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Office of Solid Waste and Emergency Response
Technology Innovation Office

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Groundwater Currents

Developments in innovative groundwater treatment

Why We Are Here

By Walter W. Kovalick, Jr., Ph.D., Director, Technology Innovation Office

Welcome to our venture to improve upon the availability of new information on the development and demonstration of innovative groundwater remediation techniques. *Groundwater Currents* will have a broader focus than its companion publication, *Tech Trends.* Not only will we report on innovative in situ and ex situ groundwater remediation technologies that are ready to be applied in the field (similar to the applied focus of *Tech Trends)* , but also on research that is not as far along the development chain, such as emerging technologies and other research still in the hopper. In addition, you will see articles on innovative monitoring technologies and analysis systems, references to new regulations that impact groundwater remediation, descriptions of data bases that capture *who is doing what* in innovative treatment and *how to access them,* highlights on current issues such as dense nonaqueous phase liquids (DNAPLs) and information on conferences and publications. *Groundwater Currents* will appear approximately four times a year.

One of our feature articles in this issue ("Dialogue Begins in Dallas," page 3) recaps the results of a facilitated meeting among stakeholders in groundwater remediation researchers, developers, consultants, the regulated community and State and Federal project managers. The *Workshop to Identify Barriers to In Situ Groundwater Remediation* was held on June 24-25, 1992, in Dallas. Among the needs identified at this meeting were improved information exchange forums. Initial responses to that need appear in the "FYI" column on page 2 that describes the

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PILOT RESULTS

Hydraulic Fracturing Enhances *In Situ* Remediation

By Wendy Davis-Hoover, Risk Reduction Engineering Laboratory

Hydraulic fracturing shows great promise for improving dramatically the effectiveness of a variety of *in situ* remediation techniques for groundwater, soils and subsurface. Hydraulic fracturing has long been used to increase production rates of oil wells. While it is of little utility as a remediation technique by itself, EPA researchers are finding that fractured wells increase both the flow rate and the radius of influence at wells utilizing vapor extraction, bioremediation, steam stripping, soil washing and other remediation techniques.

The fracturing is created when fluid is pumped down a borehole until a critical pressure is reached that fractures the soil. Sand-laden slurry is then pumped into the fracture to create a highly permeable pathway that enhances delivery of the remediation medium (*i.e.*, steam, biodegradation organisms) and subsequent recovery. The EPA research began in the laboratory in 1988 with soils contained in triaxial cells. This type of overconsolidated soil, often associated with clayey glacial deposits of low permeability, is notoriously difficult to remedy with conventional *in situ* technologies. Now, over 100 hydraulic fractures have been created in glacial drift at six different sites. Many of the fractures have been excavated for the purpose of determining

(See Fracturing, page 4)

This Month in **Currents**

POINTS OF INTEREST

In Situ Groundwater Treatment Research and Demos Inventoried

By Rich Steimle, Technology Innovation Office

Approximately 75% of the sites on the National Priorities List have groundwater contamination. An analysis of the Records of Decision for these sites shows that pump and-treat is chosen almost exclusively as the remediation technology. Additionally, the remediation or control of contaminated groundwater using conventional pump-and-treat technology is difficult at many sites and, in most cases, results in inadequate cleanup. These are some of the findings of a recent review by the EPA Technology Innovation Office (TIO) that looked at groundwater remediation options. TIO is seeking public and private partners to collaborate in the development and field application of alternative treatment technologies for groundwater remediation.

As a first step toward developing a promotion strategy, TIO inventoried alternatives to pump-and-treat The inventory encompasses chemical, biological and physical treatment techniques that either alter the toxicity of the contamination or improve removal. Specifically, the study concentrated on *in situ* technologies that are in the research stage, that have been field tested or that actually have been demonstrated or used. TIO s objective is to help speed the research and development of groundwater remediation technology alternatives. For this first go-round on the inventory, TIO concentrated primarily on information from EPA and EPA-supported groups and data bases.

TIO found that the alternatives to pump-and-treat remediation currently are extremely limited. with the exception of oxygen enhance ment by sparging and hydrogen peroxide injection, no technology has adequate data from field demonstrations or actual application to be considered an alternative at this time. The research found that only 15 alternative technologies are in the process of being developed, and most of them are still in the bench scale and pilot stages of research. At the present rate of development, these alternate technologies may not be available for three to five years However, most of the technologies are approaching, or are in, the controlled field experiment stage of development.

