Development and Field Validation of an Equilibrium Regimen Passive Sampler for PFAS

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Background/Objectives. PFAS are a group of man-made chemicals with unique properties that 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). Due to certain suspected and known negative health implications, monitoring of PFAS has become an issue of increasing concern. Passive sampling has proven invaluable in measuring the concentrations of the most bioavailable, freely dissolved fractions of many hydrophobic contaminants, including polychlorinated biphenyls (PCBs) and polyaromatic hydrocarbons (PAHs). Conventional passive samplers face some challenges when it comes to sampling PFAS. For example, polyethylene devices (PEDs) are not able to accumulate ionic PFAS compounds, while polar organic chemical integrated samplers (POCIS) are difficult to calibrate and require use of membranes which may not be appropriate for PFAS sampling. Recently, a variety of innovative passive samplers for PFAS has been reported in the literature. The majority of these samplers operate in the kinetic regimen of the uptake curve, in which their accuracy tends to be strongly affected by the water flow conditions, biofouling and other environmental conditions.

Approach/Activities. A new type of equilibrium passive sampler, called PFAS INSIGHT®, was designed and tested. The sampler is suitable for a range of ionic and neutral PFAS compounds, including carboxylates, sulfonates, and PFAS precursors. Development of this tool involved identification of the appropriate sorbent, followed by sorption characterization (adsorption kinetics and isotherms) under various conditions, and finally extraction procedure investigations. After laboratory testing concluded, PFAS INSIGHT® was deployed at several groundwater and surface water PFAS-contaminated sites in Canada (in collaboration with WSP) and in the United States. Conventional water samples were also collected to provide a reference point and allow field demonstration/validation analysis. This presentation will provide a summary of the laboratory experiments data and discuss the results of the field validation studies.

Results/Lessons Learned. PFAS INSIGHT® offers an alternative to conventional water sampling and allows for quantitative, time-integrative sampling of dissolved PFAS C4-C12 with simultaneous qualitative assessment of other PFAS analytes. The sorbent adsorption isotherm data showed that sorption capacity correlated with the PFAS carbon chain length and functional group type. Preconcentration of the analytes on the sorbents allows achievement of improved detection limits for long chain analytes, while for short chain analytes the detection limits are comparable to conventional water sampling. The sampler reaches equilibrium in 3 to 4 weeks at most sites, which results in better long-term insight into the site conditions than conventional samples and therefore can help reduce the number of samples and cost associated with the site assessment. The results of recent field deployments showed good agreement between conventional water sampling and PFAS INSIGHT® sampling in both surface water and in groundwater in wells with moderate to high recharge rates. Passive sampling can be used in combination with conventional methods for estimation of bioavailable PFAS, pre- and post-remediation assessment, and source tracking.