

Improving Activated Carbon Performance for In Situ Sequestration of Per- and Polyfluoroalkyl Substances

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Background/Objectives. Activated carbon (AC) is used widely to adsorb organic contaminants from drinking water and groundwater and has emerged as one of the few accepted treatment technologies for per and polyfluoroalkyl substance (PFAS). In situ application of injectable AC for PFAS treatment is an emerging technology for soil and groundwater remediation. AC characteristics vary greatly depending on the raw material type and the production methods used. These varying AC features, including pore volume distribution and surface chemistry, can have a major impact on the adsorption capacity and selectivity of AC for particular target contaminants. The objective of this study was to create a fundamentally based understanding of the driving mechanisms and associated AC features that govern adsorption of both long and short-chain PFAS, and to evaluate the impact of these AC features on the extent of competitive adsorption between different PFAS and natural organic matter (NOM).

Approach/Activities. Seven ACs representing a range of pore and surface functional properties were characterized in completely mixed batch reactor tests. For each AC, single-solute adsorption isotherms in synthetic groundwater were generated for perfluorooctanesulfonic acid (PFOS), perfluorooctanoic acid (PFOA), and perfluorobutanesulfonic acid (PFBS). Adsorption of these three PFAS were further evaluated in equimolar mixtures, as well as in mixtures with NOM to generate competitive adsorption isotherm data. All PFAS analyses were performed using a Waters Acquity H-Class ultra-performance liquid chromatograph (UPLC) equipped with a Waters BEH C-18 column with an eluent gradient of ammonium acetate in water and methanol, as described in EPA Method 537.1. Quantification of PFAS was achieved using a Waters Xevo tandem quadrupole mass spectrometer (TQ-S Micro) fitted with a Unispray ionization source.

Results/Lessons Learned. Adsorption isotherm results generated for PFOS, PFOA, and PFBS onto seven well-characterized AC products were fit to a Freundlich adsorption isotherm using non-linear regression procedures and the resulting data were correlated to determine key AC properties for adsorbing both long- and short-chain PFAS.