RESOURCE & ECOSYSTEMS MANAGEMENT

A Technical Resource for Government and Private Industry

For more information, contact:

Dr. Joseph L. Devary
(509) 376-8345
joe.devary@pnl.gov
or
James G. Bush
(509) 376-6555
jg.bush@pnl.gov

Resource & Ecosystems Management
Environmental Technology Division
PO Box 999
Richland WA 99352
www.pnl.gov.2080

Pacific Northwest National Laboratory

Operated by Battelle for the U.S. Department of Energy

Innovations for

Soils & Groundwater Cleanup

For years, site managers relied on conventional techniques to clean up contaminated groundwater and soils. At many sites, however, solutions such as pump-and-treat proved too expensive and ineffective, making the search for low-cost alternatives a priority.

At the Pacific Northwest National Laboratory, we provide technology breakthroughs for remediation and containment needs. Our technologies offer impressive performance and reduced cost, particularly for sites with intractable contaminant problems. We have provided solutions for sites with deep contamination, large dispersions of hazardous materials, or contaminants heavily absorbed or present as Dense Non-Aqueous Phase Liquids (DNAPL).

Alternatives That Work

Six-Phase Heating — This patented in situ technology simultaneously heats and ventilates sediments to remove volatile and semi-volatile organic contaminants from soils and groundwater. Electric current turns moisture in contaminated sediments to steam, which is extracted and treated with conventional off-gas techniques. With Six-Phase Heating, electro-kinetic processes desorb contaminants from the soil matrix for thorough cleanup. The technology won an R&D 100 award and is being widely deployed.

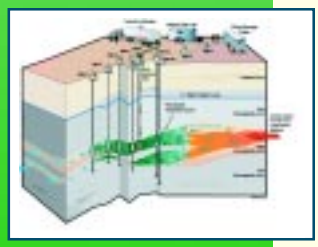
In Situ Redox Manipulation (ISRM) — By establishing a reducing environment within aquifer sediments, ISRM creates a permeable reactive barrier that destroys or immobilizes contaminants in groundwater. The ISRM is effective for destruction of certain chlorinated hydrocarbons such as TCE and immobilization of chromate, uranium, and technetium. ISRM offers cost-effective control and cleanup of large-scale, relatively-dilute (<500 ppb) and deep (>50 ft) contaminant plumes. It earned an R&D 100 award in 1998.

In Situ Bioremediation — We developed a bioremediation software tool, RT3D, to design accelerated bioremediation schemes and evaluate natural attenuation at contaminated sites. Using RT3D in conjunction with laboratory microcosm tests and with our proprietary database Biosolve℠, we help clients capitalize on microbial destruction of contaminants in the vadose zone and groundwater. It is especially beneficial for sites with high concentration (>2,000 ppb) chlorinated solvent plumes.

Other Remediation Alternatives —

- **In Situ Gaseous Reaction (ISGR)** — a gaseous mixture is injected into the vadose zone to immobilize or destroy contaminants in place
- **Surface Barriers** — a multi-layered engineered system is constructed using natural vegetation, asphalt, and capillary barriers that eliminates moisture migration through the waste storage unit
- **Mycoremediation** — fungus is used to reduce the volume of solid waste in landfills and disposal facilities.

Our technologies have provided immediate, low-cost solutions for clients with difficult-to-treat contaminant problems.



Performance Experience

Bioremediation at Pt. Mugu Naval Air Station — For a naval site contaminated with PCE, TCE and fuel hydrocarbons, we evaluated pump-and-treat, natural attenuation, and accelerated bioremediation as alternatives for cleanup. The study concluded that 1) in situ bioremediation would save time and money compared to pump-and-treat and 2) natural attenuation would be inadequate. Installation of an accelerated in situ bioremediation system confirmed the degradation kinetics for rapid cleanup.

ISRM creates a permeable barrier that destroys or immobilizes contaminants.

Preventing Chromate Contamination of the Columbia River — PNNL's ISRM technology is currently being deployed at the Hanford site's 100-D area to arrest chromate discharges to the Columbia River. Initial field tests indicate ISRM eliminates hexavalent chromium in the groundwater, which is a threat to salmon nesting areas (redds).

Six-Phase Heating Provides Fast Cleanup at Large Site — At a former manufacturing facility in the Midwest, our Six-Phase Heating technology provided complete remediation of DNAPL, TCE and PCE contamination from 23,000 cu yards of soil in less than four months. The project involved installation of 107 electrodes, including 85 that were set directly through the floor of the building. The network covered two-thirds of an acre and effectively removed liquids trapped in silt and clay-rich soils 20 feet deep.

RCRA Closure for Army Test Site — At the U.S. Army's missile testing range at White Sands, New Mexico, we installed the ISGR technology to remediate the vadose zone contaminated with hexavalent chromium. The work resulted in a RCRA closure for the chromate site and was recognized as a presumptive remedy by the State of New Mexico.

TCE Destruction at Fort Lewis, WA — In work for the U.S. Army Forces Command, we are demonstrating the ISRM technique for destruction of chlorinated solvents, in particular TCE. Extensive lab tests and initial field tests have shown greater than 90% reduction of TCE levels in the groundwater. Current efforts are focused on greater efficiencies for deployment at larger scales.

Bioremediation Through Natural Attenuation at Dover Air Force Base — Working with the Remediation Technology Demonstration Forum (RTDF), we used our RT3D Design Tool to predict the natural fate of PCE, TCE, and degradation products in the groundwater at Dover Air Force Base. The study identified natural attenuation as the preferred alternative for managing the chlorinated solvent plumes, eliminating the need for a costly cleanup action.