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EPA
U.S. Environmental Protection Agency
Office of Solid Waste and Emergency Response
Technology Innovation Office

TECH TRENDS

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

Innovative Technologies Directive Issued

The special insert in this issue of *Tech Trends* is a fact sheet on a new directive from EPA Assistant Administrator Don Clay to EPA Regions. The new directive calls on EPA staff, consulting engineers, Superfund PRPs, and RCRA owner/operators to jointly support the introduction of innovative technologies in their projects.

Lime-Treated PCB Test Results

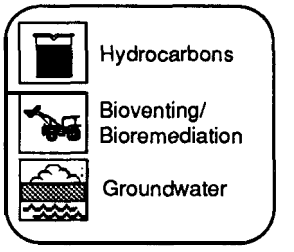
by John Convery, Risk Reduction Engineering Laboratory

At the request of Region V, the office of Research and Development's Risk Reduction Engineering Laboratory (RREL) investigated the effects of quicklime on polychlorinated biphenyls (PCBs). The research was prompted by field observations that suggested significant PCB losses after wastes were solidified with materials containing quicklime. Additionally, a report from one project claimed evidence of complete PCB destruction. However, that report was questioned during peer review. Hence, RREL and the Environmental Monitoring Systems Laboratory (EMSL) conducted research to clarify

(see ***PCB-Lime,*** *page 3)*

Bioventing/Biodegradation Remediates Liquid Hydrocarbons in Unsaturated Zone

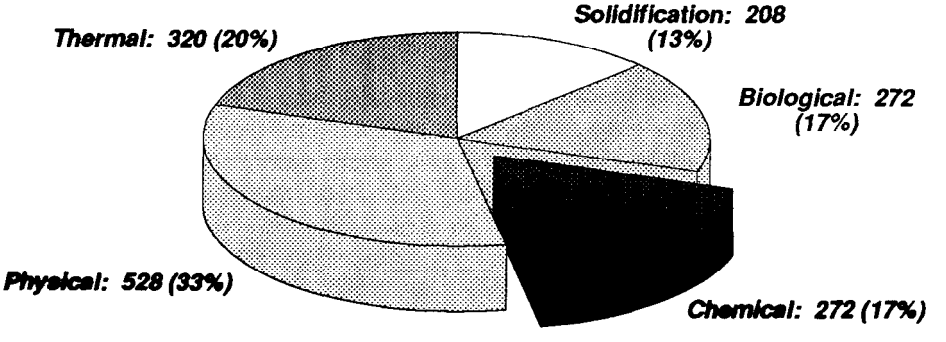
by Don Kampbell, Robert S. Kerr Environmental Research Laboratory



The use of bioremediation for unsaturated zones is a relatively new technique. Assisted by bioventing, bioremediation is being used successfully at the U.S. Coast Guard Air Station in Traverse City, Michigan. EPA's Robert S. Kerr Environmental Research Laboratory (RSKERL) and the U.S. Coast Guard are finding that their pilot demonstration is confirming earlier treatability studies that indicated that bioventing and bioremediation could be used to clean up the unsaturated zone contaminated with hydrocarbons from an aviation gasoline spill. The actual zone of contamination consists of liquid hydrocarbons in the capillary fringe on top of the groundwater. The initial concentrations of hydrocarbons in core material were as high as 10,000 milligrams per kilogram (mg/kg) when the demonstration started last October. Subsequent sampling every three months shows that the bioventing process is working and that concentrations will be reduced to 100 mg/kg by December 1991. Final benzene levels (originally 300 milligrams per liter) in

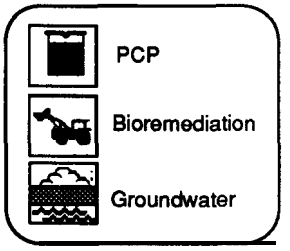
(see ***Bioventing,*** *page 2)*

Abstracts in the Alternative Treatment Technology Information Center (ATTIC) Database



Biological Treatment Removes Both Target & Background Contaminants from Groundwater

by Mary K. Stinson
Risk Reduction Engineering Laboratory



trailer-mounted aerobic biological treatment system was demonstrated at a wood preserving facility in New Brighton, Minnesota. The process, a patented system called the BioTrol Aqueous Treatment System (BATS), was tested on pentachlorophenol-contaminated groundwater under a Superfund Innovative Technology Evaluation demonstration. The system successfully reduced pentachlorophenol concentrations from 45 parts per million (ppm) to 1 ppm or less in a single pass through the system. Biotesting done with living organisms showed no acute toxicity of the treated effluent.

