

Seeking Site Closure in Bedrock: In Situ Chemical Oxidation Strategy for Treatment of a TCE Plume in Fractured Bedrock

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Background/Objectives. An in situ chemical oxidation (ISCO) program has been implemented to address a TCE plume at a site located in central New Jersey. Several rounds of ISCO injections succeeded in reducing concentrations of trichloroethylene (TCE) in the bedrock aquifer to concentrations appropriate for monitored natural attenuation, with the exception of one well, MW-12B, along the plume centerline near the property boundary. Recent groundwater sampling in monitoring well MW-12B revealed TCE at a concentration of 6,300 µg/L. A discontinuous reactive barrier was designed to intercept groundwater migrating through bedrock fractures to reduce overall TCE mass flux beyond the property boundary. The ISCO amendment selection for the treatment barrier initially considered the use of Sustained Oxidation and Controlled Oxidant Release Encapsulants (SOCORE), manufactured by Specialty Earth Sciences, LLC, to provide a controlled release of potassium permanganate over several months, reducing TCE concentrations to levels appropriate for monitored natural attenuation (MNA).

Approach/Activities. A network of 10 injection wells was installed along 120 feet of the property boundary. The wells were installed with an open interval between 100 and 150 feet below grade. Groundwater samples collected the injection well installations returned very elevated concentrations of TCE in six wells, with a maximum concentration of 940,000 µg/L. These elevated concentrations indicate that DNAPL is present near the treatment zone. The TCE distribution in the area also suggests that the remaining DNAPL mass is limited, as sharp concentration gradients were found. Injection wells IW-9B and IW-11B are located approximately 30 feet apart, but contain TCE at concentrations of 610 and 940,000 µg/L respectively.

Based on the elevated TCE concentrations in the new injection wells, the ISCO strategy was altered to include limited groundwater recovery and liquid sodium permanganate injections, in combination with SOCORE installation. The liquid permanganate injection will allow for the delivery of a higher oxidant dose in areas where TCE concentrations are greater than 10,000 µg/L. The permanganate solution will be pumped into the injection wells immediately following a groundwater extraction event, to minimize the potential for DNAPL displacement towards the property line.

Results/Lessons Learned. The permanganate loading rates were estimated based on TCE concentrations, the natural oxidant demand of the bedrock matrix, the fractured bedrock porosity and the anticipated groundwater velocity. Because of the low overall porosity of the fractured rock, and minimal natural oxidant demand, the required oxidant mass is relatively low, with an anticipated lifespan for the SOCORE cylinders of between 4 months and one year. The ISCO injections will occur in the fall of 2017.