Abstract C-07, in: B.C. Alleman and M.E. Kelley (Conference Chairs), *In Situ and On-Site Bioremediation—2005*. Proceedings of the Eighth International In Situ and On-Site Bioremediation Symposium (Baltimore, Maryland; June 6–9, 2005). ISBN 1-57477-152-3, published by Battelle Press, Columbus, OH, www.battelle.org/bookstore.

Lessons Learned: Enhanced Bioremediation of Chlorinated Solvents Using Vegetable Oil

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Chlorinated solvents represent common and recalcitrant contaminants present in groundwater on Department of Defense and industrial sites across the United States. These compounds have stringent remediation criteria, which typically drives the compliance requirements and remedial costs for any particular site. There has been significant progress made in the last decade in the development of remedial technologies for chlorinated solvents in groundwater. One of the more successful technologies that has been developed involves the use of organic substrates. There are a number of organic substrates on the commercial market that have been shown to successfully stimulate degradation of chlorinated solvents in groundwater through anaerobic reductive dechlorination. Within the last several years, the Air Force Center of Environmental Excellence has pioneered the application of alternative, low-cost organic substrates, including vegetable oil (as an injectable substrate), bark mulch and compost (as solid substrates), and gaseous hydrogen.

Vegetable oil has been applied at a number of Air Force sites to degrade chlorinated solvent mass present in high concentration source areas, as well as in barrier configurations for lower concentrations in distal portions of solvent plumes. Vegetable oil has also been applied in differing soil types ranging from silty clays with low permeability to sands and gravels with high permeability. The injection designs have been varied accordingly, depending on the site-specific remedial objectives, soil conditions, and contaminant concentrations. In most cases the injected vegetable oil was successful in enhancing contaminant degradation rates throughout the treatment area. However, in some cases the success of applying vegetable oil was limited by complex hydrogeology, inadequate substrate distribution, competing electron acceptor demand, or the development of inappropriate geochemical conditions (e.g., low pH) and production of undesirable fermentation products. Most of these conditions are not unique to the use of vegetable oils; rather, they are problematic to enhanced anaerobic bioremediation in general

Several case studies are reviewed and lessons learned observed from each case study are provided. In addition, recommendations are provided for site selection and design criteria for the successful application of vegetable oil to remediate chlorinated solvents in groundwater through anaerobic reductive dechlorination.