DAVID W. MAJOR[1], MICHAYE L. McMASTER AND EVAN E.COX
GeoSyntec Consultants, Inc., 130 Research Lane, Suite 2, Guelph, Ontario, N1G 5G3
ELIZABETH A. EDWARDS AND SANDRA M. DWORATZEK
University of Toronto, Dept. of Chemical Engineering and Applied Chemistry, 200 College Street, Toronto, Ontario, M5S 3E5
EDWIN R. HENDRICKSON, MARK G. STARR, JO ANN PAYNE AND LOIS W. BUONAMICI
E.I. DuPont de Nemours & Company, Inc., Central Research and Development, P.O. Box 6101, Glasgow 300, Newark, Delaware, 19714-6101

ABSTRACT

A laboratory microcosm study and a pilot scale field test were conducted to evaluate biostimulation and bioaugmentation to dechlorinate tetrachloroethene (PCE) to ethene at Kelly Air Force Base. The site groundwater contained about 1 mg/L of PCE and lower amounts of trichloroethene (TCE) and *cis*-1, 2-dichloroethene (cDCE). Laboratory microcosms inoculated with soil and groundwater from the site exhibited partial dechlorination of TCE to cDCE when amended with lactate or methanol. Following the addition of a dechlorinating enrichment culture, KB-1, the chlorinated ethenes in the microcosms were completely converted to ethene. The KB-1 culture is a natural dechlorinating microbial consortium that contains phylogenetic relatives of *Dehalococcoides ethenogenes.* The ability of KB-1 to stimulate biodegradation of chloroethenes in situ was explored using a closed loop recirculation cell with a pore volume of approximately 64,000L. The pilot test area (PTA) groundwater was first amended with methanol and acetate to establish reducing conditions. Under these conditions, dechlorination of PCE to cDCE was observed. Thirteen liters of the KB-1 culture were then injected into the subsurface. Within 200 days, the concentrations of PCE, TCE and cis-1, 2-DCE within the PTA were all below 5 µg/l, and ethene production accounted for the observed mass loss. The maximum rates of dechlorination estimated from field data were rapid (half lives of a few hours). Throughout the pilot test period, groundwater samples were assayed for the presence of *Dehalococcoides* using both a *Dehalococcoides*-specific PCR assay and 16S rDNA sequence information. The sequences detected in the PTA after bioaugmentation were specific to the *Dehalococcoides* species in the KB-1 culture. These sequences were observed to progressively increase in abundance and spread downgradient within the PTA. These results confirm that organisms in the KB-1 culture populated the PTA aquifer and contributed to the stimulation of dechlorination beyond cDCE to ethene.

[1] Corresponding author telephone: (519) 822-2230; fax: (519) 822-3151; e-mail: dmajor@geosyntec.com