Challenges, Optimization, and Lessons Learned Treating PFASs in Groundwater Using Granular Activated Carbon and Synthetic Media

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Background/Objectives. Per- and polyfluoroalkyl substances (PFASs) are the subject of increasing regulatory focus and concerns regarding potential health and ecological risks. This increased focus is also resulting in an increased need to treat PFASs in groundwater. Most treatment has been associated with removal of PFASs in drinking water when concentrations exceed the US EPA 2016 Final Lifetime Health Advisory Levels for PFOS and PFOA at 70 parts per trillion (PPT) individually or combined. This has included large public water and residential systems and treatment typically is accomplished using granular activated carbon (GAC). Influent concentrations are typically <100 PPT and typical PFAS co-contaminants rarely require treatment. GAC has generally proven to be very effective even considering that many municipalities are demanding PFAS-free water with self-imposed non-detect goals. However, as the focus of PFASs treatment in groundwater shifts to source areas and mid-plume areas PFASs concentrations will be higher and co-contaminants are more likely with co-contaminant concentrations often exceeding PFASs concentrations. For example, the typical fire training area (FTA) is often the most significant source area on sites that used/tested aqueous film forming foams. These FTAs will exhibit high concentrations of petroleum hydrocarbons (PHCs), may exhibit chlorinated volatile organic compounds and glycols, and will exhibit much higher PFASs concentrations (e.g. high parts per billion to low parts per million). This is a much more complex and difficult treatment scenario proving that diverse alternatives are needed to meet varied settings and objectives.

In recent years, GAC and regenerable and non-regenerable synthetic media (e.g. ion-exchange resins) have both been shown to have some effectiveness at removing certain PFASs from groundwater. But, the challenge in selecting the option with the lowest life-cycle cost is a complex one that is only coming to light now. Controlling variables include PFAS concentration and target compounds, co-contaminant concentration, cleanup goals, and effluent disposition. Influencing factors include waste management and disposal/destruction options. Is GAC, synthetic media, or a multi-media system the best alternative?

Approach/Activities. The authors draw upon experiences on several bench, pilot, and full scale GAC and synthetic media research and real world projects to assess best options for various scenarios. The assessment was aimed at allowing us to draw conclusions and reach certain generalizations that will inform future bench and pilot testing design.

Results/Lessons Learned. Results of the assessment will highlight challenges, lessons learned, and optimization measures that can be made. The assessment allows us to narrow the treatment options to those best suited for specific site conditions and treatment objectives. Certain media remove specific PFASs more effectively than others. Certain classes of PFASs are removed preferentially and certain PFASs are removed poorly by all media. Each also have unique breakthrough curves which figure prominently in optimal treatment train configurations and operations. Media costs must be weighed against removal capacity, the cost of regeneration should be weighed against media replacement, and the cost of on-site destruction should be weighed against offsite destruction or disposal costs. GAC, regenerable and non-regenerable synthetic media will all play important roles in PFASs treatment.