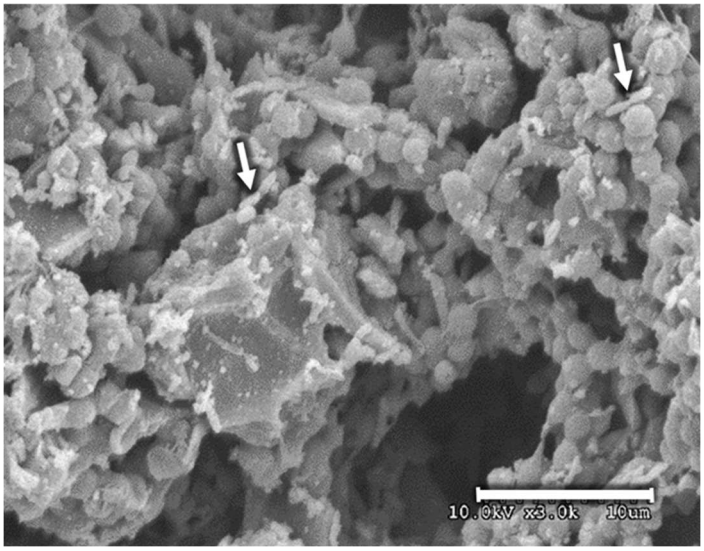
PROJECT ID:
625

Innovative Solution for Passive Management of Low-Risk Light Non-Aqueous Phase Liquid (LNAPL) Sites by Biochar-Enhanced Natural Source Zone Depletion



Scanning Electron Microscope (SEM) image of biochar with surface-localized, iron-respiring microbes participating in electron transfer interactions with the biochar material. (Photo credit: Jovan Popovic)

OBJECTIVE

The goal of this project is to demonstrate that injecting engineered biochar derived from waste biomass can improve NSZD (natural source zone depletion) for cleaning up LNAPL (light non-aqueous phase liquid), making NSZD a more viable site management solution for the Navy.

PROBLEM STATEMENT

The Navy oversees many low-risk LNAPL sites, using active recovery to manage them. However, this method becomes more expensive over time as it becomes less effective. Adding to the challenge is the disposal of PFAS (per- and polyfluoroalkyl substances) in LNAPL, which further raises costs. A Navy priority is to seek alternative solutions to transition these sites from active recovery to passive management. One promising method is natural source zone depletion (NSZD), which uses natural processes for cleanup and is more cost-effective. However, NSZD is slow and can take decades, limiting regulatory acceptance. A technology to speed up NSZD could make it a more viable and affordable solution.

DESCRIPTION

This project will build upon preliminary biochar NSZD remediation studies to further optimize the biochar properties for enhanced NSZD. The project includes four technical tasks: (i) site selection; (ii) laboratory optimization; (iii) pilot injection of biochar; and (iv) post-injection monitoring of NSZD.

The first task will identify a site suitable for biochar injection, taking site management strategies into consideration to allow for the goal of ultimately transitioning the site into passive management.

In the second task, laboratory tests will determine the ideal biochar source, dosage, and size, as well as the nutrients needed for the pilot test. The biochar's surface properties, influenced by source material and pyrolysis temperature, will be optimized for electron transfer to methanogens. The optimized biochar will be scaled up and

quality-checked for consistency with lab samples.

Task 3 involves the pilot injection of biochar to assess injectability and distribution in LNAPL-impacted subsurface. Injection parameters, such as pressure, volume, rate and daylighting, will be monitored, followed by confirmation sampling to check for biochar presence.

The final task will monitor the site post-injection, with up to three rounds of NSZD monitoring starting at least three months after injection to allow for microbial establishment. CO_2 and methane flux will be measured to assess NSZD rates. A successful demonstration requires at least a 2-fold increase in NSZD rate (from baseline) based on CO_2 and methane flux. These rates will help estimate reduced remediation time and cost savings from the biochar amendment.

RETURN ON INVESTMENT

The Navy currently manages hundreds of low-risk LNAPL sites with costly and inefficient active recovery systems. Transitioning to passive NSZD monitoring could save significant funds, allowing resources to focus on higher-priority issues like PFAS initatives. For instance, switching to passive NSZD at Yorktown could save nearly half a million dollars annually. With many similar sites, the total savings could be substantial. If successful, this demonstration could lead to widespread biochar use for enhanced NSZD across the Navy's low-risk LNAPL sites, reducing remediation time and costs.

NAVY BENEFITS

As described above, reduced time and cost of remediation are prime benefits of passive NSZD monitoring. This technology will provide a good example that can lead to application of biochar for enhanced NSZD across many of the Navy's low-risk LNAPL sites where active recovery needs to transition to passive monitoring.

TRANSITION DESCRIPTION

At the conclusion of the project, the project team will promote the demonstrated technology to Navy remedial project managers. Presentation materials, webinars and briefings to working groups will be prepared, such as the Navy's Optimization and Technology Integration (OTI) workgroup. Additional transition opportunities include presentations at the Remedial Innovative Technology Seminar (RITS), Environmental Restoration (ER) training event, and Open Environmental Restoration Resource (OER2) webinars.

Additional initiatives may include presentations to the DoD Tri-services and to regulators through engaging the Interstate Technology Regulatory Council (ITRC) LNAPL working group and the Federal Remediation Technologies Roundtable (FRTR) as well as practitioners at remediation conferences.

CONTACT

For more specific information about this project, contact the Principal Investigator, at jovan.popovic.civ@us.navy.mil

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 Office of the Chief of Naval Operations (OPNAV) Compliance and Mission Readiness Division (N4I1) and managed by the Naval Facilities Engineering Systems Command (NAVFAC) from the Engineering and Expeditionary Warfare Center (EXWC) 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 fleet readiness.

For more information, visit the program's web site at www.navfac.navy.mil/nesdi
or contact the NESDI Program Managers at NESDI.fct@navy.mil