STARx (*Ex Situ*) Hottpad™ Pilot Test for Treating PFAS-Impacted Soil

MILITARY BASE, ONTARIO, CANADA

OVERVIEW

Savron conducted a pilot test using a STARx Hottpad to destroy per- and polyfluoroalkyl substances (PFAS) in soil. The pilot was conducted at an active Canadian Federal Department of National Defence (DND) military base in eastern Ontario, in partnership with the US Department of Defense Strategic Environmental Research Program (SERDP). Until the project, this PFAS-impacted soil had been stored in containment cells at the base's former firefighting training area.

Pilot Test Objectives

One 10m^3 Hottpad and auxiliary equipment needed to run it were deployed to the site (IMAGE 1). The pilot evaluated smoldering treatment of PFAS-impacted soils, adding low concentrations of two amendments. Granular activated carbon (GAC) was added as a surrogate fuel to support the high temperatures required for PFAS destruction. Calcium oxide (CaO) was added to enhance thermal decomposition of PFAS and help form inert calcium fluoride, rather than releasing fluorinated breakdown products as emissions.

IMAGE 1: Pilot system setup, including (from left to right): control trailer, injection/extraction auxiliary equipment, and Hottpad vessel.

RESULTS

Field pilot tests demonstrated the following:

- >99.9% removal of PFAS to near or below detection limits
- X-ray photoelectron spectroscopy (XPS) confirmed fluorine sequestered in soil as calcium fluoride
- <0.2% of total fluorine emitted as PFAS, which can be captured via vapor-phase GAC
- <2% of total organic fluorine emitted as hydrogen fluoride

SYSTEM OPERATION

Two tests were conducted to assess the degree of soil treatment, constituents in process emissions, smoldering velocity (i.e., processing time), and average and peak smoldering temperatures. The PFAS-impacted soil was mixed with low concentrations of GAC and CaO and placed in the Hottpad system. For each test, self-sustaining smoldering conditions were achieved, with post-treatment soils remediated to below the US Environmental Protection Agency Regional Screening Level criteria and the Canadian Council of Ministers of the Environment soil guidelines for perfluorooctane sulfonic acid (PFOS) (IMAGES 2a and 2b). Total organic fluorine was also reduced to below detection limits in post-treatment soils.

IMAGES 2a and 2b: Site soils following STARx treatment during unloading from Test 1 and Test 2.

Adding CaO enhanced removal of hydrogen fluoride from emissions, thereby reducing vapor treatment requirements for remediating PFAS-impacted soil. Capture of PFAS and fluorinated breakdown products detected in emissions was achieved via vapor-phase GAC, which when spent, can be subsequently used/treated by smoldering. The pilot test findings support results from earlier laboratory testing and demonstrate the successful scale-up of smoldering to treat PFAS-impacted soil.

CONCLUSIONS

The STARx technology is a rapid, safe, and low-cost treatment option for soil that contains PFAS.

Adding low concentrations of GAC and CaO can support smoldering, enhance destruction of PFAS, and reduce requirements for vapor treatment. With these amendments, existing STARx systems can be used at full-scale to treat PFAS-impacted soil.