THERMAL CONDUCTION HEATING OF PFAS-IMPACTED VADOSE SOILS LESSONS LEARNED

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Background/Objectives:

The widespread use, ubiquitous environmental distribution, and potential human health effects of per- and polyfluorinated alkyl substances (PFAS) have resulted in an increased urgency to identify, characterize, and treat PFAS-impacted media. In PFAS source areas, vadose zone soils can be a long-term source of contamination to groundwater and surface water. Therefore, effective treatment of vadose zone soils can prevent or limit PFAS transport, protecting water resources, ecological receptors, and human health. The persistence and unique physicochemical properties of PFAS require innovative treatment approaches, particularly for PFAS-impacted soil. Soil excavation and transportation to a separate facility for treatment or long-term storage can result in the transfer of liability, as opposed to elimination of liability. Effective on-site and in situ treatment methods will reduce long-term liabilities and eliminate the need for excavation and soil relocation. Thermal conductive heating (TCH) using cylindrical heater casings has been demonstrated to effectively remove PFAS from soil by thermal desorption, providing an on-site treatment method that can be performed in situ.

Approach/Activities:

A field-scale TCH study was conducted at Beale Air Force Base in Yuba County, California, to evaluate thermal desorption of PFAS from vadose zone soils, with funding provided by the Environmental Security Technology Certification Program. Subsurface soil within a former fire training area was heated using vertically installed heater casings to a target temperature of 400 degrees Celsius (°C) from the ground surface to 13 feet below ground surface. Desorbed, volatilized PFAS were extracted using vacuum wells for ex situ management of the concentrated waste stream via granular activated carbon (GAC). The treatment efficacy was evaluated by measuring target PFAS concentrations in the pre- and post-treatment soils, the extracted vapor, and condensate process water.

Results/Lessons Learned:

The primary PFAS observed in baseline soil was perfluorooctanesulfonic acid (PFOS), concentrations of which were reduced by, on average, 99.5%. The total PFAS mass in the treatment area was reduced by 98% based upon target analysis. Both the vapor and liquid PFAS waste streams were successfully treated with GAC prior to compliant discharge. Subsurface temperatures of 350°C or greater were observed at 15 of the 20 temperature monitoring points. Groundwater infiltration was determined to be a key factor influencing treatment area heating and PFAS removal efficiency.

Review of the design and implementation of the in situ project was completed to identify lessons learned, as well as considerations that could improve efficiency and sustainability for in situ TCH treatment implementation. Implementation considerations such as mobilization, site applicability, and power requirements will be presented.

About The Author

Patrick Joyce, TRS Project Manager, has experience in environmental consulting and in situ thermal remediation (ISTR) industries. His ISTR experience includes both electrical resistance heating (ERH) and thermal conduction heating (TCH) technologies. Mr. Joyce has implemented thermal projects at remote sites, including in the middle of Alaska, to very active sites, such as a four-lane highway and a shopping center, which remained open to the public during construction and operations, and a high-profile Superfund site in Southern California. Patrick lives in Reno, Nevada, and enjoys camping, kiteboarding, and remodeling a cabin in his spare time.