The system consists of a mixing tank, a heat exchanger and a bioreactor where a patented microbial population specific to pentachlorophenol is added to the indigenous microbial population in the wastewater. Here's how it works. Contaminated water enters a mixing tank where the pH is adjusted and inorganic nutrients are added. A heat exchanger is used to heat the water to optimize the system. The water then flows to the submerged bioreactor chambers where the organic contaminants will be biodegraded.

The fixed-film bioreactor has three chambers that contain a mixture of the indigenous and the patented microorganisms immobilized on a support media. The growth of the microbes has been developed over a one to two week period, prior to the introduction of the wastewater from the mixing tank. Air is supplied by fine bubble membrane diffusers mounted at the base of each chamber. As the water flows through the bioreactor , contaminants are degraded and pentachlorophenol is transformed into carbon dioxide, water and chloride ion. The resulting effluent may be discharged to a Publicly Owned Treatment Works, reused onsite or even discharged directly under a National Pollution Discharge Elimination System permit.

At New Brighton, the system appeared to be unaffected by low concentrations of oil and grease (less than 50 ppm) and heavy metals in the water. The system required minimal operator attention. The ten gallons per minute (gpm) capacity unit was operated for two weeks (after the initial two-week acclimation period) at three different rates: 1 gpm, 3 gpm and 5 gpm. All three throughput rates yielded the desired reduction.

In addition to groundwater, this technology is applicable to a wide variety of wastewaters, including holding ponds and process effluents. Contaminants found to be amenable to treatment include pentachlorophenol, creosote constituents, gasoline and fuel oil, chlorinated hydrocarbons, phenolics and solvents.

For more information, call Mary Stinson at FTS-340-6683 or 908-321-6683, at EPA's Risk Reduction Engineering Laboratory Technical Assistance Program in Edison, New Jersey.

Bioventing

(from page 1)

underlying groundwater near the water table are predicted to meet the state standard of 5 micrograms per liter.

The bioventing involves a system that injects air into the contaminated zone to vaporize the liquid contaminants and transport them up through the soil. By the time the vapor reaches the surface, practically all of the contaminants have been degraded by the soil microorganisms.

The project was executed in several steps. In the first step, grass was planted on top of the demonstration area to increase the potential for biological activity. Studies have found that much of the biological activity occurs in the top six inches of soil; and, this activity is associated with root systems near the surface. Next, a nutrient solution consisting of 25 mg/kg of nitrogen, 5 mg/kg of phosphorus and 2 mg/kg of potassium was dispersed throughout the unsaturated zone to enhance the biodegradation. Fifteen air injection points, ten feet apart in a 3x5 grid, were placed just above the groundwater table. Next, a tracer test with sulfur hexafluoride was conducted to determine how far the injected air moved laterally in the soil. A second system of both injection and extraction points, ten feet apart, just above the water table, is also being evaluated to determine if it is more efficient than injection points alone. With this second system, the extracted airstreams are reinjected into the soil so that further biodegradation may occur. Both treatment areas are being monitored for air emissions which have been negligible.

Performance and economic data from this pilot demonstration show that the system will be suitable for application to full-scale remediation.

For more information call Don Kampbell at RSKERL in Ada, OK at FTS 743-2358 or 405-332-8800.

