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An Overview of PFAS Treatment Technologies with an In-Depth Analysis of Two Case Studies

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Abstract : Per- and polyfluoroalkyl substances (PFAS) have emerged as a significant environmental concern due to their ubiquity and persistence in the environment. Their chemical characteristics and adverse effects on human health demands more effective and sustainable solutions in remediation of the PFAS. The work presented here encompasses an overview of treatment technologies with two case studies that utilize effective approaches in addressing PFAS contaminated media. Currently the options for treatment of PFAS compounds include Activated carbon adsorption, Ion Exchange, Membrane Filtration, Advanced oxidation processes, Electrochemical treatment, and Precipitation and Coagulation. In the first case study, a pilot study application of colloidal activated carbon (CAC) was completed to address PFAS from aqueous film-forming foam (AFFF) used to extinguish a large fire. The pilot study was used to demonstrate the effectiveness of a CAC in situ permeable reactive barrier (PRB) in effectively stopping the migration of PFOS and PFOA, moving from the source area at high concentrations. Before the CAC PRB installation, an injection test using - fluorescein dye was conducted to determine the primary fracture-induced groundwater flow pathways. A straddle packer injection delivery system was used to isolate discrete intervals and gain resolution over the 70 feet saturated zone targeted for treatment. Flow rates were adjusted, and aquifer responses were recorded for each interval. The results from the injection test were used to design the pilot test injection plan using CAC PRB. Following the CAC PRB application, the combined initial concentration 91,400 ng/L of PFOS and PFOA were reduced to approximately 70 ng/L (99.9% reduction), after only one month following the injection event. The results demonstrate the remedy's effectiveness to quickly and safely contain high concentrations of PFAS in fractured bedrock, reducing the risk to downgradient receptors. The second study involves developing a reductive defluorination treatment process using UV and electron acceptor. This experiment indicates a significant potential in treatment of PFAS contaminated waste media such as landfill leachates. The technology also shows a promising way of tacking these contaminants without the need for secondary waste disposal or any additional pre-treatments.

Keywords : per- and polyfluoroalkyl substances (PFAS), colloidal activated carbon (CAC), destructive PFAS treatment technology, aqueous film-forming foam (AFFF)
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