PFAS Thermal Treatment of Soil Demonstrated in Multiple Pilot Tests

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Background/ Objectives. Per- and polyfluoroalkyl substances (PFAS) represent an important class of persistent pollutants that are now commonly found in indoor and outdoor environments. The presence of PFAS in the environment is due to their use in polymers, waterproofing coatings, and as aqueous film-forming foam (AFFF). Thermal treatment of soils impacted by toxic PFAS compounds is a promising technology, however the optimal treatment temperature and time, as well as associated economics have not been thoroughly evaluated. Previous results, starting at 40,000 µg/kg total PFAS, showed: 482^{o}C for 15 mins – minimal removal; 593^{o}C for 15 mins – 50% removal, and 954^{o}C for 30 mins – complete removal. In addition, none of the previous studies have evaluated the mass balance of PFAS through the treatment system to confirm contaminant destruction versus phase transfer.

The intent of this project was to evaluate the optimal treatment temperature and time to reduce the total concentration of PFAS in soil from environmentally-relevant concentrations to below detection limits and regulatory thresholds. This study also provides a quantitative mass balance confirmation of the thermal treatment process to inform remedial decision-making with a greater degree of confidence and help drive acceptance of ex situ thermal treatment as a viable remedial option to capping, landfilling, incineration or stabilization/sorption technologies.

Approach/Activities. Batches of soil contaminated with PFAS from a fire training area at a US DOD facility in the mid-Atlantic, where previous analytical results indicated PFAS impacts from AFFF, were loaded into NW Thermal's infrared heating pilot unit and subjected to a range of temperatures and treatment durations. Soil was sampled at multiple stages within the treatment process to evaluate the optimal temperature and treatment time required to achieve remedial objectives. Split samples of pre-treatment and treatment samples were analyzed by SGS AXYS and Battelle labs. At various phases, samples were analyzed for 13 PFAS compounds and 29 PFAS compounds; total oxidizable precursor (TOP) assays were also run to look at precursor transformation and degradation products. Battelle also ran PFAS analyses for mass balance within the treatment train including C18 (silica gel) cartridges to test for PFAS in vapors leaving the pilot unit and wipe samples from the inside of the pilot unit to check for residual PFAS inside the unit that may have not been destroyed or desorbed by thermal processes.

Results/Lessons Learned. Data from previous successful thermal studies will be summarized in conjunction with results from this study. The presentation will include a discussion of lessons learned from the mass balance of individual PFAS through the treatment train as well as cost information to assess competitiveness with the limited existing technologies that have been demonstrated.