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TECH TRENDS

The applied technologies journal for Superfund removals and remedial actions and RCRA corrective actions

Good News for Savannah River

Dept. of Energy's Integrated Demonstration Program to Contribute to TECH TRENDS

We're excited to carry in this issue of *TECH TRENDS* an article on horizontal wells for in situ air stripping that comes from the Department of Energy's (DOE) Integrated Demonstration Program at the Savannah River Site. We hope that it is the first of many articles from Savannah River.

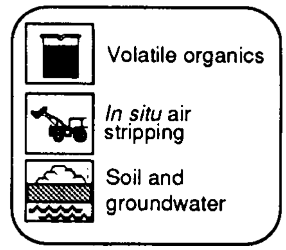
DOE's Integrated Demonstration Program was developed to facilitate timely and effective application of new and enhanced technologies to meet DOE's environmental restoration needs. Entire systems and multiple technologies are assembled and evaluated as part of a collaborative effortwith DOE laboratories, universities, federal agencies and private industries. The Savannah River program involves innovative groundwater and soil technologies.

New Information Sources Available

Don't miss this issue's special insert that highlights EPA's Technology Innovation Office's new automated database, the Vendor Information System for Innovative Treatment Technologies (VISITT), and a new publication entitled *Innovative Treatment Technologies: Overview and Guide to Information Sources.*

Horizontal Wells for Cost Effective *In Situ* Air Stripping

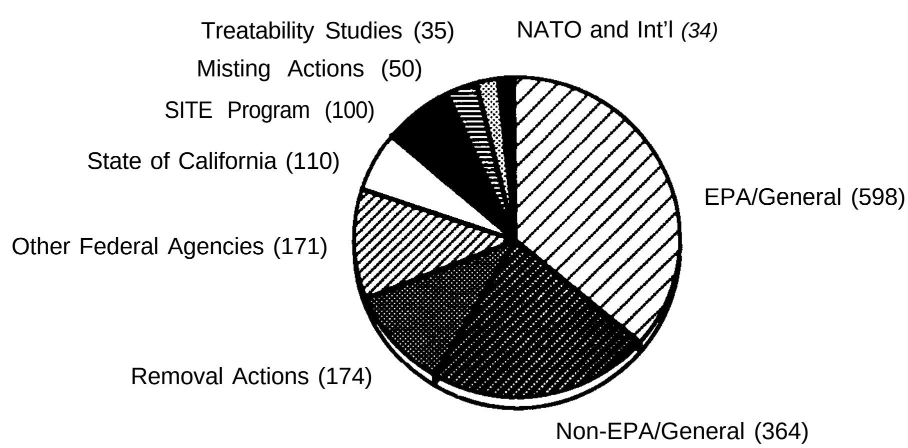
by Caroline Teelon
Westinghouse Savannah River Company



The Department of Energy (DOE) has developed and demonstrated an *in situ* air stripping technique that utilizes horizontal wells to remove volatile organic solvents from soil and groundwater. The demonstration was part of the DOE's Savannah River Integrated Demonstration Program. At the site, an abandoned process sewer line leaked trichloroethylene and tetrachloroethylene into soil and groundwater. Air injection and extraction using horizontal wells has several advantages over traditional air stripping. With horizontal wells, contaminant extraction can follow natural paths of high permeability-most likely the same paths taken by the contaminant leaking downward from the upper levels of the soil strata. The positioning of horizontal wells can be planned to conform to the distribution of subsurface contamination and can optimize the results of *in situ* remediation by providing more contact area with the contaminant plume. Horizontal wells also allow access under surface structures and buildings. This means that storage tanks and lines often associated with industrial operations can be accessed without demolishing above-ground structures or installing a vertical drilling rig within the structure. Although more costly per linear foot to install than vertical wells, a horizontal well system can save on operating expenses.

(see Horizontal Wells page 2)

Sources of Documents in ATTIC*

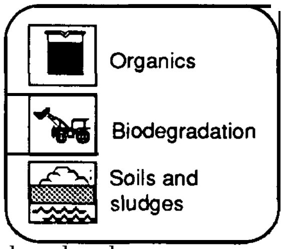


*** Alternative Treatment Technology Information Center**

SITE Subjects

Slurry Biodegradation Removes Wide Range of Organics in Soils

by Ronald Lewis
Risk Reduction Engineering Laboratory



Slurry biodegradation in a bioreactor has the potential to treat a wide range of organic contaminants such as pesticides, fuels, creosote, pentachlorophenol and polychlorinated biphenyls. The process has been used to treat coal tars, refinery wastes, hydrocarbons and wood-preserving wastes. Slurry biodegradation to treat soils and sludges with organic contaminants was pilot-tested on creosote-contaminated soil from the Burlington Northern Superfund Site in Brainerd, Minnesota as part of the EPA Superfund Innovative Technology Evaluation (SITE) Program. This SITE demonstration was conducted at EPA's Test and Evaluation facility in Cincinnati, Ohio, using a 60-liter Biolift™ reactor. Slurry biodegradation can be effective in treating highly-contaminated soils and sludges that have contaminant concentrations ranging from 2,500-250,000 mg/kg.

