Augered Soil Removal and In Situ Biological/Chemical Degradation of PCE

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Background/Objectives. A dry cleaning solvent release occurred sometime in the past at Site 3 (Former Laundry) on United States Coast Guard (USCG) Base Kodiak, Alaska, to a 25-foot thick horizon of silty sand and gravel overlying bedrock, in an area abutting a building foundation, parking lot, road and buried storm sewer and sanitary sewer lines. Groundwater occurs as shallow as 5 feet. A pilot treatment study is underway, and consists of removing release area soil impacted with tetrachloroethene (PCE) and related chloroethenes, backfilling with an amended sand designed to promote degradation of site contaminants, and pre- and post-installation groundwater monitoring. The study assesses the combination of soil removal and groundwater treatment for use in areas of utility upgrades, including decreasing chloroethene mass in shallow source media to protect against migration in groundwater, and decreasing chloroethene mass in groundwater to protect against possible vapor intrusion at nearby buildings, and against recontamination of previously remediated areas.

Approach/Activities. Pre-study groundwater characterization samples were collected from six monitoring wells in April and May, 2016, to characterize chloroethene concentrations and groundwater geochemistry in positions that are upgradient, within, and downgradient of the treatment area. Then, several buried utilities were removed. In October 2016, the field team removed and disposed of approximately 357 tons of contaminated release area soil down to bedrock using large-diameter auger and casing techniques (to maintain building stability). Many boreholes were backfilled with clean sand amended with Daramend® (from Peroxychem), containing food-grade organic carbon and zero valent iron (ZVI) to act as a permeable reactive barrier that enhances biological growth, depletes oxygen in the groundwater and drives the local redox conditions anaerobic, spurring biotic and abiotic degradation of the PCE and other chloroethenes. Evaluation of treatment effectiveness continues using groundwater monitoring.

Results/Lessons Learned. The pre-study groundwater data are generally consistent with some ongoing natural attenuation of chloroethenes, although the sulfate, ethene, and methane data indicated that the strength of the reducing environment was low, inconsistent, and/or small in extent. The total organic carbon concentrations were lower than the 20 milligram per liter level considered optimum for biological reductive dechlorination, and Dehalococcoides bacteria that anaerobically degrade the chloroethenes were not detected. Two post-installation rounds of groundwater monitoring have occurred, and geochemical parameters, chloroethenes and other organic byproducts of fermentation, and bacterial populations are being tracked. Following the installation of the Daramend® amendment, the dissolved iron concentrations and total organic carbon concentrations have risen dramatically within the release area groundwater, the microbiological consumption of the carbon in the Daramend®, accompanied by reaction of the ZVI in the amendment with groundwater has caused stronger anaerobic conditions to form in the aquifer, and changes in concentrations of various chloroethene compounds, and the loss of molar chloroethene mass, are evidence that degradation of PCE to breakdown products has accelerated. Groundwater monitoring continues, and the study design contemplates a 3- to 5-year period of effectiveness for the Daramend®.