United States Environmental Protection Agency
Office of Research and Development (481)
Office of Solid Waste and Emergency Response (5102G)
EPA 542-F-97-016
November 1997

EPA RTDF Update

RTDF
Remediation Technologies Development Forum

A Progress Report on the Remediation Technologies Development Forum (RTDF)

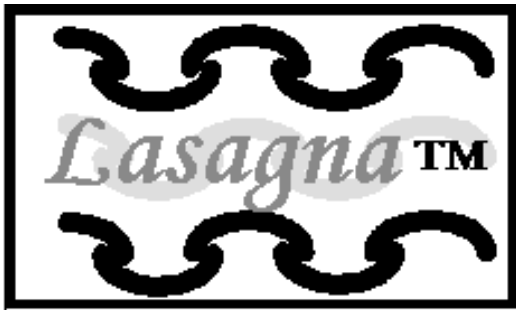
INSIDE

About the RTDF

The Remediation Technologies Development Forum (RTDF), which was established in 1992, is a consortium of partners from industry, government, and academia who are working together to develop safer, more effective, and less costly hazardous waste characterization and treatment technologies. For information on RTDF and Action Teams visit the RTDF Home Page at http://www.rtdf.org

Lasagna™ Process Preferred Remedy for DOE Site

The U.S. Department of Energy (DOE) has decided to include the Lasagna™ Process in its Record of Decision (ROD) for cleanup of a site at the agency's Paducah Gaseous Diffusion Plant (PGDP) and is pursuing regulatory approval through the CERCLA process. If approved, the vertical configuration of the technology will be used to clean up a Solid Waste



Management Unit at PGDP containing 10,000 cubic yards of contaminated material. This is the first time Lasagna™ has been chosen for actual cleanup of a site and a major milestone in its development by the RTDF's Lasagna™ Partnership.

DOE based its decision on results of two successful field demonstrations of the process at the Paducah site. In the Phase I-Vertical demonstration, completed in 1995, the Lasagna™ process removed 98 percent of TCE from a tight clay soil, and some samples showed removal of more than 99 percent. The most recent demonstration (Phase IIA-Vertical), which incorporated the use of reactive treatment zones to destroy TCE *in situ*, was similarly successful. This demonstration resulted in 99.7% TCE removal (from the 2-ft zone), provided information on the optimal spacing of treatment zones, produced evidence that Lasagna™ is capable of handling dense non-aqueous phase liquids (DNAPLs), and provided data with which to substantiate technology cost estimates.

The Phase IIA-Vertical demonstration began in August of 1996, covered an area of 30 feet by 21 feet, and reached a depth of 45 feet. Before the test began, the average TCE concentration in the soil was about 35 ppm, but local concentrations varied from a few ppm to almost 400 ppm. The higher value is equivalent to twice the solubility of TCE in the pore water. The high levels of TCE strongly indicated the presence of pure TCE droplets (DNAPLs) in the soil. For the demonstration, an electrode was placed at each end of the test site. Three treatment zones were placed at 2-foot, 5-foot, and 7-foot intervals between the electrodes. These different intervals were created to help determine the optimal spacing for cleanup using the Lasagna™ process. Each treatment zone measured 21 feet across, 1.5 inches thick, and 45 feet deep. A mixture of coke-like granular carbon and iron filings was used for the electrode material and a mixture of kaolin clay and iron filing was used for the treatment zone material.

The demonstration presented two major and unexpected challenges to the Lasagna™ process. First, TCE contamination was at least 30 times higher in the soil than indicated in pre-test soil sampling. Second, the demonstration team encountered an undefined sand lens (at a depth of 20 to 25 feet), which may have caused unpredictable hydraulic movement at the test site.

Despite these complications, the test proceeded smoothly. Voltage, temperature, and electroosmotic water flow were consistent with small-scale data and computer modeling predictions. Samples taken after about 10 months of operation showed an average TCE level of 0.1 ppm, which is substantially lower than the Kentucky soil cleanup target, in the soil region bracketed between the 2-ft-spacing treatment zones.

These results were especially significant considering the tremendous amount of TCE in the soil and that only two pore volumes of water exchange had occurred. Well water samples and analysis of reaction products also suggested DNAPL movement and in situ degradation by iron filings. This ability to handle DNAPLs significantly expands the scope of potential Lasagna™ applications.

