TCA remediation using nanoscale zero-valent iron at a former manufacturing facility located in central Ohio

I&EC 177

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Nanoscale zero-valent iron (NZVI) was used in a pilot study to remediate groundwater impacted with chlorinated solvents. The principal constituent of concern was 1,1,1-trichloroethane and its degradation products. NZVI is nanometer, bacteria-sized particles of zero-valent iron which are capable of destroying a wide range of recalcitrant contaminants, both in-situ and ex-situ, through the redox process. For chlorinated solvents, the degradation process is best described as anaerobic corrosion; the iron acts as a reductant, donating an electron and removing a chlorine atom from the hydrocarbon.

This site lies along the margin of a valley bottom formed by the deposition of glacial outwash covered by approximately 10 feet of more recent clay till and alluvium in a drainage that was incised into flat-lying bedrock. Unconsolidated deposits under the site vary in thickness from 30 to 90 feet. The buried aquifer is unconfined, and the water table is typically encountered at 20 feet below ground surface. Groundwater flow rate for the aquifer's shallow portion is 35 to 75 feet per year.

Prior to the July 2006 pilot study, NZVI dosage amounts were calculated during a bench scale study, the results of which indicated that significant contaminant reduction should occur within a week. The pilot study involved one injection point, and piezometers were installed to monitor groundwater quality down-gradient and side gradient. Baseline concentrations ranged from 190 to 370 ppm of 1,1,1 TCA and 195 to 382 ppm total VOCs. Since the initial injection, performance monitoring data indicate a steady decrease in concentration and up to 85 percent reduction of contaminants after three months. Final sampling is scheduled for January 2007. Performance monitoring data will then be used to design a full-scale implementation utilizing NZVI.

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