In addition to sparging and hydrogen peroxide injection, there are 13 other treatment techniques that are being researched. These are: nitrate/acetate enhancement, nitrate enhancement, bioremediation with methanotrophic biodegradation, reductive dechlorination, oxygen enhancement with microbubbles, dehalogenation with metal catalysts, electrokinetics, water or steam flushing, hydrofracturing,

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FYI

Log-on to CLU-IN for Groundwater Information

A Groundwater Special Interest Group (SIG) recently has been added as part of the EPA electronic bulletin board for cleanup information, CLU-IN. The Groundwater SIG provides a means for professionals working in groundwater remediation to link up with one another and access articles and other information on groundwater issues. We hope you will take advantage of the SIG s message exchange to find and reply to groundwater technology problems and to convey new information quickly to all SIG users. We particularly invite Federal, State and private researchers, technology users, technology vendors, consultants and site owners who have a stake in the development and use of technology for groundwater cleanup to use the SIG. We will keep the SIG stocked with bulletins on the latest *Federal Register* notices, recent EPA publications and other information of concern to groundwater professionals.

Also, please feel free to upload any information that you think would be of interest to other users. If there is anything in particular that you would like to see on the SIG, please leave a message for TIO s Nancy Dean; if you need to talk to Nancy in person, she can be reached at (703) 308-8797.

To log onto CLU-IN and access the SIG, you need a computer, a modem, a phone line and telecommunications software (such as CrossTalk , Procomm or SmartCom). Set your communications parameters to 8 data bits, no parity and 1 stop bit. The phone number is (301) 589-8366. If you have trouble logging on, either through your modem or through a IAN system or data switch, contact the System Operator (SYSOP) at (301) 589-8368. To get a copy of the CLU-IN User s Manual, you may: download it directly from CLU-IN; leave a message for the SYSOP on CLU-IN; or call the SYSOP.

Dialogue Begins in Dallas

EPA s Technology Innovation Office (TIO) hosted a forum in Dallas on June 24-25 at which peers in the groundwater remediation field met to identify barriers and opportunities for the development of alternative groundwater remediation technologies. About 45 researchers, technology developers, industry and consulting firms and personnel from Federal and State agencies gathered at the *Workshop to Identify Barriers to In Situ Groundwater Remediation.* To maximize substantive dialogue by all participants, the attendees broke up into three smaller discussion groups. As each group later summarized its discussions for the plenary session, it was apparent that the issues were similar from group to group.

Stringent cleanup standards were named as a major factor limiting the develop ment and use of innovative technologies, because innovative technologies may not meet those standards. Regulations are perceived as making it too difficult for a party responsible for cleanup to run pilot tests to determine the effectiveness of an innovative technology for a particular site, without incurring penalties if the test results indicate that the technology is not effective enough. Another variable that hampers decisions to try innovative *in situ* treatment technologies is the lack of cost and performance data to compare to pump-and-treat costs and performance. The groups concurred that decisions typically are made that choose traditional pumpand-treat methods in lieu of more innovative technologies, even though it is known that pumpand-treat remediation will not meet cleanup standards.

The groups focused on potential solutions to break down barriers that currently hinder the development and use of innovative groundwater remediation technologies. Solutions centered around the need to improve the current state of groundwater remediation through research and demonstrations, and the need for a stronger and broader information network. Moving research into the marketplace was seen as tied to both formal demonstration programs and information transfer.

To improve the state of groundwater remediation, panelists envision a two pronged approach a combination of existing institutions and bold new steps. Some panelists suggested: more EPA Superfund Innovative Technology Evaluation (SITE) demonstrations for groundwater; risk-sharing between the government and private industry; and a special groundwater remediation research site, such as the Borden site in Canada, to field test *in situ* innovative treatment technologies.

Panelists vocalized a clear need to generate and more widely distribute information on innovative groundwater remediation developments, information on the potential savings related to lower operation and maintenance costs, and data on performance of the *in situ* technologies in relation to intensive longer-term pump and treat methods. In addition to continuing EPA s videos, technical support papers, fact sheets and electronic bulletin board systems, panelists suggested making third-party technology evaluations available and publishing a journal to synthesize information. Information should be transferred to State and local regulators, in addition to the current audience of researchers, develop ers and cleanup parties and personnel, so that these State and local decisionmakers can become more aware of advantages of the alternatives to pumpand-treat.

