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EPA Ground Water Currents

Developments in innovative ground water treatment

** NEWS FLASH **

** GROUND WATER REMEDIATION CENTER **

By Rich Steimle, EPA Technology Innovation Office

The EPA has selected the National Environmental Technology Applications Center (NETAC) to establish and operate the National Ground Water Remediation Technology Center. The purpose of this new Center is to promote innovative technologies to clean up contaminated ground water. It will compile, analyze and disseminate information on new ground water remediation technologies. The Center will maintain an active outreach program; and, its activities will be guided by an external Guidance Committee composed of representatives from interested public and private sector organizations. As such, it will serve as a principal voice for describing and promoting the application of the latest ground water technologies throughout the country. Information from the Center will be available to everyone.

The kinds of information collected and distributed will focus on in situ ground water remediation. This information will include the status and results of research, development and demonstration activities; the identification of leading researchers and practitioners; and patent and license agreements. The Center will analyze the information and report on the status and trends of each technology. The information on research activities will be organized as to status, i.e., bench scale studies, controlled field investigations, field demonstrations and accepted use; documentation will be noted.

The Center will be located within the NETAC facilities at the University of Pittsburgh Applied Research Center (U-PARC) in Harmarville, Pennsylvania, where it will be operated in association with the Environmental Engineering Program at the University of Pittsburgh (Pitt). Dr. Edgar Berkey, President of NETAC, will serve as Center Director. Dr. Frederick G. Pohland, who holds the Edward R. Weidlein Chair of Environmental Engineering at Pitt will be Associate Director. The Center's activities will be coordinated closely with the Technology Innovation Office of EPA, which is directed by Dr. Walter W. Kovalick, Jr. Center reports will be prepared by technical teams drawn as appropriate from NETAC, Pitt and other supporting institutions, including Carnegie-Mellon University.

NETAC was chosen by EPA through a competitive process. The award is for a three-year base period funded annually at $250,000 per year. GROUND WATER CURRENTS will report from time to time on the developments and products of the Center.

For more information on the Center, call Dr. Berkey at 412-826-5320 or Dr. Pohland at 412-624-1880.

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A SOLUTION TO BIOREMEDIATION'S SOIL PLUGGING

By Peter R. Jaffe, Ph.D., Princeton University

The results of research sponsored by EPA's Northeast Hazardous Substances Research Center (HSRC) have direct application for the design of in situ bioremediation of contaminated ground water. The research results clearly show under what conditions soil clogging occurs and how to mitigate this problem.

Manipulating the ground water by adding constituents that enhance the growth of microorganisms can cause the soil to become plugged or clogged -- that is, gases and water are no longer able to flow through it freely. Several factors can lead to clogging of soils during in situ bioremediation, including the accumulation of biomass in soil pores; the precipitation of chemicals such as iron, which can occur as the oxygen in ground water increases; and the entrapment in soil of small gas bubbles formed by bacterial metabolism. Biomass, precipitates and gas bubbles all reduce the area through which the water can flow in the soil. If such clogging occurs, pumping and controlling the ground water flow in the subsurface will be difficult; the bioremediation design may even fail.

The research focused on identifying which types of in situ bioremediation designs are more likely to have clogging; in what types of soils clogging is more likely to occur; and how to design and operate a bioremediation scheme in order to minimize clogging of soils. In order to address these issues, a computer model was developed that simulates the accumulation of biomass in the soils. This computer model was based on results of laboratory studies on the physics of soil clogging by biomass. With the aid of this model, researchers at the Northeast HSRC investigated clogging during in situ bioremediation of contaminated ground water sites having different soil and pollutant properties.

The results of this research project have shown that heterogeneous soils are more likely than homogeneous soils to exhibit clogging during in situ bioremediation. This potential for clogging has been expressed in terms of soil-type parameters used in soil physics, such as a pore-size distribution index, which gives engineers and geohydrologists a tool to assess the potential for clogging in a specific soil condition. In terms of the pollutant itself, it was shown that clogging will be most severe in the vicinity of injection wells when the bioremediation design requires that a specific substrate for the microorganisms and oxygen both be injected simultaneously. The model developed in this project was used to illustrate how to operate such injection wells in order to minimize soil clogging. By alternating the injection of the food source and the oxygen, the researchers estimated that the injection pressure at the injection well could be reduced tenfold.

