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Novel Approach to Optimize GAC Performance for PFAS Treatment

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Background/Objectives. Granular activated carbon (GAC) treatment for PFOA and PFOS impacted water has been demonstrated at full-scale treatment plants in the US and is the preferred technology in recent years. Although PFOA and PFOS can be successfully treated to meet the remedial goal at parts per trillion levels, the practical experience suggests GAC's effectiveness on treating AFFF impacted groundwater (mix of PFAS compounds) remains uncertain and unproven. PFOS and PFOA at the demonstration site are currently treated by pumping out the contaminated groundwater and sending it through a GAC filtration system. PFOS and PFOA break through more frequently than expected, and require GAC to be replaced frequently and greatly increasing operating expenses. A pilot study is conducted to monitor for PFAS breakthrough and demonstrate that PFASs can be treated by laccase catalyzed oxidative humification reaction with GAC to extend the operating life of the GAC units.

Approach/Activities. The proposed pilot system comprises three treatment trains. The first treatment train is a GAC only system, which serves as the "control" against the other two treatment trains. The second treatment train entails the use of a separation and destruction approach coupling GAC and a concentrated form of naturally-occurring enzyme (i.e., laccase). The PFASs are separated and concentrated on GAC then destructed with laccase catalyzed oxidative humification process. Laboratory studies conducted by Dr. Jack Huang at University of Georgia (UGA) indicated that enzymatic humification reactions can reduce PFOS and PFOA concentrations by 60-70% by breaking them into smaller compounds ("Laccase Catalyzed Degradation of Perfluorooctanoic Acid", *Environ. Sci. Technol. Lett.*, 2015, *2* (7), pp 198–203). The third treatment train tests the ability of RemBind™ to remove PFASs from contaminated groundwater in a batch reactor. RemBind™ is a proprietary formulation consisting of GAC, aluminum hydroxide (as a coagulant) and organic matter. The purpose of the pilot study is to test these laboratory results against actual field conditions. The first two treatment trains run in parallel and the water samples are collected from influent and effluent as well as between treatment vessels to verify the performance of each treatment train. PFASs in groundwater are screened against a long list of PFASs that can be semi-quantitatively or quantitatively analyzed. The analytical approach has been optimized and looked into the key site-specific PFASs only for routine analysis of each water sample. Selected water sample are also analyzed using two screening tools: total oxidizable precursors (TOP) and Particle Induced Gamma-ray Emission (PIGE).

Results/Lessons Learned. This pilot study is currently under study. This is the first comprehensive study to evaluate the breakthroughs of short chain to long chain PFASs through the GAC filtration systems and incorporate an enzymatic humification treatment approach for GAC treatment optimization. This is also the first study that tests the effectiveness of RemBind™ for water treatment.