***In Situ* Remediation with Colloidal Activated Carbon to Reduce PFAS Risk**

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**Background**. PFAS (per- and polyﬂuoroalkyl substances) constitute a group of thousands of synthetic organic chemicals that contaminate all environmental media and impact drinking water resources for communities globally. These chemicals have been released into groundwater at tens of thousands of sites, including military bases, airports, landfills, and various industries. As a result, 45% to 60% of US drinking water resources are likely contaminated with PFAS. The US Environmental Protection Agency's (EPA) designation of perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) as hazardous substances under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) in April 2024 will force many PFAS-contaminated sites into remediation to prevent future impacts on drinking water wells and other receptors.

**Approach/Activities.** The two active remediation approaches that can feasibly address PFAS in groundwater involve groundwater extraction and separation treatment (pump-and-treat) or *in situ* remediation with colloidal activated carbon (CAC). Despite its use for groundwater remediation for over 40 years, pump-and-treat has been ineffective in restoring aquifers contaminated with common groundwater pollutants such as trichloroethene (TCE). Using pump-and-treat to flush PFOA and PFOS out of aquifers effectively would be even more problematic as these contaminants sorb to aquifer soils approximately 5 and 25 times more strongly than TCE, respectively, while having enforceable maximum contaminant levels (MCLs) that are 1,250 times lower. Pump-and-treat, therefore, can only be used for hydraulic containment to stop advancing PFAS groundwater plumes. However, using this approach has downstream consequences that must be considered. By pumping PFAS contamination to the surface for separation treatment, concentrated PFAS waste is generated. This waste must be managed, transported, and disposed of at a landfill or treated, with each step in the process potentially leading to PFAS exposures. Since PFAS do not degrade naturally and bioaccumulate in animals and humans, PFAS-laden wastes present new risks and liabilities not encountered previously with other contaminants. Solutions that do not generate these wastes in the first place are desired.

*In situ* remediation with CAC occurs below the surface and does not generate waste. The CAC technology comprises <2 micron-sized activated carbon particles that coat aquifer materials upon application, converting the subsurface into a pollutant filter that passively removes PFAS from the dissolved phase. With PFAS removed, the potential for exposure is also removed, eliminating the risk to receptors downstream.

**Results/Lessons Learned**. *In situ* remediation with CAC has been successfully implemented at over 50 PFAS-contaminated sites globally across four continents. The presentation will feature case studies demonstrating the approach's effectiveness in halting the migration of PFAS in the subsurface to prevent future exposure risk and liability. The results of independent modeling studies for typical *in situ* PFAS groundwater remedies will be presented, showing how these treatments can be effective for many decades. Optimized in situ remedies that target both the source and the dissolved plume may offer a permanent risk reduction solution. Finally, a life cycle assessment completed for a PFAS-impacted airport site will demonstrate how *in situ* remediation with CAC was implemented at one-third of the cost with a 98% lower carbon footprint than the leading pump-and-treat alternatives.