For more information, call Peter Jaffe at Princeton University at 609-258-4653. See also: Taylor, S.W. and P.R. Jaffe, "Enhanced In Situ Bioremediation and Aquifer Permeability Reduction," JOURNAL OF ENVIRONMENTAL ENGINEERING, ASCE, Vol. 117, No. 1, Jan. 1991, pp. 25-46.

BIOREMEDIATION VIDEO

The Great Lakes/Mid-Atlantic Hazardous Substances Research Center has produced a training videotape on bioremediation. The video is designed to help train state and local government regulators in the elementary concepts of bioremediation. It defines commonly used terms, discusses both in situ and engineered reactor approaches to bioremediation and identifies some of the criteria that establish the site- and chemical-specific characteristics for remediation. This video was developed by The University of Michigan and produced by Michigan State University with support from EPA's Bioremediation Action Committee.

The video can be purchased for $35 by contacting Michael Berger by telephone at 313-763-1312; by FAX at 936-2195; or by mail at The University of Michigan, 2028 Dana Building, Ann Arbor, MI 48109-1115.

VISITT UPDATE

EPA has updated the Vendor Information System for Innovative Treatment Technologies (VISITT). VISITT 4.0 is an electronic database that features 48 new vendors and now provides data on a total of 204 companies offering 325 technologies in 32 technology categories. There are 236 full-scale, commercially available technologies, an increase of 35 full-scale technologies. The technologies in VISITT have the potential to treat a wide range of contaminants. The number of VISITT 4.0 technologies that will treat volatile organics increased almost 20% from VISITT 3.0. The number of technologies which will treat metals increased 30%, semivolatile organics and

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SITE SUBJECTS

UPDATE ON ZENON PERVAPORATION

By Ron Turner, EPA National Risk Management Research Laboratory

The ZENON cross-flow pervaporation system employs a membrane to remove volatile organic compounds (VOCs) from aqueous matrices contaminated with liquids such as solvents, degreasers and gasoline. VOCs with water solubilities of less than 20,000 parts per million (ppm) are generally suited for removal by pervaporation. Pervaporation provides an alternative approach to treating organic-contaminated water at sites where conventional air stripping or carbon adsorption are under consideration for use. Unlike air stripping, pervaporation releases negligible amounts of VOCs to the outside air. Unlike activated carbon, the treatment medium does not require frequent replacement and disposal. Periodic cleaning of the membranes is necessary to maintain the treatment efficiency. The full-scale ZENON system can be easily transported and requires only an electrical source.

ZENON was evaluated during a SITE (Superfund Innovative Technology Evaluation) full-scale demonstration at a former waste disposal area at Naval Air Station North Island in San Diego, California in February 1995. The demonstration was conducted as a cooperative effort among EPA, ZENON, the Naval Environmental Leadership Program, Environment Canada and the Ontario Ministry of Environment and Energy. Long-time readers of GROUND WATER CURRENTS may recall that we first reported in our June 1994 issue (EPA 542-N-94-005) the good results from the Canadian government's pilot scale demonstration of Zenon's pervaporation process. At Naval Air Station North Island the ground water contained elevated concentrations of trichloroethylene (TCE), as well as other contaminants. The TCE influent concentrations were up to 250 ppm. The Zenon pervaporation system removed about 98% of the TCE at a flow rate of 10 gallons per minute or less. The average TCE concentration in the treated water was approximately 1,380 micrograms per liter. Air releases were minimal.

The ZENON membrane material is a nonporous organophilic polymer, such as silicone rubber, formed into capillary fibers measuring less than one millimeter in diameter. Silicone rubber is highly permeable to organic compounds and resistant to degradation. The capillary fibers are aligned parallel on a plane and spaced slightly apart. This arrangement of fibers forms one membrane layer. Separate membrane layers are aligned in series, with the interior of the capillary fibers exposed to a vacuum (about one pound per square inch, absolute). The number of membranes used in a particular system depends on expected flow rates, contaminant concentrations in the untreated water and target concentrations for contaminants in the treated water.

