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In Situ Containment of PFOA/PFOS Using Colloidal Activated Carbon

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Background/Objectives. With the increasing awareness to the widespread contamination associated with PFOA, PFOS, and other PFAS compounds, there is an established need for new and lower cost treatment options that can address the large, dilute plumes that these contaminants commonly form. At the present time, the accepted remediation method for these contaminants is to use pump-and-treat systems equipped with activated carbon. The costs associated with running these systems and replacing the carbon can be quite high. For that reason, the ability to implement an in situ barrier of activated carbon that can cut off and contain these plumes for many years with a single application affords a beneficial means to decrease or avoid the operating and maintenance costs in the existing aboveground systems. This paper examines the use of a colloidal activated carbon that readily distributes within the subsurface, providing a method for injecting an in situ barrier of activated carbon for PFOA and PFOS treatment.

Approach/Activities. Laboratory studies were conducted to measure the adsorption isotherms for PFOA and PFOS with a distributable form of colloidal activated carbon. The isotherm data were then used in an adapted version of the BioChlor model to estimate the expected adsorption longevity that a barrier of the colloidal carbon can provide for PFOA and PFOS considering the flux and the concentration. Additionally, a 16-foot sand column experiment was conducted to determine the ability of the colloidal activated carbon to flow and deposit in an aquifer.

Results/Lessons Learned. The measured PFOA and PFOS isotherms were fit to the Freundlich equation and the isotherm parameters were determined. The isotherm measurements included a demonstration that a dose of the colloidal activated carbon could reduce 100 μg/L of PFOA and PFOS to below the 2016 revised EPA health advisory limits of 70 ng/L. Using the measured isotherm parameters within the BioChlor model, it was shown that a 5 μg/L plume of either PFOS or PFOA traveling with a velocity of 120 ft/yr could be contained and meet EPA limits with a single barrier of the colloidal activated carbon for over 50 years. While this timeframe will also depend on other water components, for example TOC and additional contaminants present, the containment time can be increased with multiple barriers or a higher dose of the colloidal carbon. Results of the column studied demonstrated plug-flow transport of the colloidal activated carbon at least 16 feet through the sand column. The adherence of the colloidal activated carbon to the sand was also measured and found to be evenly and permanently deposited onto the surface of the sand.