Investigation of PFAS Contamination from Land-Applied Industrial Compost and AFFF Sources

Ian Ross (Ian.Ross@arcadis.com) (ARCADIS, Cheshire, UK)
Thomas Held (thomas.held@arcadis.com) (ARCADIS, Darmstadt, Germany)
Jake Hurst (Jake.Hurst@arcadis.com) (ARCADIS, Leeds, UK)
Erika Houtz Ph.D. (Erika.Houtz@arcadis.com) (ARCADIS, San Francisco, CA, USA)
Jeffrey McDonough (Jeffrey.McDnonough@arcadis.com) (ARCADIS, Newtown, PA, USA)
Jeff Burdick (Jeff.Burdick@arcadis.com) (ARCADIS, Newtown, PA, USA)

Background/Objectives. A large area of PFAS-impacted soil was discovered as a result of composting activities some ten years ago. Industrial sludge was blended with composted soil and applied to agricultural land as fertilizer to a depth of 30 cm, resulting in PFAS contamination over 3.7 km^2. The fertilizer comprised mainly polyalkylyphosphates (PAPs) and some fluorinated polymers. PAPs were not able to be measured as no commercial analyses are currently available. Soil and groundwater contained high concentrations of perfluoroalkyl carboxylic and sulfonic acids, suggesting that the original contamination has already undergone biotransformation to the persistent perfluoroalkyl acids (PFAAs), but the concentrations of the remaining residual precursors were not estimated. Hence, the total oxidizable precursor (TOP) analysis was used to investigate the soil. The composted soil contamination is overlain in certain areas by a second PFAS contamination originating from the usage of aqueous film forming foams (AFFF). In this area, the PFAS distribution differs from the industrial sludge-related contamination.

Approach/Activities. The results of the TOP assay analysis of the PaPs impacted soils showed that substantial amounts of precursors still remained in the soil, but the groundwater was nearly free of precursors. These results were confirmed by the AOF (adsorbable organic fluorine) analysis. In the AFFF impacted area significant concentrations of precursors were detected in groundwater and it is hypothesized that hydrocarbon surfactants also occurring in AFFF created a strongly reducing biogeochemical environment, conserving the aerobically transformable precursors, whereas in the rest on the area, oxidizing conditions allowed a fast and nearly complete biotransformation of the precursors to PFAAs immediately after transport into groundwater.

Results/Lessons Learned. The remediation of PFAS contaminated soil is only needed to the extent that rainwater infiltration of the low contaminated soil left in place will not cause an exceedance of the intervention values for groundwater set by regulators. Since the extent of the contaminated area soil is large infiltration will lead to a PFAS accumulation in groundwater passing the contaminated area. Nevertheless, in the beginning of the project it was not known at what rates and over what time the PFAS would be transported from soil to groundwater and at what rates the precursors would be biotransformed to the persistent PFAAs. Hence, a study was initiated to determine site specific sorption coefficients. These sorption coefficients were used in a contaminant transport model to calculate the plume extension and to predict the influence of future soil remediation measures.

For the site a provisional feasibility study was conducted to investigate treatment alternatives, including effective proven technologies and also innovative but not yet mature remediation technologies. In order to finalize the feasibility study, a research and development project was initiated to develop a better model that predicts PFAS sorption and release and determines the rate of the microbial production of PFAAs from precursor contaminated soil.