PROJECT FACT SHEET

PROJECT – A NOVEL TECHNOLOGY FOR PERMANENT PFAS DISPOSAL

Objective

Aqueous Film Forming Foam (AFFF) based on per- and polyfluoroalkyl substance (PFAS) based surfactants was for decades the water-based firefighting agent of choice in military and civilian applications until it was determined that the major class of compounds that make AFFF work — PFAS — pose a health risk to humans. The Air Force, and in fact, the DoD is phasing out AFFF, and currently the only acceptable method of disposal is incineration in a Resource Conservation and Recovery Act (RCRA) certified incinerator, which is very costly. The DoD is working aggressively to address the national PFAS issue in a cohesive, consistent manner while coordinating and communicating with external stakeholders. We are making substantial progress toward understanding the Department's use of AFFF and researching fluorine-free alternatives to AFFF; monitoring and communicating information on the health effects of human exposure to PFAS; establishing policies and collecting data to track PFAS cleanup progress and costs; and supporting research and development efforts for all of these activities. This project on novel disposal of PFAS works to further those goals in research and development. The objective is to find a novel technology that achieves permanent disposal of AFFF and associated PFAS components.

Technology Description

A practical method for disposal of AFFF residues and AFFF concentrate will have to manage several significant challenges—the concentrate is typically supplied as a mixture of water, soluble organics and anionic, amphoteric, and/or non-ionic hydrocarbon surfactants, with a total fluorosurfactant content of 1–10%; the C–F bonds of PFAS, either attached to the surfactant or as the free acid or salt, are extremely stable; the high-temperature chemistry of the thousands of PFAS compounds have not been characterized, so there is no precedent to predict products of pyrolysis or combustion, temperatures at which these will occur, or the extent of destruction that will be realized.

Liquid Carbonic proposed a treatment for AFFF that will also work for other polyfluorinated chemicals (PFCs) and their derivatives. The strength of the C-F bond is the ultimate problem in disposing of PFCs and residues. The very severe conditions of supercritical water oxidation achieved in a hydrothermal flame zone reactor (HFZR) accomplish this objective. Fluorine scavenging by calcium ions is achieved in a salt separation module (SSM) that is integral to the process. Temperature, phase and salt solubility vary in the SSM, allowing withdrawal of a calcium fluoride brine. The thermal decomposition of AFFF by supercritical water oxidation (SCWO) was accomplished in a continuous flow reactor during Phase I demonstrating >99% AFFF conversion efficiency. Phase II has built on the bench-scale work by characterizing the decomposition reaction kinetics to support development of design equations for scaling the process. Additional work is focusing on alternative reactor designs to minimize technical problems related to the corrosive environment produced by SCWO. These tasks will be completed in conjunction with the overall effort directed towards the design, construction and operation of a pilot scale system.

Benefits

Legacy AFFF concentrate and PFAS contamination of water at DoD firefighting training sites is an expensive cleanup bill for the DoD with the current method of incineration. Finding a more economical method would save the DoD millions in cleanup costs per annum.