approval. So limit values for the leaching tests have to be derived. For this purpose the mean concentrations in the contact layer were plotted against the total releases in the leaching tests and transfer functions for the deduction of permissible releases in the leaching tests were generated.

A comparison of the permissible releases and the test results showed no exceedings for unsaturated polyester resins and the polyurethanes. For the bituminous sealings the permissible release of phenols was exceeded in three cases. For acrylate gels very high concentrations of TOC were found in the contact layer. It has to be deliberated about whether biological and chemical decay should be considered. Otherwise it can be predicted that acrylate gels will not fulfil the strict requirements for the protection of ground water for some organic pollutants. For the cement suspensions the permissible releases were exceeded for serveral parameters. However, it has to taken into account that the column tests were started directly after the injection of the cement suspensions. Because of the high flow rate the leaching at the beginning of the test is strongly increased. Due to this a curing time, e. g. 24 h, should be specified. With this requirement the permissible releases will probably be met, however it has to be stated that the leaching behaviour of a grouting base made with cement suspension will differ from the leaching behaviour of the suspension in the column test. In reality the leaching will be similar to concrete so leaching will continue over a longer time period and the first wash-off will be a lot lower. Insofar the evaluation concept on the basis of the column test is only a convention and does not reflect the real conditions.