

### **SUMMARY OF FINAL REPORT**

Research project: Elaboration of a standardized method for the assessment of the effects of compounds used for soil injection in construction and repairing sewage systems on soil and ground water applying the column experiment with reversed flow direction

Client: Deutsches Institut für Bautechnik (DIBT), 10792 Berlin

Tests carried out: Hygiene-Institut d. Ruhrgebietes, Gelsenkirchen

---

The column experiment with reversed flow direction (i.e. the water flowing through the sand column from bottom to top) has been used for the assessment with regard to polluting or toxic effects of various compounds used for injection into soil saturated with water. The mode of experimental procedure has been improved by performing parallel experiments several times in a row with 8 different soil injection compounds. The results were subjected to analytical examination with regard to repeatability as well as the applicability for different products and techniques.

The compounds to be analysed were: one soft gel on the basis of water glass containing inorganic hardener used for sealing foundation soil, two liquid sealing agents on the basis of water glass containing organic hardener used for repairing sewage systems, two polyacrylate compounds used as grouting or infiltrated film solution for sealing fissures, two isocyanate compounds used as grouting for sealing fissures, one compound used for lime cross-linking for the stabilization/sealing of ground.

The test water samples were examined according to the following parameters: pH value, conductivity, colour, turbidity, and the content of organic compounds (TOC). Some of the analysed compounds were also examined for certain anions and cations. Moreover, the water samples were examined for toxic effects with the aid of the daphnia test, the algae test, and the fluorescent bacteria test.

The repeatability was determined with the help of coefficients of variation of certain parameters and of the respective maximum concentrations (such as TOC, conductivity) of the test water samples of an analysed compound. The tests results of the polyacrylate compounds showed a high degree of repeatability with coefficients of variation between 0.2 % and 12.9 %. Some of the analysed compounds had higher coefficients of variation (e.g. concerning the TOC concentrations of polyurethane I: 18 % and polyurethane II: 39 %), and formed irregular injection bodies (particularly polyurethane II). In these cases, the cause of this deformation has to be determined in future, and the tests will have to be repeated. The highest coefficients of variation were determined in the tests of the compounds on the basis of water glass. Varying periods of infiltration in the parallel experiments and an undefined reaction between the two components of the compound may be responsible for this.

The analyses of all compounds showed that toxicity of components in the test water samples decreased significantly from maximum elution to the abatement period. There are obvious similarities between the effect on daphnia and the inhibition of the algae growth. The fluorescent bacteria showed the lowest degree of susceptibility to toxicity in most test water samples.

According to the examination results, the column experiment with reversed flow direction is suitable for the assessment with regard to polluting or toxic effects of homogeneous compounds. Liquid sealing agents, which consist of various liquids infiltrated in a row, will not produce repeatability of results because a "stoichiometric" commixture is not to be expected. According to the test results, the column experiment with reversed flow direction is also suitable for the testing of relining systems, such as felt hoses impregnated with epoxy resin.