PFAS Treatment Method Optimization for a Large Public Water Utility

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Background/Objectives. Per- and polyfluoroalkyl substances (PFAS) associated with the use of aqueous film-forming foams (AFFF) at military and civilian airports have been identified in public drinking water supply wells at a number of locations in New England above United States Environmental Protection Agency (EPA) health advisory levels for long-term exposure of 70 parts per trillion (ppt) in drinking water. Treatment systems to remove PFAS from the impacted water supply wells must be carefully designed to assure the desired PFAS removal given the concentrations present and flow demands. PFAS treatment is challenging due to their chemical characteristics and the need for ppt finished water concentrations. High solubility, low adsorption coefficients, and varying water chemistries make optimizing treatment methods difficult. Use of pilot tests and "treatment trains" comprised of multiple treatment methods appear to result in effective and efficient designs for municipal use.

Detection of PFAS compounds associated with use of AFFF for firefighting and training at the former Pease Air Force Base in Portsmouth, New Hampshire led to the shutdown of three valuable well supplies. These sources totaled up to 1.2 MGD of drinking water to some 9,000 customers. Because PFAS concentrations varied significantly between wells, final treatment schemes required optimization to effectively remove the PFAS.

Approach/Activities. Three pilot efforts including an initial comparison of multiple resin media and granular activated carbon (GAC) were conducted. Samples of water from various locations in the media test columns were collected to track the PFAS migration and breakthrough over time. Each media revealed unique responses to raw water constituents, PFAS components, and varied flow rates and empty bed contact times.

The approach to this project was also driven in large part by the abundance of public scrutiny due to the emerging concerns for exposure from drinking water. Simultaneous blood testing studies caused the need for one of the pilot studies to be a full-scale demonstration project using two 20,000 lb GAC vessels in series.

The final selection of a hybrid-style filtration plant will include the use of ion exchange resin media followed by GAC filters to polish. Startup procedures and water quality monitoring revealed wide fluctuations in pH causing close monitoring of neutralization and corrosion control systems to eliminate disruption to the municipal infrastructure.

Results/Lessons Learned. Comparative pilot studies including full-scale demonstration projects have provided unique breakthrough curves of the remnant PFAS compounds associated with AFFF use. In particular, PFBA and PFPeA can be used as indicator compounds to establish the timing of breakthrough in each filter vessel. These results at various contact times provides both short- and long-term operational parameters along with a unique design targeting extended filter life and minimizing costs.

This case study also reveals the need for significant public involvement and transparency in treatment efforts for municipal systems.