Based on the data obtained, DuPont determined that the cost of the Lasagna™ treatment is in the range of $50-100/yd^3 for cleanup of a 1-acre or larger site. The Lasagna™ Partnership is looking for sites for additional demonstrations of the

process and moving forward on commercialization activities.

The Partnership also is continuing its efforts to develop the horizontal configuration of the Lasagna™ process. This work is led by the U.S. EPA National Risk Management Resource Lab (NRMRL) working with the University of Cincinnati. Two small-scale horizontal cells have been installed in TCE contaminated soil at Rickenbacker Air National Guard Base in Columbus, OH. In addition, the infrastructure for two large-scale horizontal cells has been installed in TCE contaminated soil at Offutt Air Force Base in Omaha, NE. Tests at both locations will continue through 1998.

For more information about the vertical configuration of the Lasagna™ process, contact Dr. Sa V. Ho, (Monsanto), 314-694-5179 or Dr. B. Mason Hughes, (Monsanto), at 314-694-1466. For information about work on the horizontal configuration of Lasagna™, contact Dr. Michael Roulier, (U.S.EPA/ NRMRL), 513-569-7796.

RTDF Members Meet

The Remediation Technologies Development Forum (RTDF) meets October 15-16, in Evanston, IL. Meeting participants are expected to include representatives of government, industry, and academia currently involved in one or more of the RTDF's seven action teams as well as others interested in cooperative efforts to develop more permanent, cost-effective technologies for remediating hazardous wastes.

Since its inception in 1992, the RTDF has grown to include seven action teams, consortia, and partnerships. They are: the Bioremediation Consortium, the In-Place Inactivation and Natural Ecological Restoration Technologies (IINERT) Soil-Metals Action Team, the *In Situ* Flushing Action Team, the Lasagna™ Partnership, the Permeable Reactive Barriers Action Team, the Phytoremediation of Organics Action Team, and the Sediments Remediation Action Team. Each of these self-managed teams uses the combined expertise, facilities, and resources of its members to develop, test, and evaluate *in situ* technologies to address high-priority problems. The agenda for the meeting includes an update on the research and demonstration activities of each team. In addition, the meeting features discussion of cross-cutting issues, including the status of commercial development of innovative technologies, funding opportunities for public-private partnerships, and cooperative efforts with the states through the Interstate Technology Regulatory Cooperation (ITRC) Working Group.

A full report on the meeting will be available early in November on the RTDF's World Wide Web site. For more information about the RTDF, contact Co-Chairs Dr. Walter W. Kovalick (U.S. EPA Technology Innovation Office) 703-603-9910 or Robert Olexsey (U.S. EPA/NRMRL) 513-569-7861.

Long-Term Performance of *In Situ* Permeable Reactive Barriers Is Research Priority

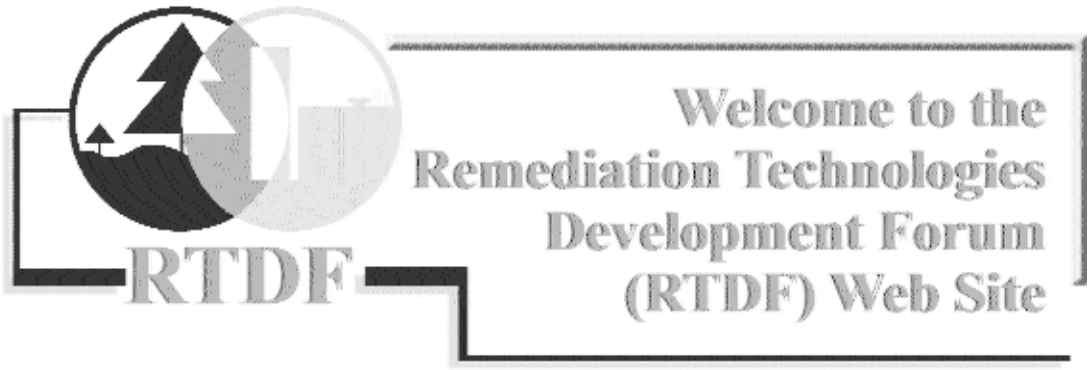
The Steering Committee of the Permeable Reactive Barriers Action Team has identified long-term performance issues associated with permeable reactive barriers (PRBs) as a priority for continued research to advance the acceptance and implementation of this innovative and cost-effective technology.

