Site-Specific Desorption Testing of Perfluorononanoic Acid (PFNA) to Assess Potential Soil Leaching to Groundwater

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Background/Objectives.
The adsorption/desorption behavior of poly and perfluoroalkyl substances (PFAS) in soils is influenced by a number of factors including organic carbon content, pH, ionic strength and sorption hysteresis. For this reason, site-specific investigation of partitioning behavior is necessary to more accurately evaluate the potential for PFAS leaching to groundwater from soil. Existing studies have demonstrated that for longer chain perfluoroalkyl carboxylic acids (PFCAs; C8 and above) a portion of the PFCA becomes irreversibly sorbed to soils. Therefore, partition coefficients and derived Koc values determined by forward adsorption tests in the laboratory tend to be lower than those determined under field conditions. This phenomenon is attributed to the fact that as a release weathers, the reversibly sorbed fraction will leach, leaving the irreversibly or strongly sorbed fraction associated with the soil. Depending on the age of the release, different effective partition coefficients are expected, with stronger partitioning to soils expected associated with an older, weathered release.

Approach/Activities.
Desorption tests were conducted on soils collected during site investigation. Testing consisted of sequentially leaching soil samples representing a range of PFNA concentrations in 50 mL centrifuge tubes using deionized water. Following one week of agitation, samples were centrifuged and the water decanted, weighed, and analyzed. The process was repeated three times by adding additional deionized water to the centrifuge tubes. Starting soil concentrations, water masses, and aqueous concentrations were used to perform mass balance calculations on the mass of PFNA desorbed and remaining on soils through each of the three desorption cycles. The resulting data were used to calculate a partition coefficient (Kd) and in conjunction with organic carbon analyses, partitioning to organic carbon (Koc).

Results/Lessons Learned.
Desorption testing resulted in calculated partition coefficients that are one to two orders of magnitude higher relative to published literature values for PFNA. This site-specific information will be incorporated into the evaluation and development of soil cleanup targets for a PFCA release at an operating manufacturing facility in the context of an overall soil and groundwater investigation and remediation.