Combining Biotic and Abiotic Treatment Processes Post In Situ Thermal Treatment (ISTT)

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Background/Objectives. Soil and groundwater remediation using in situ thermal treatment (ISTT) or combined in situ chemical reduction (ISCR)/in situ bioremediation (ISB) are both widely accepted approaches in the USA and internationally. Typically, ISTT is implemented to address source area contamination, such as non-aqueous phase liquids (NAPLs), to maximize the benefits for contaminant mass removal. At most of these sites a downgradient dissolved phase plume extends away from the source area and requires remediation. The use of ISCR/ISB implemented as permeable reactive barriers (PRBs) can be an effective, sustainable approach for addressing dissolved phase contaminant migration and both abiotic and biotic reaction kinetics can benefit from elevated groundwater temperatures. This presentation will discuss results from the combined implementation of ISTT and ISCR/ISB PRBs at a site, located in the northeastern USA region, to remediate chlorinated volatile organic compounds (CVOCs) in soil and groundwater.

The full-scale implementation is presented to illustrate the combined approach at a site where multiple injected combined ISCR/in situ bioremediation (ISB) barriers were installed for the treatment of chlorinated volatile organic compounds (CVOCs) (primarily trichloroethene, up to 180 mg/L, cis-dichloroethene up to approximately 90 mg/L, and vinyl chloride up to approximately 4 mg/L) that have migrated from a previously thermally remediated source area.

Approach/Activities. Exceedances of regulatory criteria were present in groundwater at the site. The zones of highest mass flux were identified through sampling of monitoring wells, high resolution site characterization, and groundwater flow assessment. The PRBs were designed to intercept the groundwater plumes and provide a green and sustainable in situ remedy. Reagents were selected based on site-specific geochemistry and COCs, while the reagent dosing and placement was determined based on groundwater geochemical parameters (e.g., pH, ORP), groundwater flux and reductive contaminant stoichiometry. The injected PRB barriers were installed to provide variable dosing of ISCR reagents and bioaugmentation culture to target contaminated groundwater, migrating at defined depth intervals ranging from 10 to 57 ft below ground surface (bgs), with abiotic and biotic chemical reduction processes while leveraging the post thermal treatment heat migrating from the former source areas.

Results/Lessons Learned. Post-injection monitoring results from over 3 years indicates significant improvement in downgradient groundwater biogeochemical conditions and reductions in groundwater CVOCs. An analysis of the performance data including groundwater biogeochemical parameters, groundwater temperature, and CVOC trends and distributions will be presented. Groundwater temperature within the PRBs have ranged to over 40^{o} C.