XVIII International Conference on Water Resources
CMWR 2010
J. Carrera (Ed)
CIMNE, Barcelona 2010

SIMULATION OF ENHANCED REDUCTIVE DECHLORINATION FOR REMEDIATION OF TCE IN A FRACTURED CLAY SYSTEM: A NEW MODEL APPROACH AND APPLICATION TO FIELD SITE

G. Manoli[*], J. Chambon[*], C. Christiansen[*], M. Broholm[*], P. L. Bjerg[*], P. J. Binning[*]

[*] Department of Environmental Engineering
Technical University of Denmark
Miljøvej , Building 113, DK-2800 Kgs. Lyngby, Denmark
e-mail: pjb@env.dtu.dk, web page: http://www.env.dtu.dk

Summary. An innovative model is developed for Enhanced Reductive Dechlorination (ERD) of chlorinated solvents in a fractured glacial till. The model consists of three components: hydraulics, transport and degradation. The hydraulic component calculates the flow of water through a fractured clay till with interspersed sand lenses and stringers. The transport model couples diffusion dominated transport in the clay matrix, with advective-dispersive transport in the fractures and higher permeability sand lenses. The reactive model calculates sequential reductive dechlorination of TCE (trichloroethylene) to its daughter products DCE (dichloroethylene), VC (vinyl chloride) and ethene. The model employs a Monod kinetic description, with two degrading bacterial populations, and competitive inhibition. The model is applied to a field site located in Tommerup, Denmark, where ERD has been used to remediate a contamination of trichloroethylene located in a fractured clay till. The site is simulated using the model developed. Fracture geometry, site parameters and degradation rates are based on observations from the site and lab studies. The risk for drinking water is assessed and cleanup times are simulated using model results. The spatial extent of remediation and downstream impact of the technology is evaluated. Perspectives for enhanced bioremediation technologies in fractured clay systems are discussed.