For the SITE demonstration, the contaminated soil was first screened to remove oversized material. Next, the soil was mixed with water to form a slurry composed of 20-30% soil by weight. The slurry was passed through a milling process to achieve a suitable grain size distribution for the bioreactor. The slurry was fed to a continuously-stirred tank bioreactor, and microorganisms and nutrients were added to enhance the biodegradation process. The additions included an inoculum of indigenous PAH degraders, an inorganic nitrogen supplement in the form of NH-N and a media broth containing potassium, phosphate, magnesium, calcium and iron. Once the biodegradation was completed, the treated slurry was sent to a separation/dewatering system. The process converted the PAHs into relatively harmless by-products of microbial metabolism and inorganic salts.

The greatest decline in contaminant concentrations occurred in the first two weeks of the study. Soil-bound PAH which had initial concentration levels of 728-4,920 mg/kg soil showed a 70-97% reduction (average of 89%) over nine weeks of testing. Liquid-phase PAHs with original concentration levels of 1.1 mg/liter were below the detection limits in post-treatment samples.

The residence time in a bioreactor will vary with the soil or sludge matrix, the physical/chemical nature of the contaminant (including concentration and the biodegradability of the contaminants). After the biodegradation process is completed, the solids can be further treated if they still contain organic contaminants. The process water can be treated in an onsite treatment system before it is discharged or recycled back into the slurry system. Should air emissions occur (depending on waste characteristics), it may be necessary to use an air pollution control, such as activated carbon.

A Technology Evaluation Report and an Applications Analysis Report describing the complete demonstration will be available this summer. For more information, call Ron Lewis at EPA's Risk Reduction Engineering Laboratory at FTS-684-7856 or 513-569-7856.

Horizontal Wells

(from page 1)

At Savannah River, two horizontal wells were installed along the abandoned sewer line. To install the horizontal wells, a curved bore hole was drilled to a predetermined depth, then a horizontal bore was drilled for the length of the well. Sections of the horizontal run of the well contain screen openings to allow for a broader lateral distribution of gas injection and extraction. Both wells operated concurrently. First, one well, installed below the water table (within the contamination zone) was used to inject air from injection pumps. The pumps drove the air across the contamination plume so that the contaminants volatilized. The second well, installed above the water table was used as a vapor extraction well to collect the volatilized contaminants and pump them into an above-ground treatment device. After the treatment device separated the contaminants from the air, the air could be recycled into the injection well or dispersed into the atmosphere. The volatile organics were successfully stripped from the groundwater and soils. In the most effective wells located in the center of the site, trichloroethylene levels were reduced from over 1,800 parts per billion (ppb) to 10 ppb and tetrachloroethylene levels from 180 ppb to 2 ppb.

The horizontal well process can also be applied to other volatile organic contaminants such as gasoline hydrocarbons, benzene and other chemicals having an affinity for a gaseous versus liquid phase, because of a relatively higher vapor pressure and/or a lower solubility. The injection medium can be air or other gas or a gas and liquid mixture depending on the type of contaminant to be removed. Air may be the most economical method for large plumes. Steam also can be used to facilitate volatilization. Reactants, such as bicarbonate, which react with the groundwater to form purging gases, may also be used. Treatment options for the extracted volatilized contaminant are: filtration (such as carbon activated filters); incineration; or an off-gas stack or similar treatment method.

For more information, call Caroline Teelon at Westinghouse Savannah River Company at 803-725-5540.

Out of the ATTIC

Information on Metals Removal in ATTIC

EPA's Alternative Treatment Technology Information Center (ATTIC) is a source for locating data and technical information on innovative treatment technologies for the cleanup of hazardous wastes.

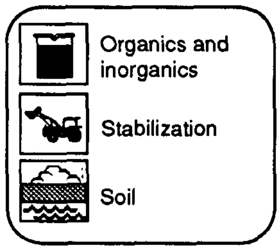
David Smith of EPA Region 8 recently consulted ATTIC looking for information on technologies for remediating former wood preserving sites. Using his PC and modem, he dialed into ATTIC, accessed the ATTIC database, and performed a summary search for the phrases "wood preserving" and "wood treatment" and found 35 abstracts that contained information on relevant contaminated sites. Eighteen of these references were from Records of Decision and the other 17 were treatability studies, removal actions, Superfund Innovative Technology Evaluation (SITE) Program demonstrations, and case studies. The abstracts described reports on the applications of various technologies including bioremediation, ultraviolet oxidation, and chemical fixation/stabilization. David then narrowed his search criteria and found that four of these reports involved sites in his Region.

