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Environmental Protection
Agency

Solid Waste and
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EPA

Engineered Approaches to *In Situ* Bioremediation of Chlorinated Solvents: Fundamentals and Field Applications

Fact Sheet and Order Information

Introduction

Chlorinated solvents, such as trichloroethene (TCE), are the most frequently occurring soil and groundwater contaminants at Superfund and other hazardous waste sites in the nation. The U.S. Environmental Protection Agency (EPA) estimates that, over the next several decades, site owners will spend billions of dollars to clean up these and other waste sites.

Engineered Approaches to In Situ Bioremediation of Chlorinated Solvents: Fundamentals and Field Applications (EPA 542-R-00-008) provides an overview of the basic science and implementation of *in situ* bioremediation to remediate chlorinated solvents in contaminated soil and groundwater. The report presents information at a level of detail intended to familiarize federal and state project managers, permit writers, technology users, and contractors with *in situ* bioremediation. The report describes degradation mechanisms for chlorinated solvents, enhancements of the degradation mechanisms by the addition of various materials and chemicals, design approaches, and the typical steps taken to evaluate technology feasibility at a specific site.

Contents of Report

The report discusses the following aspects of *in situ* bioremediation of chlorinated solvents:

- The mechanisms of bioremediation: aerobic oxidation (direct and cometabolic) and anaerobic reductive dechlorination
- The types of technologies used for *in situ* bioremediation, including approaches used to design remedial systems
- The steps involved with the selection and implementation of *in situ* bioremediation as a site remedy

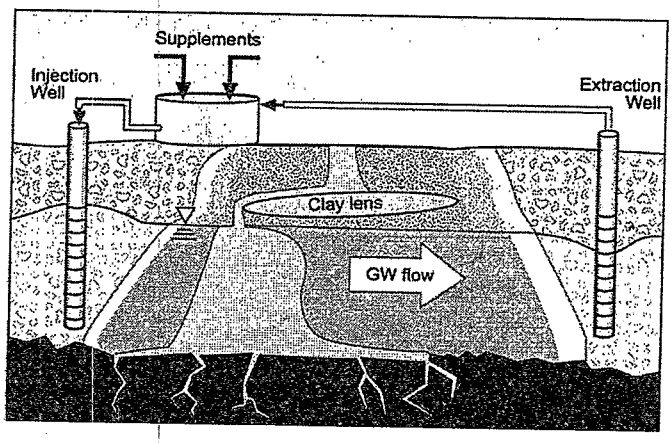
In addition, the report includes:

- Nine case studies of applications of *in situ* bioremediation of chlorinated solvents at Superfund and other sites (eight for groundwater, one for soil)
- Summary information for 16 full-scale and 14-pilot-scale *in situ* bioremediation of chlorinated solvent projects
- Information about vendors of *in situ* bioremediation technologies

Description

The scope of the report encompasses chlorinated ethenes, such as tetrachloroethene (PCE), TCE, and dichloroethene (DCE); chlorinated ethanes, such as 1,1,1-trichloroethane; and chlorinated methanes, such as carbon tetrachloride. The report describes the types of mechanisms typically used for *in situ* bioremediation of each of these constituents.

The design approaches discussed in the report include direct injection, groundwater recirculation, permeable reactive barriers, and bioventing. Schematic diagrams of *in situ* bioremediation system configurations are provided, such as shown below for a groundwater recirculation system.



The report describes the following aspects to consider when selecting and implementing *in situ* bioremediation technologies:

- Evaluation of site characteristics
- Identification of general site conditions and engineering solutions
- Identification of primary reactants and possible additives
- Performance of treatability (bench-scale) testing
- System design, field testing, and implementation

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