Repurpose and Optimization of an Existing Groundwater Pump and Treat System for Removal of Perflouroalkyl Substances

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Background/Objectives. An existing groundwater treatment system (GWTS) originally designed to remove fuel and solvent related compounds was repurposed to remove perfluoroalkyl substances (PFAS) detected in a former fire department training area. The granular activated carbon (GAC) system was optimized to treat an average influent PFAS concentration of 70 µg/L at an approximate flow rate of 15 to 20 gallons per minute (gpm). Optimization activities included conducting a treatability study to evaluate coconut shell-based GAC (coconut) versus coal-based GAC Filtersorb® 400 (F400), followed by the optimization of the existing GAC system.

Approach/Activities. The treatability study indicated the PFAS examined sorbed approximately 2.5 less to the coconut than to F400 GAC. Additionally, sorption of the shorter chain length PFAS (e.g., PFBA, PFPeA, PFBS) was on the order of 4 to 5 times higher for F400 compared to the coconut GAC. Observed adsorption coefficients for the F400 were similar to those found in the literature, whereas literature values for the coconut were not found.

Concurrent to this treatability study, both the coconut and F400 GAC were evaluated through the operation of a full-scale treatment system in the field. The coconut was first used for an approximate 4 month period to evaluate its effectiveness before introducing the F400 product that was used in combination with the coconut thereafter. Samples were initially collected weekly for 3 months from the influent, midpoint and effluent of a two carbon system. Sample frequency was then temporarily changed to monthly before reverting back to weekly when the field results indicated a quicker breakthrough of the carbon than was expected based on the treatability study and literature values.

Results/Lessons Learned. The existing GWTS was designed to operate with an oil water separator, greensand filter, air stripper, bag filters and two 1,500 lbs carbon filters to address both fuel and chlorinated solvent constituents in groundwater. However, during the optimization process, it was determined that much of the pretreatment was not needed and the system was reduced to just bag filters and the GAC units. Additionally, water impurities and fouling significantly lowered the efficiency of the lead carbon vessel when compared to the treatability data and literature values. This was addressed by adding a third carbon vessel that was used primarily for pretreatment, with two additional vessels in series to serve as a primary and polishing vessel, respectively. Coconut GAC, which is about half the price of the F400, was used in the pretreatment vessel and the F400 was used in the middle and lag vessels. Utilizing this configuration proved both efficient and cost effective, since more frequent changeouts were done with the less expensive coconut GAC. The F400 was able to achieve removal efficiencies that were more closely aligned with those seen in the treatability study and previously published literature once the abovementioned changes were implemented.