Full-Scale ISCR and EISB to Treat Chlorinated Solvents in Unsaturated Soils at a Former Chlorinated Solvents Manufacturing Plant

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Background/Objectives. A former chlorinated solvent manufacturing facility undergoing remediation at a Solid Waste Management Unit (SWMU) #77 that was formerly a production area (Area of Concern [AOC] E). The site is managed under the RCRA Corrective Action program with oversight by the Louisiana Department of Environmental Quality (LDEQ). Various chlorinated volatile organic compounds (CVOCs) are present in the unsaturated soils at concentrations greater than 100 parts per million (ppm) at multiple locations. The unsaturated soil impacts range from ground-surface to approximately 15 feet below ground surface. The chlorinated solvents originated from storage and transfer of solvent products in this former production area (Per/Tri Area). These CVOCs include carbon tetrachloride (CT), chloroform, 1, 2 dichloroethane (DCE),1,1,2 trichloroethane (1,1,2 TCA), tetrachloroethylene (PCE), and trichloroethene (TCE). Heterogeneous, tight, depositional soils in the target area, along with buried debris from former operations and proximity to a tenant's active pilot plant operations make this a challenging area to remediate.

Approach/Activities. Following a successful technology feasibility study at the site, between December 2015 and April 2016, in situ chemical reduction (ISCR) and enhanced in situ bioremediation (EISB) applied via direct push technology was determined to be a viable remedial alternative to treat the targeted CVOCs. Chemical reductants for direct chemical dehalogenation of the targeted chlorinated compounds, as well as co-injection of electron donor, nutrients and enriched bacteria culture to enhance both abiotic and biotic dechlorination. Pre-injection baseline sampling and analysis of CVOC concentration were performed at three target depths (3-5 ft, 8-10 ft, and 12-15 ft bgs) over the 15-foot vertical injection horizon. In addition, microbiological/genomic testing was conducted on soil samples to determine the presence or absence of dechlorinating bacteria, and thereby determine the biotic and abiotic degradation pathways. Post-injection soil sampling was conducted approximately 100 days after the initial injection event to determine the effectiveness of the remediation program to destroy and/or degrade the targeted chlorinated volatile organic compounds (CVOCs) present in soil. Follow-up genomic testing was also performed to determine the effects of the injected chemistry on the biological communities present in the subsurface soils. Additional remedial performance testing is planned for late 2017/early 2018.

Results/Lessons Learned. The reduction in CVOC concentrations is mixed and not as dramatic as the feasibility test results, although initial post-injection performance testing likely occurred too soon to fully realize the benefits of the EISB amendments. The initial short-term CVOC concentration reductions via abiotic processes were not realized as expected from the feasibility test results, but portions of the injection area showed positive results for several CVOCs. This presentation will discuss the reductions achieved as well as challenges faced and lessons learned that will assist in targeting future injections or alternative remedy selection.These include: subsurface obstructions/refusal; severe wet weather conditions during injection, as well as amendment distribution challenges due to the tight, heterogeneous clay soils across the AOC. Initial genomic data indicate that both reductive biotic and abiotic pathways are likely occurring

with abiotic sulfate reduction being the predominant pathway, and we expect greater reductions to be observed in planned future performance testing (Dec. 2017/Jan 2018).