For the demonstration, contaminated water was

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SITE SEARCH -- NAPL CONTAMINATED SITE WANTED

EPA's National Risk Management Research Laboratory (NRMRL) in Ada, Oklahoma is conducting an evaluation of innovative technologies for extracting nonaqueous phase liquids (NAPLs) from subsurface environments. NRMRL is searching for a second site to repeat an evaluation currently in progress at Hill Air Force Base (Hill AFB), Utah where ten side-by-side evaluations are being conducted in highly controlled test cells constructed with sealable joint sheet piles keyed into a clay confining layer. The first approach tested used spirit grade alcohol for solubilizing the contaminants. The cosolvent was successful in removing from 80% to 100% of the target constituents in approximately ten pore volumes. The remaining tests at Hill AFB will be completed before the end of fiscal year 1996.

The research program calls for repeating the evaluation at additional sites with different hydrologic environments. We are seeking a highly contaminated NAPL site which meets the following minimum criteria: (1) the site must be on government property; (2) the confining layer must be within 40 feet of soil surface; and (3) site owners and regulators should be willing to actively support the activity.

A short list of proposed sites will be prepared by the middle of October 1995. Work is scheduled to begin in the Spring of 1996. Field work at the site will be completed by the Summer of 1999.

Those interested in proposing a potential test site should contact Carl G. Enfield, NRMRL, Ada, Oklahoma at 405-436-8530.

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other organics increased 15% and 65% respectively.

EPA has made the VISITT 4.0 software and user manual available for downloading (free) on the Internet accessible Clean-Up Information Bulletin Board System (CLU-IN). For instructions on downloading VISITT from these resources, contact the VISITT HELP LINE at 800-245-4505 or 703-883-8448. VISITT software is also available from EPA's File Transfer Protocol (FTP) site on the Internet (FTP.EPA.GOV). It can also be obtained from the following electronic information resources: America Online (AOL); Defense Environmental Network for Information eXchange (DENIX) (Telenet: 128.174.5.51). VISITT 4.0 diskettes (3.5") and user manual can be obtained by sending a request to EPA/NCEPI either by mail (P.O. Box 42419, Cincinnati, OH 45242-0419) or by FAX (513-489-8695). EPA requests that, whenever possible, you download directly from one of the electronic bulletin boards rather than ordering the diskette due to limited funds for duplicating diskettes.

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pumped from an equalization tank through a prefilter to remove debris and silt particles and then into a heat exchanger that raised the water temperature to about 165 degrees F (75 Degrees C). The heated contaminated water then flowed into a pervaporation module that contained dense polymeric membranes. The organophilic composition of the membrane caused the organics to adsorb to the membrane (capillary fibers). The organics migrated to the interior of the capillary fibers and were then extracted from the membrane by the vacuum. Contaminated water that passed through the pervaporation module was depleted of organics and exited the ZENON system for sewer discharge. The organic vapor (called permeate) that adsorbed to the membrane and which was extracted by vacuum was condensed and vented downstream of the condenser, thus minimizing air releases.

The condensed liquid permeate, containing highly concentrated organic compounds and significantly reduced in volume, generally separates into aqueous and organic phases, rendering the organic fraction potentially recoverable. The organic phase permeate is pumped from the containment vessel to storage, while aqueous phase permeate can either be returned to the pervaporation module for further treatment or removed for disposal.

For more information, contact Ron Turner at EPA's National Risk Management Research Laboratory at 513-569-7775. Detailed information on the technology's capabilities and the results of the ZENON SITE demonstration will be discussed in the forthcoming SITE Technology Capsule (Document No. EPA/540/R-95/511a) and the Innovative Technology Evaluation Report. To get on the mailing list for these documents, send a FAX request to Ron Turner at 513-569-7787.

MAILING LIST/ORDER INFO

To order additional copies of *Ground Water Currents*, or to be included on the permanent mailing list, send a fax request to the National Center for Environmental Publications and Information (NCEPI) at 513-489-8695, or send a mail request to NCEPI, P.O. Box 42419, Cincinnati, OH 45242-2419. Please refer to the document number on the cover of the issue if available.

Ground Water Currents welcomes readers' comments and contributions. Address correspondence to: *Ground Water Currents*, NCEPI, P.O. Box 42419, Cincinnati, OH 45242-2419.

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