# Sulfidated ZVI Accelerates Bioremediation in Permeable Barriers and Source Zones

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**Background/Objectives.** Anaerobic bioremediation is an established technology for addressing contaminated groundwater. Although effective in many environments, the technology is inherently slow, and this places limitations on the situations where successful remedies can be implemented. These limitations include using stand-alone bioremediation in permeable reactive barriers, where the residence time of the dissolved phase advecting through the barrier is usually insufficient to eliminate the contaminants before they pass downgradient. Anaerobic bioremediation also has limitations when addressing source zones containing DNAPL where stand-alone anaerobic bioremediation has the tendency to produce high concentrations of persistent daughter products. Our objective is to describe the results of research, modeling, and field programs that demonstrate the synergistic benefits of using sulfidated zero valent iron (SZVI) to promote accelerated bioremediation.

**Approach/Activities.** Laboratory column studies compared the performance of using a product mixture of sodium lactate and dehalococcoides to that of a product mixture also containing SZVI. These studies involved passing 2 mg/L TCE through columns and measuring contaminant concentrations in the effluent. It is anticipated that by incorporating SZVI, degradation kinetics will be increased, and the extent of daughter product formation will be reduced.

Field studies were undertaken to evaluate the ability of a mixture of SZVI, a fermentable organic emulsion product, and microbes to address source zone contaminants. Several rounds of quarterly data were taken to measure and evaluate groundwater response.

**Results/Lessons Learned.** The laboratory studies showed that small additions of SZVI promoted abiotic degradation and accelerated bioremediation rates. No parent or daughter products were eluted from the column at 10 weeks. This compared to a 30% removal in the bioremediation-only column. Modeling of this data was used to predict the environments where SZVI enhanced bioremediation can be successfully applied in permeable reactive barriers.

The source zone field study showed a clear method of action. This involved the partitioning of TCE into the hydrophobic oil droplets. Eight months after product application, the oil phase droplets had sufficiently degraded to release the contaminant into the aqueous phase, mostly as cDCE. Only one year after product application 99.6% of chlorinated ethenes were eliminated with notable increases in ethene and ethane, indicating that both abiotic and biological processes were operable.