STARx (Ex Situ) Hottpad™ Pilot Test for the Treatment of PFAS-Impacted Soils

Canadian Forces Base Trenton, Ontario

PROJECT OF THE YEAR 2021 SERDP DOD • EPA • DOE ENVIRONMENTAL RESTORATION

Overview

The subject Site, Canadian Forces Base (CFB) Trenton, is an active Air Force base owned and operated by the Canadian federal Department of National Defence (DND) located in Southern Ontario. In partnership with the US Department of Defense (DoD) Strategic Environmental Research Program (SERDP), a STARx Hottpad™ pilot test was conducted to treat per- and polyfluoroalkyl substance (PFAS)-impacted soils from soil containment cells in the Former Fire Fighting Training Area (FFTA).

Pilot Test Objectives

The pilot system deployed to the site consisted of a single 10m^3 Hottpad and auxiliary equipment (IMAGE 1). Smoldering treatment of PFAS-impacted soils was evaluated during the pilot with the addition of low concentrations of two amendments: granular activated carbon (GAC) to act as a supplementary fuel to support the high smoldering temperatures required for PFAS destruction; and calcium oxide (CaO) to further enhance thermal decomposition of PFAS and minimize release of fluorinated breakdown products in the emissions through the formation of calcium fluoride (CaF_2).

IMAGE 2: Pilot system setup, including (from left to right): Hottpad vessel, injection / extraction auxiliary equipment, control trailer, generators / fuel cubes, and emissions extraction and treatment system (granular activated carbon [GAC]).

Conclusions

The STARx technology is a rapid, safe, and low-cost treatment option for soils impacted with PFAS.

The addition of low concentrations of amendments (i.e., GAC and CaO) support smoldering, enhance destruction of PFAS, and reduce requirements for vapor treatment. Existing STARx systems are ready to support full-scale treatment of PFAS-impacted soils with the use of these amendments.

System Operation

A total of two (2) tests were conducted to assess the degree of soil treatment, constituents in process emissions, smoldering velocity (i.e., processing time), and average/peak smoldering temperatures. The mixture of PFAS-impacted soil, GAC, and CaO was placed in the Hottpad system for treatment then covered with a limestone cap to act as a heat sink and preliminary stage of emissions treatment. For each test, self-sustaining smoldering conditions were achieved, with post-treatment soils remediated to below the US Environmental Protection Agency Regional Screening Level (EPA RSL) criteria and the Canadian Council of Ministers of the Environment (CCME) soil guidelines for PFOS (IMAGE 2). Total organic fluorine (TOF) was also reduced to below detection limits in post-treatment soils.

The addition of CaO effectively enhanced removal of hydrogen fluoride (HF) from emissions, thereby reducing vapor treatment requirements for remediating PFAS-impacted soil. Removal 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 demonstrates the successful scale-up of smoldering to treat PFAS-impacted soils.

a)

b)

c)

IMAGE 3: Site soils following STARx treatment from: a) Test 1 front of Hottpad, b) Test 1 rear of Hottpad; and c) Test 2.