EGU21-8501
https://doi.org/10.5194/egusphere-egu21-8501
EGU General Assembly 2021

Testing PFAS Immobilization

Thomas Bierbaum[1], Juergen Braun[1], Norbert Klaas[1], Claus Haslauer[1], Frank Thomas Lange[2], Gudrun Nuerenberg[2], and Marco Scheurer[2]

[1]IWS, VEGAS, University Stuttgart, Stuttgart, Germany (thomas.bierbaum@iws.uni-stuttgart.de)

[2]TZW, DVGW-Technologiezentrum Wasser, Karlsruhe, Germany (frankthomas.lange@tzw.de)

In the region Rastatt/Baden-Baden in the Upper Rhine Valley, Germany, approximately 1000 ha of predominantly agricultural land has been contaminated with per- and polyfluoroalkyl substances (PFASs) about one decade ago when paper-fiber biosolids mixed with compost was applied. These substances affect various land uses (agriculture, open pit gravel quarries, and urban planning) and the underlying aquifer as the main drinking water resource for surrounding cities and municipalities.

Remediation attempts have been limited to date, particularly due to the large spatial extent of the contamination and the related high costs. One strategy currently being investigated is to immobilize the PFASs in the soil in-situ. Substances with a high sorption capacity would be applied on the ground surface and mixed with the soil. The then altered soil should still fulfill its original purpose (e.g., for agriculture). Another strategy could be to remove the contaminated soil and use it for construction (e.g., noise protection embankment) after treatment with the immobilization agents.

The purpose of this research is to develop a test strategy to evaluate the long-term leaching characteristics of soil treated with substances to increase its sorption capacity. Treated soil is tested on three different scales (batch experiments, column experiments, lysimeters) and under different saturation conditions (saturated, variably saturated). Effluent concentrations are monitored over time with different analytical methods (target analysis, determination of sum parameters (EOF/AOF), Total Oxidizable Precursor Assay (TOP)). Mathematical models are employed to evaluate the appropriateness of various processes (e.g., equilibrium sorption) and the leaching behavior for time scales larger than possible in laboratory experiments.

A special challenge for both the analytical strategy and the numerical modeling poses the fact that PFASs consist of a more than 4700 compounds (according to OECD), from which currently only about 20 usually are quantified in routine analysis. A number of these analytical targets are breakdown products, derived from larger precursors by microbial activity, which makes the source term undefined.

The current data illustrate significant reductions in PFAS desorption rates in some of the treated soils. In comparison to the control material (N-1), eluate concentrations in a treated soil (R-1) are

found to be lowered by a factor of 1000. The desorbed PFAS mass in the column experiment with R-1 is less than 4%, relative to N-1. In the lysimeter experiments (variably saturated), delayed increasing eluate concentrations indicate additional processes (source term).

The measured and modelled time-series of effluent concentrations serve as the basis for a simple and cost-effective method for the experimental testing of immobilization measures for PFASs.