The Steering Committee is developing an unified approach for addressing this need, which includes leveraging resources from DOE, DOD, EPA, and other sources and integrating ongoing collaborative research by of these agencies and researchers in industry and academia.

Use of PRBs is an *in situ* approach for remediating ground water contamination that combines subsurface fluid flow management with a passive chemical treatment zone. Removal of contaminants from the ground-water plume is achieved by altering the chemical conditions of the plume as it moves through the reactive barrier. Extensive research over the last few years has improved our understanding of the mechanisms and kinetics involved in the removal of chlorinated solvent compounds in such *in situ* treatment systems. However, actual field implementation has been somewhat slow, due in large part to the risks and uncertainties associated with long-term performance. Pilot and commercial installations to date have proven that PRBs can be cost-effective and efficient but have provided few data on the long-term performance.

The Steering Committee intends to use several sites where PRBs have been installed in the last two years, including the U.S. Coast Guard site near Elizabeth City, North Carolina, to focus future research efforts. Action Team members from EPA and the University of Waterloo are the primary research investigators at this site, where long-term performance is a primary research objective. The Steering Committee's objective is to evaluate long-term performance issues, using the same analysis methods at three to five sites, and to develop cost-effective and efficient protocols to monitor these systems over time.

Information about pilot and full-scale PRB systems is available in *Permeable Reactive Subsurface Barriers for the Interception and Remediation of Chlorinated Hydrocarbon and Chromium (VI) Plumes in Ground Water* (EPA/600 /F-97/008). To order this fact sheet, contact the U.S. EPA Center for Environmental Research Information (CERI), 513-569-7562. A copy also may be downloaded from the Internet at http://www.epa.gov/ada/kerrlab. For more information about the Permeable Reactive Barriers Action Team,



http://rtdf.org

contact Dr. Robert Puls, U.S. EPA/NRMRL, 405-436-8543.

Early Results of IINERT Field Study Encouraging

Preliminary results of a field study at a site in Joplin, MO, indicate that the addition of phosphorus (P) may significantly reduce the bioavailability of lead (Pb) in Pb-contaminated soils. The field study was initiated by the In-place Inactivation and Natural Ecological Restoration Technologies (IINERT) Soil-Metals Action Team in cooperation with the U.S. EPA, Missouri Department of Natural Resources (MDNR), University of Missouri, the U.S. Department of Agriculture-Agricultural Research Service (USDA-ARS), the Doe Run Company, and DuPont Company. The one-acre test site is in an urban area three to four blocks away from the site of a former smelter site.

USDA-ARS workers at Joplin Site maintain test plots to which phosphorous (P) has been added.

Initial results are from studies using soil with a total Pb concentration of 4,000 ppm that was treated in the laboratory. University of Missouri and MDNR researchers used immature swine, dosed with treated and untreated soil from the site, to measure changes in Pb-bioavailability. This study showed that the application of 1% P to the soil significantly reduced Pb-bioavailability, compared to untreated soil from the site.

Researchers at the USDA-ARS have conducted similar studies with the same laboratory-treated soil using weaning rats. Their studies showed that the application of 1% P alone, and in combination with 2.5% Fe (as Iron Rich), significantly reduced soil Pb-bioavailability, as compared to the untreated soil.

There also is evidence that reductions in Pb-bioavailability in soils treated in the field may be greater than those treated in laboratory studies. Researchers already have collected samples of soil treated in the field with 0.5% and 1.0% P for analysis using the swine model to measure Pb-bioavailability. The research team is in the process of collecting additional plant and soil samples. Plants will be analyzed for elemental concentrations in their tops, including concentrations of Pb, Zn, and Cd. Pb-bioavailability in the soils will be measured using the weaning rat model. For more information, contact Dr. Bill Berti (DuPont Central Research and Development) 302-451-9224, or Dr. Jim Ryan (U.S. EPA/NRMRL), 513-569-7653.

Phytoremediation Team Sponsors Alternative Cover Workshop

The Phytoremediation of Organics Action Team sponsored a September 1997 workshop in Cincinnati, OH, to assess field application of alternatives to conventional landfill covers, with particular emphasis on vegetative caps. A vegetative cap is a long-term, self-sustaining cover of plants growing in or over materials that pose environmental risk, which reduces the risk to an acceptable level and requires minimal maintenance.

