

Assessment of Freely Dissolved Per- and Polyfluoroalkyl Substances (PFAS) Using Newly Developed Passive Sampler

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Background/Objectives. PFAS are a group of man-made chemicals with unique properties, which made them suitable to a variety of industrial commercial, and domestic applications, including stain guards for carpeting, upholstery, food wrappings, metal plating and aqueous film forming foams (AFFFs). PFAS compounds are ubiquitous, persistent in the environment, bioaccumulative, and subject to biomagnification. Also, they have been shown to negatively impact human and ecological receptors. U.S. Environmental Protection Agency and Department of Defense have identified hundreds of sites contaminated with PFAS that require characterization and remediation. One of the key inputs into setting remediation goals is estimating the risk posed by the contaminants of potential concern. It has been long known that the total concentration of certain chemicals in an environmental matrix does not provide an adequate insight into the risk, as bioavailability of many contaminants including hydrophobic organic contaminants (HOCs) and metals decreases significantly if the contaminant is bound to particulate or dissolved organic carbon or other particulates such as clay minerals. Passive sampling has proven invaluable in measuring the freely dissolved HOC concentrations and predicting risk associated with contamination. Presented here are the results of the laboratory and field testing of a PFAS passive sampler (PS) prototype.

Approach/Activities. Passive sampling relies on the spontaneous mass transfer of the analyte from the sampled medium onto/into the sorbent resulting from the differences in chemical potentials. Development of the PFAS PS involved identification of the appropriate sorbent, followed by the laboratory determination of the PFAS uptake kinetics and construction of the adsorption isotherms which provide sorption characteristics of the sorbent. Extraction procedures for eluting PFAS from spent sorbent were developed as well. The experiments were conducted for 16 anionic PFAS analytes (C4-C12), including carboxylic and sulfonic acids and fluorotelomer sulfonates. The performance of the PS was also evaluated under varying conditions such as ionic strength, pH, and dissolved organic matter content. Finally, the PS was field tested through deployment at a site with known PFAS contamination. The PS was deployed for the period of four weeks. Grab water samples were also collected at deployment and at retrieval of the PS to allow comparison of the results obtained.

Results/Lessons Learned. Presented laboratory data provide the sorbent-water partitioning information for wide range of PFAS analytes, which is necessary for PS data interpretation. Parameters such as ionic strength, pH, and presence of dissolved organic carbon were all shown to affect the partitioning of the analytes. Careful analysis of the collected data allowed calculation of the expected uncertainties associated with sampling in different types of water. With kinetics uptake on the order of weeks, the PFAS PS provides time-integrated results, which offer better long-term insight into the site condition than grab samples and therefore can help reduce the number of samples and cost associated with the site assessment. As in other types of passive sampling, the spontaneous mass transfer is expected to result in sampling exclusively the freely dissolved fraction of the contaminant and therefore correlate better with bioavailability and risk than bulk water samples.