A Screening Tool for Selection of Treatment Systems for Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous Solutions

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Background/Objectives. Per- and polyfluoroalkyl substances (PFAS) are now established as high-priority and high-profile contaminants. PFAS contamination exists in a wide range of settings with a broad spectrum of co-contaminants, from fire training areas (FTAs) with high concentration PFAS and non-aqueous phase hydrocarbons and solvents to very dilute PFAS in drinking water aquifers with mainly inorganic co-contaminants that impact specific media. Aqueous solutions requiring treatment include municipal and private drinking water supplies, industrial waste, decontamination fluids, stockpiled waste fire-fighting foam (AFFF), and landfill leachate, each with unique treatment challenges and objectives. In recent years, granular activated carbon (GAC), selective ion exchange resin and other synthetic media have been shown to be effective at removing PFAS from groundwater in ex-situ treatment configurations. The challenge of selecting the optimal treatment technology and the one that offers the lowest life-cycle cost is a complex calculus that is only coming to light now. Major controlling variables include PFAS and co-contaminant profiles, treatment goals as low as non-detect for an increasing number of PFAS, and treated water use or disposition. Influencing factors include waste management and disposal options. Optimal choices can include single-use media, regenerable media, or treatment trains with multiple media to arrive at the most cost-effective solution. A screening tool has been developed to assist in narrowing the treatment options to those best suited for specific site conditions and treatment objectives - the tool is based on knowledge gained from bench and pilot trials as well as full-scale PFAS treatment systems.

Approach/Activities. Bench- and pilot-scale testing of GAC and synthetic media to treat PFAS have demonstrated the unique capacity of each media to remove PFAS. Certain media remove specific PFAS more effectively than others. Certain classes of PFAS are removed preferentially and certain PFAS are removed poorly by all media. PFAS removal efficiencies are greatly influenced by co-contaminants and geochemistry; pre-treatment is fundamental to removal efficiency, treatment train configurations, and operations. For full-scale systems, media costs are weighed against removal capacity, the cost of regeneration is weighed against media replacement, and the cost of on-site destruction is weighed against disposal costs.

Results/Lessons Learned. The screening tool offers a starting point to select treatment alternatives appropriate to a given set of site conditions. The primary screening criteria are application (the water stream requiring treatment), the specific PFAS to be removed, influent concentrations, treatment goals, and co-contaminants. The screening tool assists to expedite the treatment alternatives evaluation and design process and may in some cases negate the requirement to perform site-specific pilot-scale testing. Over time, as more full-scale systems are built and optimized, the screening tool will be updated to further expedite design and reduce cost associated with the treatment of PFAS in aqueous solutions.