

In Situ Chemical Reduction of TCE Using Multiple Electron Donors in Low Permeability Subsurface Soils

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Background/Objectives. GHD applied in situ chemical reduction (ISCR) using multiple electron donors – emulsified lecithin substrate (ELS™; PeroxyChem, LLC), sodium lactate (lactate), and zero-valent iron (ZVI) via pneumatic fracturing for aggressive treatment of trichloroethene (TCE) at a site in Mountain View, California. The site geology in the target treatment interval of 5 to 20 feet below ground surface (bgs) is characterized by silty clay, clayey silt, and clays with inter-bedded 2- to 3-foot thick sand channels. The treatment of ELS+lactate+ZVI began in 2017. The purpose of ISCR treatment was to aggressively treat persistent elevated TCE concentrations (above 100 micograms per liter [µg/L]) at a site consisting of a parking lot and an occupied office building. Static groundwater level was at 5 feet bgs. TCE concentrations up to 400 µg/L were found in the groundwater beneath the target treatment area.

Approach/Activities. ISCR was implemented by injecting ELS, sodium lactate, ZVI, Accelerite®, and bioaugmentation culture SDC-9™ (CB&I, LLC) containing *Dehalococcoides* type dechlorinating microorganisms by pneumatic fracturing. The soil matrix was fractured by pressure injecting nitrogen gas into the treatment area formation to increase the distribution of treatment products. The distribution of injected materials was analyzed by utilizing a magnet lowered down wells to capture ZVI and by measuring ZVI in confirmation soil borings using a magnetic susceptibility meter. The treatment design consisted of injecting approximately 39,560 pounds (lbs) of ELS, 19,324 lbs of sodium lactate, 136,000 lbs of ZVI, 900 lbs of Accelerite, and 179 liters of SDC-9, in a total of 115 direct-push borings placed at 18-foot on-center over 60,000 square feet of target treatment area. Quarterly groundwater sampling to evaluate the performance of ISCR treatment began in 2017.

Results/Lessons Learned. TCE degradation without significant production of cis-1,2-dichloroethene and vinyl chloride was observed following ELS+lactate+ZVI application. Evaluation by magnetic susceptibility and magnetic capturing in wells indicated that ZVI was effectively distributed by pneumatic fracturing in silts and clays. The distribution of ZVI reached approximately 10 feet laterally from injection locations. ISCR substrates are expected to stay in place and provide treatment over the long term. Evaluation of ISCR treatment will continue over the next five years.