Thermal Treatment of PFAS-Containing Soil Piles

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Background/Objectives. PFAS-containing soils are stock-piled at Eielson AFB in Alaska awaiting treatment. Under the ESTCP program, TRS and Paragon implemented a pilot demonstration of thermal treatment. Laboratory testing has shown strong PFAS removal at 350°C and near complete elimination at 400°C. For treatment of the ~50 piles, thermal treatment is an option. This demonstration was completed to document PFAS reductions achievable at the field scale using thermal conduction heating (TCH) to temperatures around 350 to 400°C.

Approach/Activities. A small soil pile was chosen for the demonstration. It contained 134 cubic yards of soil and was approximately 4.5 feet tall. The soil contained PFOS at an estimated starting concentration of 230 µg/kg (two orders of magnitude higher than the Alaska cleanup objective of 3.0 µg/kg). Heater borings were installed through the soil pile and the surface was covered and insulated. Heating was performed for 100 days, reaching temperatures in the pile between 350 and 450°C. Vapors were extracted from dedicated vacuum extraction wells, cooled and treated on site using a wet scrubber and activated charcoal filtration. Detailed sampling of the soil and extracted fluids was used to document the performance. This included vapor sampling using the novel EPA Method OTM-45 and paired soil samples for comparison of pre- and post-heating soil concentrations. PFAs remediation mechanisms were studied at the laboratory scale.

Results/Lessons Learned. Significant reductions of PFAS compounds were shown. All the soil samples from locations which reached 400°C were non-detect for PFOA and PFOS. Soils heated to 340-360°C for less than one week had PFOS concentrations in the 0-10 µg/kg range. One such soil sample was heated for an additional week in the laboratory at 350°C – resulting in non-detect concentrations (<0.5 µg/kg).

For large-scale field applications, the energy usage and associated costs and sustainability impacts are major factors for thermal treatment. Energy densities in the range of 600-800 kWh per cubic yard treated means that the cost of the energy will be in the order of $80-150 per cubic yard depending on local electricity costs. Total treatment costs are expected to fall in the range of $500-800 per cubic yard for larger treatment volumes. With PFOA and PFOS scheduled to be added to the CERCLA list of hazardous compounds, such treatment costs may be competitive with alternate solutions such as landfilling. If soil washing is used as the primary treatment method at a lower unit cost but produces 15-40% of the volume as untreated fine material, the fines may be treated thermally rather than landfilled. On-site thermal treatment removes the long-term liability, sometimes justifying the cost.