Abiotic Degradation of TCE in Groundwater: A Case Study

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Background/Objectives. In the mid-1990s, groundwater under and downgradient from a manufacturing facility in Missouri was found to be contaminated with TCE at concentrations exceeding 5 mg/L and extending up to a mile downgradient. A PRB consisting of zero valent iron is planned on being installed on the site to mitigate the source to downgradient contamination. Laboratory tests are being conducted to evaluate the best ZVI source and the estimated longevity of the PRB. In the laboratory tests the loss of ZVI in the soil with TCE-contaminated groundwater was monitored by using magnetic susceptibility as a non-destructive means of monitoring the ZVI concentration. The testing indicated that the site soil contained a relatively high magnetic susceptibility without any added ZVI. Since natural magnetic susceptibility is often associated with the presence of magnetite, and magnetite can abiotically degrade TCE, an evaluation of whether abiotic degradation was an important factor in the remediation of the groundwater was conducted.

Approach/Activities. Abiotic degradation of TCE can be indicated by several lines of evidence, including:
• Loss of TCE over time and distance in the groundwater
• Absence of the high concentrations daughter products (vinyl chloride and DCE) from biotic degradation
• Confirmation testing using radiolabeled TCE

Results/Lessons Learned. TCE concentrations over time at groundwater monitoring wells on site and downgradient showed a decrease with both time and distance, with a concentration pattern suggesting a first order decay (consistent with magnetite-induced degradation) with a half-life of under one year. Concentrations of daughter products are orders of magnitude lower in concentration than the TCE, again consistent with abiotic degradation by magnetite. The groundwater concentrations patterns are consistent with abiotic degradation. Confirmation suing radiolabeled TCE is currently being conducted. The results indicate that abiotic degradation is a significant factor in site remediation, and will decrease the amount of ZVI needed in the PRB.

The potential for abiotic degradation is often overlooked, but may be an important factor in design and cost savings in the remediation of chlorinated ethane-contaminated groundwater.