Berichte der Geologischen Bundesanstalt
ISSN 1017-8880 | Band 77 | S. 20–21 | Wien, November 2008
30 JAHRE ANGEWANDTE GEOCHEMIE IN ÖSTERREICH

Soil Protection and Small Flotation Dumps in Former Mining Areas

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ntroduction

One of the problems for risk assessment of the soil-groundwater transfer today in Germany is that there is no legally effective guideline for choosing proper leaching/extraction tests or in-situ sampling techniques. In the past a wide range of leaching tests has been developed for different problems. The difficulty is to decide, which method should be used to answer which question. This decision depends on the contaminants as well as on the soil type and local conditions. The most suitable method has to be chosen in each individual case. In a project founded by regional authorities of Rhineland-Palatinate strategies will be developed for the realisation of a groundwater risk assessment for typical inorganic contaminations in this country.

Background

Leaching tests are an important tool for the source term investigation because most of them are cheap and short. Usually batch tests are used which are not very close to reality and hence may lead to unrealistic results. Another possibility are column tests under saturated or unsaturated conditions which may be much closer to reality but have a large time-need. An intelligent strategy is needed to establish how different tests relate to another, when keeping in mind that for regulatory control and quality control short procedures are needed. For understanding mechanisms and leaching processes, which are used to define and optimize theses shorter procedures for specific purposes, more fundamental and elaborate tests are required. Distinction should be made based on the amount of a priori knowledge, material quantity, and proper balancing between testing and management costs to achieve economic efficiency. Finally, the results also must unambiguously guide the evaluator to a well founded decision. Leaching tests are the only possibility for risk assessment of materials that will be used for landfill or disposal in future.
In-situ sampling procedures like suction lysimeters or centrifugation have the advantage that they are leading straight to real concentrations in the seepage water. If samples are taken in different dephts it is although possible to make some time-dependent assumptions. Disadvantages are problems regarding interpolation, because of the small soil volume which is characterised by each sampling point. Statistical certainty of sampling is investigated by Liedl & Teutsch (1998). Spatial distribution of sampling points and statistical certainty of investigation grids are discussed by Reichert & Roemer (1997).

Investigations

Main intention of this project is to develop strategies for the realisation of a groundwater risk assessment for typical inorganic contaminations in Rhineland-Palatinate. There are two typical contamination scenarios: Flotation dumps from the ore mining in the low mountain ranges of Germany and abandoned industrial sites which are common in the neighbourhood of rivers.
An exemplary realisation of a source term investigation for two test sites is to be worked out with several different methods. Different in-situ sampling techniques like suction cups and centrifugation are tested and also several leaching/extraction tests (e.g. saturation soil
extraction, the German S4 test, pH static tests at pH 4, ammonium nitrate extraction and modifications of common procedures) in order to enable a well founded statement on practicability and suitability of these techniques. The leachates and seepage water samples are analysed to measure heavy metals and metalloids such as zinc, lead, copper, cadmium, and arsenic using ICP-MS. Field parameters like electrical conductivity and pH and although the major anions and cations are investigated as well. Aside this soil samples are analysed to investigate the total amounts of elements using XRF and aqua regia extracts as well as to identify mineral phases using XRD.
On of the test sites is a flotation dump from the zinc and lead ore mining. Since the age of the Romans until 1961 non-ferrous metals have been mined there. The dump consists of clay and silt and its thickness varies from four to seven meters. Field surveys show significant contaminations with lead, zinc, copper, cadmium, and arsenic. The other test

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site is an arsenic contaminated former production site of sulphuric acid and aluminium. It is an anthropogenic affected accumulation of ground excavation and building rubble. Arsenic, lead and fluoride can be found here in elevated concentrations.
Currently, selection criteria for leaching tests are developed and an evaluation of significance and correlation of in-situ sampling procedures and leaching tests is to be worked out. Geochemical behaviour of different inorganic contaminants and geochemical conditions in different leaching tests are to be taken into account as well.

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