One of the abstracts found in his fist search was entitled "Recovery of Chemicals from Water Using Ion Exchange: A Case Study," As explained in the abstract, this report described extraction of heavy metals from stormwater runoff and groundwater using

(see ATTIC page 4)

Successful Stabilization of Organics

by Edward Bates, Risk Reduction Engineering Laboratory



An innovative immobilization technology that stabilizes semi-volatile organic compounds as well as inorganic compounds was recently demonstrated by the Silicate Technology Corporation (STC) of Scottsdale, Arizona. This technology is particularly exciting because immobilization technologies, although generally effective in immobilizing metallic and other inorganic contaminants, have not been effective previously for wastes containing semi-volatile organic constituents. The STC technology showed favorable results when it was recently demonstrated as part of the EPA's Superfund Innovative Technology Evaluation (SITE) program at the Selma Pressure Treating Site in Selma, California. Former wood treatment operations at the site had contaminated approximately 18,000 cubic yards of soils with high concentrations of pentachlorophenol (PCP), arsenic, chromium, copper and oil and grease.

For the process, STC developed two proprietary reagents, SOILSORB HC for the organic constituents and SOILSORB HM for the inorganic constituents. These silicate reagents adsorb the contaminants prior to encapsulating the waste in a strong , leach-resistant, cement-like material. Results from treatability studies can be used to adjust the amounts of reagents required for stabilization according to variations in organic and inorganic contaminant concentrations.

At Selma, treatment of contaminated soil began with the separation of the coarse and fine waste materials. The coarse materials were crushed to less than 3/8 inch. The waste was then weighed and predetermined amounts of the silicate reagents were added. The mixture was conveyed to a pug mill mixer where water was added and the mixture blended. (Sludges may be placed directly into the pug mill, reagents added and mixing continued). Treated material was then placed into onsite molds for curing and casting and subsequent placement into a prepared storage area for long-term (multi-year) study.

The STC process successfully solidified contaminated soils containing less than 2% oil and grease with a moisture content of up to 6%. Extensive sampling and analysis before and after treatment compared physical, chemical and leaching properties. Initial PCP total waste concentrations as high as 10,000 parts per million (ppm) were reduced 91 to 97% (to as low as 53 ppm) as measured by EPA Method SW846-8270 (methylene chloride extraction). After adjusting data to eliminate any apparent reduction due to dilution, standard Toxicity Characteristic Leaching Procedure (TCLP) leach tests on raw and waste material produced small and inclusive numbers for PCP but indicated up to 92% reduction (from 1.82 ppm to 0.09 ppm) for arsenic and 97% for copper (from 9.43 ppm to 0.06 ppm). Substituting distilled water for acetic acid in the TCLP procedure indicated reductions up to 97% for PCP (from 40.0 ppm to 0.6 ppm), 98% for arsenic (from 0.80 ppm to less than 0.01 ppm) and 90% for copper (from 0.56 ppm to 0.03 ppm). Permeability of the treated waste was low: 1/10th of a foot per year ($< 1.7 \times 10^{-7}$ cm/set). Unconfined compressive strength of the treated wastes was moderately high, averaging 260-350 pounds per square inch. The treated waste volume increased 59-75% over the original waste volume.

Replication of the process should prove cost effective. The estimate for treatment of large amounts of wastes (15,000 cubic yards) similar to waste found at Selma is approximately $200 per cubic yard.

An Applications Analysis Report should be available by mid-1992. For more information, call Ed Bates at the Risk Reduction Engineering Laboratory at FTS-684-7774 or 513-569-7774.

Conference Alert

Subsurface Restoration Conference

June 21-24, 1992

This conference will present state-of-the-art assessments of regulatory strategy, basic science, site characterization, contaminant immobilization and containment, and technologies for contaminant removal and destruction. It is sponsored by EPA and four national research centers. The conference will be held at the Doubletree Hotel-Lincoln Centre, Dallas, Texas. The poster title deadline is March 16. Extended abstracts must be submitted by May 4. For more information call 713-285-5429.

ATTIC *(from page 3)*

ion exchange treatment. The site, an operating wood treatment plant, was contaminated with chromium, copper and arsenic. The reported concentration of chromium in the groundwater was originally 50 ppm. A reduction in concentration to 11 ppb was achieved. Mr. Smith searched for other reports on ion exchange and found 26 more abstracts.

Another abstract he found was entitled "Arsenic Removal Using Electrochemically Generated Iron in Conjunction with Hydrogen Peroxide Addition." This paper compared several physicochemical processes that are commonly used in the removal of metals from water such as precipitation, coprecipitation, surface complexation, and electrostatic attraction. The feasibility of electrochemical technology for arsenic and chromium removal was studied using bench-scale tests and treatability studies.

From these and other abstracts, Mr. Smith was provided with information that included publication references, contact names, addresses and phone numbers. After scanning the abstracts he had retrieved, Mr. Smith called the ATTIC System Operator and requested the full reports described in the abstracts. Brian, one of the System Operators, copied the reports and sent them out the same day.

Over 1400 members of the hazardous waste community are registered users of the ATTIC system. There is no charge for accessing, searching or downloading reports from the system. Information on ATTIC is available from the System Operator at 301-670-6294 or Joyce Perdek, of EPA's Risk Reduction Engineering Laboratory, at FTS-340-4380 or 908-321-4380. To access ATTIC by modem, dial 301-670-3808.

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