- Containment and Recovery,
- Louisiana Special Session,
- Detection, Tracking and Remote Sensing,
- Oilspill Treating Agents,
- Spill Modeling,
- Shoreline Protection and Cleanup,
- In Situ Burning,
- Technical Seminar on Chemical Spills (TSOCS),
- Poster Sessions.

The papers run the gamut from very practical (Spill Response Exercises and Lessons Learned — A Response Organization's Perspective) to theoretical (Model of Oil Fate and Water Concentrations With and Without Application of Dispersants).

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Steam and Electroheating Remediation of Tight Soils

Katherine Baishaw-Biddle, Carroll L. Oubre, C. Herb Ward (Eds.); Lewis Publishers, Boca Raton, FL, 2000, US$ 69.95, 410 pp., ISBN: 1-56670-465-0

The purpose of this project was to demonstrate the ability of steam and electroheating to remediate soils. It was one of several projects conducted under the Rice University-directed and Department of Defense-funded Advanced Applied Technology Facility Program for Environmental Remediation Technologies to evaluate the viability of a newly developed remediation methods and to promote more wide-spread use of effective innovative technologies. The initial purpose of the project described in this book was to investigate hydraulic fracturing and steam injection technologies for their utility in contaminated site remediation and to develop guidance for their use.

During well installation, however, it was observed that the lateral extents of the hydraulic fractures were significantly less than expected, consequently limiting the utility of steam injection. Thus, it was decided to modify the project strategies to include evaluation of electroheating and limited steam injection.

"Steam-enhanced hydrocarbon recovery, or steam injection, an in situ treatment technology for remediation of organic contaminants. Steam heating was first implemented for environmental applications in The Netherlands during the mid-1980s. The technology was originally developed in the petroleum industry as a secondary- or tertiary-enhanced oil recovery technique, which relied on viscosity reduction and injection pressure to mobilize crude oil for extraction.

In environmental applications, steam has been injected into contaminated soils to raise the temperature of hydrocarbon contaminants. The elevated soil temperatures increased the vapor pressure and volatilization rate of volatile and semivolatile contaminants, and the high temperature also increased the fluid mobility of semivolatile and nonvolatile contaminants by reducing viscosity and residual saturation. Large quantities of vapors and mobile separate-phase hydrocarbons (SPHs) are produced using this method, so steam injection is generally applied in conjunction with SVE and groundwater extraction".

Because, as noted above, the soils were very tight and fracturing was limited, an electroheating system was employed. This system was based on a combination of three-phase electroheating and soil vapor extraction techniques. The heating technology used the soil to form the resistant heating element of an in situ multiphase alternating current heating system. Computer models were used to evaluate the soil heating methods for the project. The techniques were tested at Fort Hood, Texas.

The results are best summarized under the heading "Remediation Advantages and Disadvantages".

- Steam injection and hydraulic fracturing

  Advantages
  - ability to increase mass removal rates over standard techniques in tight soils by raising the soil temperature and increasing the secondary porosity;
  - mobilization and extraction of separate and adsorbed-phase contaminants;
  - acceleration of rates of mass removal and shortened duration of remediation;
  - reduction in costs for operation and maintenance, labor, materials, and the analytical laboratory;
  - reduction in achievable concentrations for clean-up goals.

  Disadvantages
  - increased capital cost for equipment and piping construction;
  - higher health and safety risk due to thermal systems and high-pressure fluids;
  - potential for off-site migration or venting to atmosphere if extraction systems are not properly designed for capture.

- Electroheating and hydraulic fracturing

  Advantages
  - as with steam injection, electroheating with hydraulic fracturing increases mass removal rates in tight soils;
  - capability to heat soils without fluid migration and without restriction of soil permeability;
  - capability to use multiple temperature strategies such as lower temperature heating to enhance biodegradation or higher temperature to enhance volatilization and pyrolysis;
  - capability to install electrodes in a straightforward and low-cost manner.

  Disadvantages
  - heat generation within a small radius of the electrode, which results in elevated electrode temperatures and inefficiency, may require cooling by an irrigation system;
  - electrode design is dependent on soil resistivity and extensive in situ testing required at some sites;
  - impact of soil moisture content on efficiency of heat transfer effectively limits heating to below 90°C (190°F);
  - potential need for large transformers and associated power generation costs to offset inefficient power transfer.

As is common with other reports in the series, cost data are given. Not surprisingly, electroheating adds to the cost; an increase of approximately US$ 500,000 is expected in utilizing electroheating over steam sparging for the hypothetical site.

Consistent with other reports in the series, detailed information in the study is found in the appendices. The appendices in this case only encompass one-half of the book. Appendices contain boring logs, slug test analysis, particle size distribution, working data analytical reports, design manual, Fort Hood demonstration report and analysis of vacuum dissipation data from prefracturing pilot tests.

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Sequenced Reactive Barriers for Groundwater Remediation

Stephanie Fiorenza, Carroll L. Oubre, C. Herb Ward (Eds.); Lewis Publishers, Boca Raton, FL, 2000, US$ 69.95, 730 pp., ISBN: 1-56670-446-4

This is a report by a University of Waterloo (Ont., Canada) research group of a study performed to degrade chlorinated hydrocarbons. It was conducted under the umbrella-funded Advanced Applied Technology Demonstration Facility (AATDF) Program grant by the US Department of Defense to Rice University (TX, USA).

This is the 10th (largest) and the last book in the series. Having reviewed all these reports, I must state my admiration for the conceptual design of the program by Dr. Herb Ward and his staff at Rice University, the breadth of the remediation topics studied and the quality, extent and depth of the 10 reports.

The goal of this federally-funded project was to test the potential of reactive barriers to minimize long-term operation and maintenance costs while limiting the migration of a contaminated groundwater plume. In this project, the researchers advanced their use of reactive barriers by testing combinations of several technologies in sequence.

Altogether, five technologies were tested including two anaerobic–aerobic sequences as well as an intrinsic remediation option.

In this demonstration project (field study), passive and semipassive in situ remediation technologies were assessed in anaerobic–aerobic sequences for the treatment of a mixed aromatic-contaminated groundwater. Field studies were conducted at Canadian (Armed) Forces Base Borden (Ont., Canada) and the US Naval Air Station (Alameda, CA).

Treatment systems evaluated included the following:

- sequential in situ treatment using granulated iron and ORC^{TM} (oxygen-releasing compound);
- intrinsic remediation — use of natural attenuation to reduce environmental risk posed by groundwater contamination;
- sequential anaerobic–aerobic bioremediation;
- in situ sequential treatment using granulated iron and oxygen sparging.

Based on the results of the study, the team designed and costed two hypothetical full-scale sequential permeable reactive barrier (SPRB). Systems and these costs were compared to pump-and-treat systems designed to capture the same dimensions.