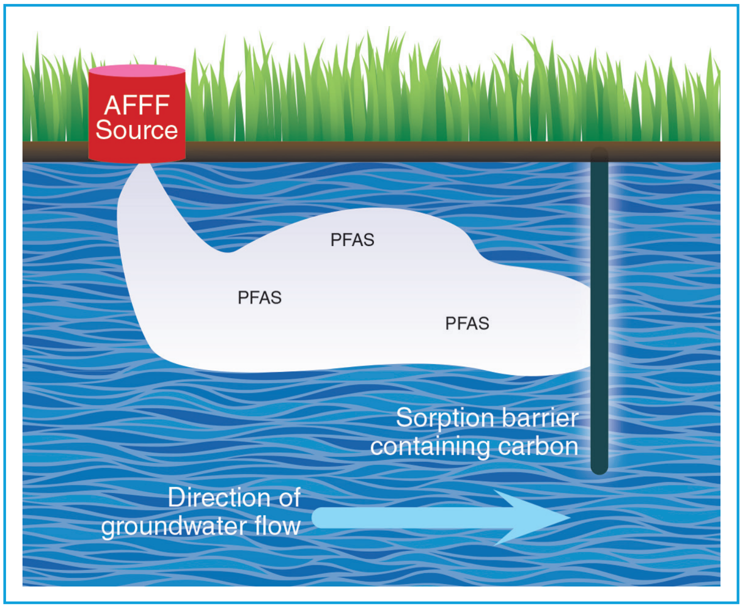
Field Demonstration of Colloidal Activated Carbon for In-situ Sequestration of Per- and Polyfluoroalkyl Substances

PROJECT ID:
569



OBJECTIVE:

The primary objective is to demonstrate and validate the field application of colloidal activated carbon for in situ sequestration of per- and polyfluoroalkyl substances (PFAS) in groundwater, thus mitigating migration of these compounds.

PROBLEM STATEMENT:

Per- and polyfluoroalkyl substances are a group of chemicals that have become widespread in groundwater at Department of Defense (DoD) sites largely through their use in aqueous film-forming foams (AFFF), commonly used in fire fighting

At AFFF-impacted sites, PFAS has been found in the soil and groundwater. In some cases, AFFF constituents have been detected in shallow soils years to decades after their use was terminated. Because PFAS are highly resistant to treatment and highly mobile, plumes continue to expand both within and beyond facility boundaries, potentially further increasing the number of impacted wells and the overall treatment costs.

While ex situ treatment approaches are progressing and full-scale systems are currently operational (primarily granular activated carbon systems added to existing pump-and-treat infrastructure), there are as yet no validated in situ approaches to treat PFAS in groundwater. One promising type of in situ amendment, designed to sorb (through adsorption or absorption) PFAS, is powdered and colloidal activated carbon (CAC). These amendments are currently being applied in the field as sequestering agents for PFAS in soils and/or groundwater aquifers. The advantage of CAC treatments is that they can be applied immediately. However, many questions remain regarding the effectiveness, long-term capacity and potential for detrimental effects associated with these treatments. Therefore, there is a clear need for objective research concerning the true effectiveness of CAC treatments.

DESCRIPTION:

CAC suspensions have been demonstrated to disperse into aquifer settings under low pressure injection or gravity feed. This material is reported to coat the aquifer matrix with a thin layer of immobilized, highly sorbent CAC. Dissolved compounds are rapidly sorbed by the applied CAC, effectively reducing dissolved phase concentrations. Based upon laboratory studies, this approach appears to be an effective option for sequestering many PFAS including PFOA and PFOS, thus slowing further plume migration. This project was formed to demonstrate this approach in situ.

The first task facing the team is the choice of an ideal site—one with shallow groundwater containing PFAS at concentrations above health advisory levels and a groundwater flow rate sufficient to evaluate the technology. The optimal site will have hydrogeological information available and geological characteristics that will allow for direct-push injection of CAC.

There is a clear need for objective research concerning the true effectiveness of CAC treatments.

After collecting groundwater and aquifer sediment from the demonstration site, researchers will conduct a treatability study in the laboratory. Groundwater will be added to two columns containing aquifer sediment—one with CAC and one without. In a short-term laboratory study with site aquifer material that is placed into a small column, researchers will measure PFAS breakthrough in the column effluent as a function of time, and will evaluate the extent to which the CAC migrates through the aquifer sediment over time. The column experiment will provide valuable data on the transport and distribution of CAC in the aquifer sediment as well as the expected adsorption capacity of CAC for representative PFAS from the demonstration site. This experiment will yield data relevant to barrier installation and overall sampling schedule.

Next, a monitoring well network will be installed at the site using a direct-push rig and prepacked wells. After installation, baseline sampling will be conducted for PFAS and other volatile organic compounds (VOC). A pilot-scale barrier will then be installed via a single row of direct-push injection points. CAC will be injected across the entire vertical extent of PFAS contained in the aquifer. A solution of sodium bromide will be added to the CAC mixture as a conservative tracer to determine distribution of the injected fluid and subsequent evaluation of groundwater flow velocity.

Over the course of the next two years, groundwater samples will be collected from all of the monitoring wells an additional eight times and analyzed for PFAS, VOCs (if present), anions (including bromide) and basic geochemical parameters. Groundwater sampling data from the monitoring well network, along with estimates of relevant groundwater flow (based on previous site characterization efforts, modeling and tracer sampling data), will be used to estimate mass flux of PFAS over time and thereby the effectiveness of the CAC treatment.

TRANSITION DESCRIPTION:

A final report will be prepared for Navy Remedial Project Managers (RPM) concerning the correct application of this approach as well as any potential problems. Results will be distributed to appropriate personnel through existing Navy contracts. The field demonstration results will be presented at a major environmental conference during the third year of the project. Additional efforts could include a presentation at the Remediation Innovative Technology Seminars (RITS) and the Environmental Restoration Training Event, Open Environmental Restoration Resource (OER2) webinar and briefings in various Navy workgroups including the Risk Assessment Workgroup (RAW) and the Alternative Restoration Technology Team (ARTT).

CONTACT:

For more specific information about this project, contact the Principal Investigator at 805-982-4805. Contact the NESDI Program Manager at 805-982-4893 for more general information about the program.

ABOUT THE NESDI PROGRAM

The Navy Environmental Sustainability Development to Integration (NESDI) program is the Navy's environmental research and development demonstration and validation program, sponsored by the Chief of Naval Operations Energy and Environmental Readiness Division and managed by the Naval Facilities Engineering Systems Command from the Engineering and Expeditionary Warfare Center in Port Hueneme, CA. The mission of the program is to provide solutions by demonstrating, validating and integrating innovative technologies, processes and materials and by filling knowledge gaps to minimize operational environmental risks, constraints and costs while ensuring Navy readiness and lethality.

Visit the program's public website at https://www.navfac.navy.mil/NESDI for more information.