Tetrachloroethylene Groundwater Remediation in a Dolomitic Limestone Aquifer Using Injectable Zero Valent Iron

Valerie L. Wilson, EIT, and ***Timothy H. DeWitt, P.E.***
(August Mack Environmental, Inc., Indianapolis, IN, USA)

Background/Objectives. Tetrachloroethylene (PCE) and its daughter products were detected in the shallow portion of a dolomitic aquifer between 5 and 30 feet below ground surface (ft bgs) at a former dry cleaning facility located in Indiana. To delineate impacts across the Site, two geophysical surveys, which utilized electrical resistivity and seismic refraction, were conducted to evaluate the competency of the bedrock so that monitoring wells could be specifically located in areas of more or less competent bedrock. Selecting locations to install monitoring wells based on surveyed bedrock competency helped to distinguish groundwater flow and contaminant migration pathways. Based on select geochemical analysis and groundwater concentration data results, injection of zero valent iron (ZVI) into the dolomitic aquifer was selected to mitigate the groundwater and source area impacts present at the Site. ZVI was injected along with a carbon compound to enhance both biotic and abiotic processes within the contaminated aquifer.

Approach/Activities. Prior to selecting and conducting ZVI injections for Site-wide treatment, a pilot test was completed to evaluate the chemical selection/injection technology and the ability of the bedrock to accept chemical injections for contaminant treatment. Since the contaminated intervals reside in bedrock, permanent injection points were installed via Rotosonic® drilling methods. A borehole straddle packer was selected as the injection tooling and a chemical grout pump was selected for pumping the chemicals into the bedrock formation. ZVI coupled with a specialized carbon substrate was selected for the chemical injection to enhance biotic and abiotic chemical pathways, while also limiting methanogenesis. The pilot test included four injection point locations to test the ability of the selected injection tooling and pump assembly in areas of weathered to highly competent rock and to further validate results from the geophysical surveys. Additional monitoring points were installed 10 and 20 feet away from the injection point locations to allow sample collection to evaluate the Radius of Influence based upon the presence of migrating ZVI and subsequent geochemical analysis to assist with design of a full scale injection.

A full-scale ZVI injection was subsequently implemented based upon the results of the pilot test activities. The full scale injection included 21 injection locations with reuse of five injection points utilized during the pilot test. The injection strategy included injecting the outer points first followed by injection of the inner points to limit the potential contaminant push further offsite. Following full scale injection, a methane survey was also completed to alleviate limit State Agency concerns that excessive levels of methane would be generated during this application.

Results/Lessons Learned. Pilot test results provided insight into the relationship of injection pressures versus ZVI injection rates, which was a lesson learned and was invaluable during full-scale implementation of the injection activities. Pilot test results also helped evaluate the Site specific conditions allowing modification of the required ZVI dosage which resulted in a substantially reduced dose versus pre-pilot test estimates that were based upon bedrock porosity with an application factor applied by the chemical vendor. This lesson learned helped alleviate the potential for overdosing and over-driving the environment into un-necessary methanogenic conditions. The presentation will share chemical concentration percent reductions, geochemical trends, and full-scale injection design strategies. Baseline concentration data along and post pilot test and post full-scale implementation concentration

data will be provided in addition to final result interpretations and trend evaluations and discussions.