The discussions at Dallas were productive. TIO plans to incorporate the Workshop proceedings, along with input from EPA Regional, laboratory and headquarters staff, State program staff and Federal facilities staff, to produce a broader strategy for increasing the development and use of innovative treatment technologies for groundwater remediation.

For more information, or a copy of the workshop proceedings, please contact TIO s Rich Steimle at 703-308-8846 or Nancy Dean at 703-308-8797. ▲

Why (from page 1)

new Groundwater Special Interest Group network that you can access on the CLU-IN Electronic Bulletin Board. We also are including an article on a recent inventory of groundwater research that focuses on the status of *in situ* research at EPA and by EPA-supported groups.

In addition to the information we uncover, we would like to hear from you. Let us know when you have new developments that we could pass on to your colleagues in the groundwater remediation arena, or when you would like us to address a question or an issue. Please address correspondence to ⟶

Editor,
Groundwater Currents
Technology Innovation Office (OS-ll0W)
Office of Solid Waste and Emergency Response
U.S. EPA
401 M Street, S.W.
Washington, DC 20460

Fracturing (from page 1)

geometric parameters such as thickness, diameter, shape and orientation. Data from the excavations and sites surfaces have been entered into a data base that enables one to design the depth, desired shape, etc., of fractures to tailor them to site conditions.

During the past year, fractured wells (with non-fractured conventional wells as controls) were installed at EPA s Center Hill field site in silty-clay tills of low permeability in order to test the flow rate and the radius of influence of groundwater vapor extraction wells. Flow rates at the fractured wells increased up to tenfold 5 cubic feet per minute (CFM) in the fractured wells compared to only 0.5 CFM in the control well, depending on weather conditions (precipitation decreased flow rates until the water was removed from the wells).

Groundwater bioremediation is receiving special consideration in a sister project where EPA is developing a solid compound that slowly releases oxygen, with slowly dissolving granulated nutrients, to fill the fractures at a site seeded with a surrogate contaminate of propylene glycol. EPA is also testing the effectiveness of hydraulic fractures with vapor extraction and bioremediation in contaminated soil.

The current technology allows for the creation of horizontal fractures from vertical wells. EPA is currently researching other drilling techniques for the installation of horizontal wells to enable access to areas under buildings, tanks and other structures where conventional drilling techniques are not feasible.

For more information, call Wendy Davis-Hoover at EPA s Risk Reduction Engineering Laboratory at 513-569-7206. ▲

Inventory (from page 2)

surfactant mobilization, alteration of chemical conditions, pneumatic fracturing and solvent mobilization.

Only two recovery technologies are specifically designed to solubilize or mobilize inorganic compounds. However, approximately 20% of Superfund sites have groundwater contaminated by lead, arsenic or chromium.

Another conclusion from the inventory is that the success of a remediation technology is contingent on its compatibility with the delivery system. The systems for delivering *in situ* treatment to contaminated groundwater are complicated and underdeveloped. While some researchers are developing necessary new delivery systems, others are relying on existing delivery systems such as injection or trench infiltration.

The results of the inventory pint toward the need to develop a strategy to orient research toward more *in situ* groundwater treatment research and demonstration.

In addition to EPA research, TIO is working with other Federal agencies to evaluate the activities in their demonstration programs to further support *in situ* groundwater technologies.

For more information on the Inventory, call TIO s Rich Steimle at 703-308-8846.▲

Conference Alert

The Fourth Forum on Innovative Hazardous Waste Treatment Technologies: Domestic and International will be held in San Francisco, California, on November 17-19, 1992.

Call (800) 783-3870 for registration information.

To order additional copies of *Groundwater Currents*, or to be included on the permanent mailing list, send a fax request to the EPA Publications and Information Center (EPIC) at 513-891-6685, or send a mail request to EPIC, 11029 Kenwood Road, Building 5, Cincinnati, OH 45242. Please refer to the document number on the cover of the issue if available.

Groundwater Currents welcomes readers' comments and contributions. Address correspondence to: Managing Editor, *Groundwater Currents* (OS-110W), U.S. Environmental Protection Agency, 401 M Street S.W., Washington, DC 20460.

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