PFAS-Laden Spent Media Destruction Using Supercritical Water Oxidation Technology

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Background/Objectives. Granular activated carbon (GAC) and anion exchange (AIX) resin have been successfully demonstrated to remove PFAS from water sources. These PFAS separation technologies do not destroy PFAS and generate spent media requiring waste management. The solid-phase waste management methods for spent media are limited to off-site landfill, incineration, and GAC reactivation. With growing concerns and public scrutiny of PFAS-containing wastes returning into the environment through air emission, atmospheric deposition, and groundwater contamination, the spent media waste management options are needed to handle the amount of PFAS containing wastes generated through PFAS treatment. This project is the first study to report the use of supercritical water oxidation technology (SCWO) to destroy PFAS-laden spent media including the destruction of PFAS adsorbed onto the spent media. The SCWO technology is commercially available and was demonstrated to destroy AFFF and biosolids.

Approach/Activities. Multiple spent media samples were collected from two DoD installations. One installation has one GAC and one AIX pump and treat groundwater treatment systems. The second installation has a mobile unit with treatment train comprising organoclay, GAC and AIX for high-strength wastewater treatment. The PFAS mass in the spent media are presented in two ways. PFAS mass in spent media was calculated based on the treatment system operation conditions and monitoring data. PFAS mass in the PFAS-laden spent media was also analyzed using Draft USEPA Method 1633 with modifications. The spent media samples were shipped to SCWO testing facility. This is the first time that SCWO was used to destroy PFAS-laden spent media. The feedstock samples (spent GAC or spent AIX) were prepared in slurry forms and fed into the SCWO unit at flow rate of approximately 2 gpm. PFAS and spent media were mineralized and destroyed in seconds after the SCWO conditions were achieved. The SCWO effluent was analyzed using Draft USEPA Method 1633 for 40 PFAS.

Results/Lessons Learned. This project demonstrates the potential of using SCWO as a method to destroy PFAS-laden spent media. The spent media was completely mineralized in the SCWO unit into water, CO_2 and negligible amount of residual minerals (not quantifiable in this study). PFAS were destroyed. Based on the operation and monitoring data collected from a GAC treatment system, approximately 11 mg/kg of PFOA and 59 mg/kg of PFOS were loaded to the GAC before GAC changeout. Using SCWO, PFAS were oxidized under supercritical water conditions with PFOS (243 ng/L, 99.97% destruction) and PFOA (1.1 ng/L, 99.9993% destruction) detected in the SCWO effluent. When SCWO was used to mineralize PFAS laden AIX, PFOA was not detected and PFOS was detected at 62.7 ng/L in the SCWO effluent. For AIX used to treat high-strength industrial PFAS wastewater as the polishing step after GAC, the SCWO study confirmed spent AIX destruction, PFOA and PFOS were detected at 1.82 ng/kg and 501 ng/L in the SCWO effluent respectively. A larger scale field demonstration is planned to treat large quantity of spent media at DoD installation sites. The study will evaluate the life-cycle costs and sustainability comparing to traditional spent media waste disposal options.