# Comparison of Chlorinated Solvent Dechlorination Rates Across Batch-, Laboratory-, and Pilot-Scales

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Although bioremediation is a well-established remedy for groundwater contaminated with chlorinated solvents, using laboratory-measured dechlorination rates may result in overestimation of contaminant degradation and underestimation of contaminant clean-up times. To compare rates of microbial reduction dechlorination (MRD) in systems of increasing complexity, microcosm experiments, a 0.6m long x 0.38m high x 1.4m thick aquifer cell experiment, and a 1m long x 4m wide x 1m thick biostimulation/bioaugmentation field-scale pilot test were completed. The field test was performed at a trichloroethene (TCE)-contaminated Superfund site (Williston, VT) and soil and groundwater from the site were used in laboratory studies. Experiments were completed with the same commercially-available tetrachloroethene–to-ethene dechlorinating inoculum, KB-1® (SiREM), provided with lactate as electron donor.

Effective dechlorination rates in the 2-D aquifer cell and 3-D pilot test were compared using a fully coupled flow, transport, and biodegradation numerical simulator. MRD was modeled using modified Monod kinetics accounting for limited election donor availability and daughter product inhibition. Modeling results reveal that applying microcosm-derived maximum substrate utilization rates (0.33, 0.08, and 0.21 mmol/mg-cell-day, for the transformation of TCE to *cis*-1,2-dichloroethene (*cis*-DCE), *cis*-DCE to vinyl chloride (VC), and VC to ethene, respectively) did not yield good predictive agreement (108% relative error) with aquifer-cell observations of chlorinated ethene concentrations. An optimal fit was obtained (19% relative error) by reducing the maximum substrate utilization rate for *cis*-DCE to VC to 0.06 mmol/mg-cell-day and by removing TCE and *cis*-DCE inhibition of VC transformation. Application of temperature-adjusted, aquifer-cell calibrated parameters to predict the *in situ* measurements of ethene and chlorinated ethene concentrations did not yield good agreement with field measurements due to the lack of a detailed knowledge of field soil heterogeneity. Coupling laboratory observations with numerical modeling demonstrated the importance of local heterogeneity and resultant system residence time on complete biotransformation of TCE to ethene

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