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# TCE reduction modeling in soil column: Effect of zero-valent iron, ferrous iron, and iron-reducing bacteria

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**ABSTRACT**

A model was developed to simulate the reduction of trichloroethylene (TCE) by permeable reactive barriers (PRBs). The model based on an axial transport model with chemical reaction terms was operated for a TCE solution, incorporating dispersion, convection, and reaction along the column flow-path and time. Reaction terms included TCE reduction by zero-valent iron (ZVI) or ferrous iron produced from ferric iron by iron-reducing bacteria (IRB). ZVI was oxidized by TCE to ferric iron which has no ability to reduce TCE. IRB reduced ferric iron to ferrous iron by transferring electrons from organic carbon sources such as lactate or glucose. Ferrous iron, thus produced, constantly reduced TCE although it had a relatively low reducing power compared to ZVI. The TCE concentration at the mid-port of the ZVI column was lower than one-tenth of the influent concentration until 200 h, but reached a 99% breakthrough at 1,390 h. The TCE reduction efficiency by the ZVI column was not recovered after the breakthrough. On the other hand, the life of ferrous iron column was prolonged in the presence of IRB. The TCE reduction efficiency was maintained at over 60% with 10,000 mg-IRB/L–pore volume of IRB. These results indicate that the application of IRB would be economical for a long-term operation of iron-based PRBs.

*Keywords*: Trichloroethylene; Modeling; Zero-valent iron; Ferrous iron; Iron-reducing bacteria

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