The workshop agenda included presentations and discussions to provide background and data for use in determining research needs and priorities. Work group sessions during the meeting examined a variety of topics, including alternatives for infiltration control, erosion control, and remediation; case histories of applications of vegetative caps and other non-conventional covers; and ecosystem factors to be considered in using sustainable covers. In addition, attendees considered regulatory issues, data needs, resource requirements, and potential sites in defining priorities for further research on alternatives.

A report on the workshop, including action items and timetables for accomplishing them, will be available late in October on the Phytoremediation Action Team's page on the RTDF's World Wide Web site. For additional information, contact Steve Rock (U.S. EPA/NRMRL) at 513-569-7149.

In Situ Flushing Team Holds Organizational Meeting

The *In Situ* Flushing Action Team held its organizational meeting May 8-9, 1997, at Hill Air Force Base (AFB), Utah. Team co-chairs are Stephen Shoemaker (DuPont Engineering) and Dr. Lynn Wood (U.S. EPA's NRMRL). The two-day meeting provided an update on field demonstrations conducted at Hill AFB of various *in situ* flushing techniques, an assessment of the potential applicability of these technologies for source zone remediation, and information on barriers to technology deployment, including uncertainties associated with performance, cost, and predictability.

Based on this information and other discussions during the meeting, participants agreed to focus the team's activities on achieving the following objectives:

- to design a full-scale demonstration
- to refine technical practices and develop technical practices guidance information
- to compare the costs/benefits of *in situ* techniques and conventional treatments
- to develop and evaluate adjuvant recovery and reuse systems
- to analyze appropriate technology performance criteria and end points.

The team is in the process of organizing subgroups to address these objectives. The work of the subgroups will be used to design a generic, large-scale source remediation system using enhanced *in situ* solubilization or mobilization.

A complete summary of the meeting is available on the *In Situ* Flushing Action Team's page on the RTDF site on the

World Wide Web. For more information, contact Dr. Wood, 405-436-8552, or Mr. Shoemaker, 713-586-2513.

Bioremediation Demonstrations Continue

Phase I demonstrations of three bioremediation processes—cometabolic bioventing, accelerated anaerobic biodegradation, and intrinsic bioremediation—will continue until 1998. (See the April 1997 issue of RTDF Update for a report on interim results from these demonstrations.) All three of these demonstrations, sponsored by the Bioremediation of Chlorinated Solvents Consortium, are underway at Dover Air Force Base (AFB) in Dover, DE.

The Bioremediation Consortium has selected Hill Air Force Base, UT, as the site for a Phase II demonstration of cometabolic bioventing, and preparatory laboratory work using site soil is underway. The Consortium is seeking sites for Phase II work on intrinsic bioremediation and accelerated anaerobic biodegradation.

Information about the bioremediation processes under study and the demonstrations being conducted at Dover AFB is available on the Bioremediation Consortium's page on the RTDF's World Wide Web site. For additional information, contact Dr. Gregory Sayles (U.S. EPA/NRMRL), 513-569-7607, or Dr. David Ellis (DuPont Specialty Chemicals), 302-892-7445.

Resources

The following updated fact sheets on the RTDF and each of its Action Teams will be available soon from U.S. EPA's National Center for Environmental Publications and Information (NCEPI).

Remediation Technologies Development Forum (EPA 542-F-97-012)

Remediation Technologies Development Forum: Questions and Answers Fact Sheet (EPA 542-F-97-017)

Lasagna™ Public-Private Partnership (EPA 542-F-97-012a)

Bioremediation of Chlorinated Solvents Consortium (EPA 542-F-97-012b)

Permeable Reactive Barriers Action Team (EPA 542-F-97-012c)

IINERT Soil-Metals Action Team (EPA 542-F-97-012d)

In Situ Flushing Action Team (EPA 542-F-97-013)

Phytoremediation of Organics Action Team (EPA 542-F-97-014)

Sediments Remediation Action Team (EPA 542-F-97-015)

Printed copies of these publications may be ordered by contacting NCEPI at 513-489-8190. Be sure to specify the document number shown when ordering. Copies of the fact sheets also may be downloaded from the RTDF's World Wide Web site.

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EPA 542-F-97-016
October 1997

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