Enhanced In Situ Chemical Oxidation Pilot Test, Guarulhos, Brazil

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Background/Objectives. In situ chemical oxidation (ISCO) projects involve the delivery of chemical oxidants into the subsurface with the goal of contacting residual contaminants in soil and groundwater where the contaminants can be destroyed by reaction. This remedial approach has been conducted since the mid 1990s with varying levels of success in a wide variety of geologic environments such that pilot tests are often not completed. This paper will present the detailed results of an injection pilot test using base-catalyzed persulfate (BCP) at a manufacturing Site in Brazil where the findings of the pilot test were critical to the selection of a remedial approach.

Approach/Activities. Subsurface geology consists of a 20-meter thick fine grained, low hydraulic conductivity, weathered saprolite sequence. Residual concentrations of Tetrachloroethylene (PCE) greater than 1 milligram per liter (mg/L) and lower concentrations of daughter products were present in the pilot area. Given the fineness of the formation, an injection pilot test was completed to evaluate various injection techniques to deliver ISCO reagents to the target strata. BCP was selected as the injection media in order to provide a measurable geochemical signature (i.e., active tracer) and reactive oxidant (i.e., to provide pilot treatment of residual concentrations) for to the pilot evaluation.

BCP ISCO reagents were prepared using an automated mixing trailer and applied to the subsurface using a single well triplet to focus the injectate into each of three three-meter thick (3 m) intervals. Evaluation of the injection employed a detailed monitoring network including three 20 meter deep Continuous Multi-channel Tubing (CMT®) monitoring wells (each provided with up to seven channels for discrete groundwater measurement) as well as several existing monitoring wells.
Injection activities were completed using up to four discrete means of injection:

- gravity injection (~3 psi, 29 kpal)
- low pressure injection (10 – 30 psi, 70 – 210 kpal)
- high pressure injection (30 psi or slightly less than fracture pressure)
- pulsed/pore dilation using Primawave® technology

Injections were initiated in a single interval in each means of injection and the resultant monitoring completed. The injection pressures were successively increased in individual and combined screens so as to evaluate the injectate distribution, injection rate, backpressure and competition between wells thereby simulating various injection scenarios.

Results/Lessons Learned. This paper will discuss the overall injection approach and will illustrate the detailed data analysis and visualization completed to illustrate the data in a unique visual format for ease of interpretation.