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Sorption Behavior of Per- and Polyfluoroalkyl Substances (PFASs) on Filter Material for Remediation

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Background/Objectives. In recent years, per- and polyfluoroalkyl substances (PFASs) have received much attention due to their ubiquitous global distribution, environmental persistence and potential toxicity. PFASs are characterized by their fully fluorinated carbon chain and acidic functional group. PFASs are used by the industry as anionic surfactants in various products such as an additive in aqueous firefighting foam (AFFF) in the last 50 years. Recent studies have shown that the application of AFFF at firefighting training sites have polluted the nearby environment. This is in particular problematic since PFASs have reached groundwater and surface water and has contaminated drinking water source areas. However, there is a lack of efficient treatment techniques for PFASs in soild and water. The aim of this study is to evaluate the sorption behavior of PFASs to a variety of different sorbent to assess their suitability as filter materials in water treatment plants or soil immobilization amendment.

Approach/Activities. In total, 18 different PFASs were investigated in laboratory batch experiments including perfluoroalkane sulfonates (PFSAs), perfluoroalkyl carboxylates (PFCAs), and perfluoroalkyl sulfonamides (FASAs) using different types of activated carbons, biochars, clays and minerals, sludges, ashes, nanomaterials, pulp industry residues and other industrial waste products. The experiments were performed in triplicates with a liquid/solid ratio of 50 at environmental relevant concentration levels for PFASs (1 μg/L). The samples were shaken for seven days using end-over-end mixing to reach equilibrium and after centrifugation, the PFAS concentration in the water phase was extracted using solid phase extraction and the PFAS concentration was determined using liquid chromatography-mass spectrometry (LC-MS/MS).

Results/Lessons Learned. Solid/liquid partitioning coefficients were determined for more than 40 different materials and characterized by sorption capacity for 18 different PFASs. The results indicate that the functional group and chain length of PFASs have a strong influence on their sorption affinity to the materials. These results will improve our understanding of the adsorption mechanisms for PFASs and will help in the future to select the sorption material which is most efficient to remediate/clean PFAS contaminated soil and water.