Regeneration of Granular Activated Carbon (GAC) Used for Per- and Polyfluorinated Substance (PFAS) Remediation

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Background/Objectives. With the emerging evidence of PFAS toxicity, federal and state agencies have been issuing drinking water advisories. Recent EPA guidelines (2016) establish the advisory level for combined perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) concentration in drinking water at 70 parts per trillion (ppt). The most commonly used treatment for PFAS contaminated water relies on the use of granular activated carbon, GAC; however, there are currently no efficient regeneration options for spent GAC. This research investigates GAC regeneration and performance of regenerated GAC in adsorbing PFOA and PFOS. The objective of this project is to develop a regeneration method for GAC that has been used for removal of PFAS from groundwater such that the GAC maintains its sorption capacity for PFOA and PFOS.

Approach/Activities. All experiments were conducted in polypropylene centrifuge tubes. Initially, virgin (uncontaminated) GAC was exposed to aqueous PFOA and PFOS solution in a batch reactor to develop sorption kinetics. Contaminated GAC was eluted with a polar solvent system and different percentages of bases. Eluents were collected for analyses at a few time intervals to assess the desorption efficiency and kinetics. After desorption of the PFOA and PFOS contaminated GAC, sorption isotherm batch reactor experiments were constructed. The GAC was again exposed to aqueous PFOA and PFOS solution to evaluate the sorption capacity of the regenerated GAC. The PFOA and PFOS was analyzed using liquid chromatography tandem mass spectrometry, LC-MS/MS.

Results/Lessons Learned. The solid to liquid ratio was determined quantitatively. The laboratory batch sorption kinetics data showed 99 to 100% removal of PFOA and PFOS to GAC in 10 days. Increasing hydrophobicity and basicity showed to have better desorption capacity. The presentation discusses the sorption and desorption kinetics of GAC and development of the regeneration method for the spent GAC.