Design Considerations and Implementation Techniques for In Situ Applications of Modified Clay for PFAS Sequestration

Use of common adsorbents for the remediation of per- and polyfluorinated substances (PFAS) in situ has generally been limited to colloidal activated carbon (CAC) or conventional pump and treat systems. Most of these low-energy CAC applications are not adequate to capture the total PFAS contaminant mass present due to limits in total effective sorption capacity and mobility of the product in the subsurface pore space. Further, conventional emplacement techniques of CAC can be ineffective for optimal distribution within certain overburden and regolith mediums and, due to this mobility, are less ideal for permeable reactive barrier (PRB) design and deployment. Overburden injection of a modified clay (MC) has been demonstrated on several pilot programs using direct push technology (DPT) and high-solids slurry batching and injection equipment to be effective in the sequestration of PFAS compounds.

The MC used in these field demonstrations for remediation of PFAS was FluoroSorb®, which is manufactured by applying an organic chemical modifier to bentonite clay. The resultant product has high sorption kinetics, significant sorption capacity, is effective across a wide range of PFAS concentrations, and, if necessary, is compatible for co-mixing with many other common site remediation reactants. This has been verified by independent university laboratory testing where the MC was comparatively assessed with ion exchange resin (IX), GAC, and biochar. Additionally, competitive adsorption was tested with co-contaminants such as chlorinated volatile organic compounds (CVOCs) and petroleum hydrocarbons (PHCs). Relevant sorption and kinetics data will be discussed.

Field deployments of MC were conducted in demonstration projects in the United States and Canada to prove the injectability and performance of the technology in source (grid) and plume bisection (PRB) deployments. These demonstrations verified the injectability and distribution of the MC as effective in numerous geologies and site implementations.

Various MC slurry densities have been tested, examining increasingly dense and higher solids mixes to mimic site situations where significant product mass would be matched to significant PFAS mass. The slurry designs and specifications will be discussed from bench scale evaluation to field deployment, and the lessons learned from varying the ratios of product and carrier fluid (water). For one site, the MC was co-injected with calcium polysulfide (CaSx) for treatment of both PFAS and hexavalent chromium, proving slurry design flexibility and compatibility. In Canada, the MC was installed as a PRB and then monitored for over a year with a continued PFAS source upgradient. The performance and longevity of this installation will be discussed, along with groundwater monitoring data and post-injection soil core evaluation of product distribution in situ using a newly developed MC dye test.

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Mike has been involved with in-situ remediation design and implementation for over twenty-five years. His role as Senior Remediation Engineer at AST involves project assessment and design, field implementation oversight, and post project data analysis for projects in North America, Europe, and Australia. Mike is a dual graduate of Pennsylvania State University holding BS and MS degrees in Environmental Engineering.