Comparison of Hydraulic and Pneumatic Injection Techniques for In Situ Chemical Reduction of TCE in Low Permeability Aquifers

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Background/Objectives. This presentation describes comparison of hydraulic and pneumatic injection techniques for in situ chemical reduction (ISCR) of trichloroethene (TCE) in low permeability aquifers. GHD applied ISCR for the treatment of TCE using multiple ISCR substrates – EHC®, emulsified lecithin substrate (ELS™; PeroxyChem, LLC), sodium lactate (lactate), and zero-valent iron (ZVI) at a site in Mountain View, California. EHC and ELS+ZVI were injected by hydraulic emplacement in 2013 and 2015, respectively. The treatment of ELS+lactate+ZVI by pneumatic emplacement was evaluated in 2017. 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. Static groundwater level was at 5 feet bgs.

Approach/Activities. Distribution of EHC injection by hydraulic emplacement in 2013 was evaluated by collecting confirmatory soil cores and scanning them with a magnetic susceptibility (MS) meter to measure iron content as indicative of EHC in the formation. The distribution of ELS+ZVI injection by hydraulic emplacement in 2015 and that of ELS+lactate+ZVI injection by pneumatic emplacement in 2017 was evaluated by lowering a magnet in a well to determine the presence of ZVI.

Results/Lessons Learned. EHC distribution in low permeability sediments was influenced by stratigraphic heterogeneity. MS meter readings indicated preferential distribution of EHC in single fractures created by hydraulic emplacement. However, MS meter readings indicated EHC was distributed through silts and clays in the target interval of 5 to 20 feet bgs. An average distribution radius of 7 feet with injection flow rates less than 10 gallons per minute (gpm) were observed during EHC injection by hydraulic emplacement. In comparison, an average distribution radius of 10 feet with injection flow rates up to 15 gpm were observed during ELS+ZVI injection by hydraulic emplacement. The distribution radius of ELS+lactate+ZVI injection by pneumatic emplacement was estimated to be more than 10 feet with injection flow rates up to 25 gpm. Surfacing of materials was observed with both injection techniques.

Both injection techniques were found to be effective in distributing ISCR materials through low permeability aquifer sediments in the shallow target interval. Pneumatic emplacement was found to have better flow rates and consequently better distribution radius compared to hydraulic emplacement.