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Lessons Learned from Application of In Situ Chemical Reduction Technology to Treat Chlorinated Ethenes in Fractured Bedrock at a Redevelopment Site

Fayaz Lakhwala (fayaz.lakhwala@peroxychem.com) and Ravi Srirangam
(PeroxyChem, LLC, Philadelphia, PA, USA)
Ronald Harwood, Eric Mertz, Mike Meriney and Lawra Dodge
(Excel Environmental Resources, North Brunswick, NJ, USA)

Background/Objectives. A former dry cleaner facility and surrounding properties in River Edge, New Jersey were being redeveloped into a retail mall. The dry cleaning operations ended in late 1990s. Discharge of perchloroethylene (PCE) wastes directly onto the ground surface resulted in two source areas at the site. Since the removal of source material in early 2000s, concentrations of PCE and daughter products decreased but still remained significantly above the NJDEP Ground Water Quality Standards (GWQS).

The complex subsurface geology consists of unconsolidated silt, sand and clay as the overburden unit. Weathered and fractured rock underlies the overburden. Concentration of PCE in source area monitoring wells ranged from 5,000 to 25,000 ug/L. A comprehensive investigation was undertaken to map the site-specific geologic features, hydrogeology, geochemistry and contaminant distribution to develop a conceptual site model (CSM).

Approach/Activities. Remediation strategy was largely driven by the redevelopment aspects of the site with a realization that there would be limited to no future access at the site for continued treatment. The CSM indicated that the geochemical conditions in the targeted treatment zone supported an in situ chemical reduction (ISCR) approach. ISCR would also provide both short and long-term treatment which was a key consideration. Remediation goals were to achieve a significant reduction in mass of total CVOCs within three years.

A remediation plan around EHC®, an ISCR amendment that combines the synergistic effects of zero valent iron (ZVI) and organic carbon for treatment of chlorinated ethenes (CE) was developed and approved. A total of seventeen injection points were installed in the two source areas based on an estimated radius of influence of 25 ft. EHC was injected by creating 175 fractures using pneumatic fracturing technology. Approximately 1,500 lb of EHC was injected in each fracture. The EHC injections were completed in March 2012.

Results/Lessons Learned. Hydraulic fracturing was very effective in achieving a ROI greater than 25 feet. Rapid reduction of PCE accompanied by temporal fluctuations of degradation products TCE, DCE and VC was observed. Complete reduction of PCE to below 1 ug/L was noted at several key well locations. However, after 4 years due to diminishing electron donor and continued back diffusion from the rock, CE concentrations in some areas reached an asymptote. A strategy was developed to target these areas based on lessons learned. The overall approach was still ISCR but the chemistry and formulation was altered slightly to get better performance. Results from the second phase of this remediation will be presented.