PHASED TREATABILITY TESTING OF ISCO AND BIOREMEDIATION AT A PETROLEUM-IMPACTED SITE

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Background/Objectives:
In situ chemical oxidation (ISCO) was identified as a primary remedial technology in the Record of Decision at a former wood preservation and creosote Superfund site in Ohio. Contaminants comprised primarily of polycyclic aromatic hydrocarbons (PAHs) are present within both silty clay units and the underlying permeable sands and weathered bedrock, each with unique geochemical and physical characteristics requiring different remediation application methods.

Approach/Activities:
High resolution laser induced fluorescence (LIF) borings for NAPL detection, high resolution sampling, and a phased treatability testing program were carried out to assess the applicability and effectiveness of ISCO and bioremediation technologies prior to pilot study implementation. The silty clay layers have low permeability, leading to the concept of applying ISCO via soil mixing to ensure thorough contact with the contaminated material. ISCO injections are planned for the more permeable weathered bedrock and potentially the gravel and sand layers within the gray silty clay.

Results/Lessons Learned:
Frequent PID readings using a low-level PID detector was the most effective tool for identifying impacted intervals. Impacts were most widespread within a deep, relatively thin zone of permeable sands and weathered bedrock below silty clay layers and above competent rock. Phase 1 of the ISCO testing demonstrated effective contaminant reduction through soil mixing in the silty clay units. A mixture of sodium persulfate and potassium persulfate without added activator was the most effective chemical oxidant for a wide range of PAHs. The weathered limestone planned for injections displayed a high background oxidant demand and no contaminant degradation in the first phase of testing. Phase 2 identified some contaminant degradation using elevated doses of hydrated lime and potassium persulfate. While ISCO can quickly reduce contaminant levels, its practicality is often hindered by site-specific oxidant demands and the costs of reagents. In contrast, bioremediation, although slower in reaction rates compared to ISCO, may present a more sustainable and cost-effective method that leverages natural microbial processes for long-term degradation. The impacted groundwater is depleted of electron acceptors, including sulfate, and has elevated methane concentrations, indicating methanogenic conditions under which the rate of biodegradation can slow. These findings underscore the significance of phased treatability testing in guiding the selection of the most suitable remediation technologies, ultimately balancing treatment efficacy, practical implementation, and overall project costs.

About The Author

Georgia Caplen is an Environmental Scientist in Denver, Colorado with seven years' experience supporting environmental site characterization and risk assessment.