United States
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Agency

Office of
Solid Waste and
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EPA Furthering the Use of Innovative Treatment Technologies in OSWER Programs

Introduction

The Office of Solid Waste and Emergency Response (OSWER) is seeking to further the use of innovative treatment technologies to permanently clean-up contaminated sites in the Superfund, RCRA, and Underground Storage Tank (UST) programs. According to a directive from OSWER s Assistant Administrator Don Clay, ...we must invest the necessary resources and take the risks now to develop the technologies necessary to fulfill the long-term needs of our hazardous waste clean-up programs. The directive, which was signed on June 10, 1991, includes a forwarding memorandum to EPA regions that calls for technological leadership and a sense of responsible urgency to prevent expenditures in pursuing less effective or more costly remedies. This fact sheet is based on OSWER Directive 9380.0-17.

Reasonable risk-taking is encouraged in selecting innovative treatment technologies that are capable of treating contaminated soils, sludges, and ground water more effectively, less expensively, and in a manner more acceptable to the public than existing conventional methods.

Innovative treatment technologies are newly-developed technologies that lack sufficient full-scale application data to ensure their routine consideration for site remediation. They may be new technologies, or may already be in use for various industrial applications other than hazardous waste remediation. As such, innovative technologies are not part of standard engineering practice or the competitive market process where available alternatives are routinely presented to the government and private sector. In functional terms, OSWER labels as innovative those treatment technologies other than incineration and solidification/stabilization for source control, and other than pumping with conventional treatment far ground water.

Inherent risks associated with early technology use serve as very serious impediments. The directive calls on potentially responsible parties, facility owners/operators, and consulting engineers to constructively work with uncertainty to further the application of technologies that are truly innovative. The directive also calls on EPA regional and headquarters managers to support Remedial Project Managers and On-Scene Coordinators in their efforts to use new technologies.

Innovative treatment technologies should be routinely considered as an option in engineering studies where treatment is appropriate. They should not be eliminated from consideration solely because of uncertainties in their performance and cost. These technologies may be found to be cost-effective, despite the fact that their costs are greater than conventional options, after consideration of potential benefits including increased protection, superior performance, and greater community acceptance. In addition, future sites will benefit by information gained from the field experience.

The directive sets forth several initiatives and new procedures that will provide incentives for broader use of innovative technology. Some of these initiatives are directed toward potentially responsible parties and owner/operators, since these groups will be assuming a larger share of the remedial projects in the future. Other new initiatives are intended to remove impediments to the first-time use of new equipment. The directive also encourages wider application of available resources and tools and highlights some important on-going program efforts.

New Initiatives

1. Superfund Innovative Technology Start-Up Initiative

OERR will be revising its procedures for setting Remedial Action funding priorities to give more consideration to innovative technologies. Expedited funding of Fund-lead remedial design and construction projects that involve innovative treatment technologies will move the agency toward the Superfund program s goals for technology development and will provide data to support future Records of Decision (RODS).

This initiative also provides contract flexibility in the start-up phase of selected remedial and removal actions to assist vendors in establishing operations that satisfy performance standards. In an effort to remove some of the impediments to the use of new full-scale equipment, this

initiative will provide financial support for initial start-up and shake-down prior to beginning actual remediation. Funds are not targeted at making the technology work at any cost , but in establishing performance adequacy of the technology prior to the onset of the contracted clean-up. Contracting strategies are being considered to compensate vendors regardless of whether or not they are able to meet performance requirements for a portion of the site remediation.

2. Dual Track RI/FS Initiative (Superfund)

EPA regions may fund additional treatability studies and engineering analyses for promising treatment technologies that would otherwise be considered unproven or too early in the development process. For PRP-lead sites early in the planning process, this initiative encourages the use of treatability studies to ensure that alternative remedies are thoroughly evaluated and considered in the ROD. Even if, in a particular case, there may be some doubt as to EPA s ability to recover the costs for these additional studies, they should nonetheless be pursued because of their value to the overall program.

3. Tandem ROD Evaluation Initiative (Super-Fund)

Primarily applicable to PRP-lead sites (though also to some Fund-lead sites), this program will enable regional staff to rapidly evaluate the efficacy of a PRP-proposed innovative remedy that is offered in tandem with the primary one approved in the ROD. Both remedies would be part of the proposed plan. The alternate solution would be approved in the ROD on a contingent basis but would undergo further development and pilot testing during the design period of the primary technology. Tandem RODs move the process of cleanup toward closure while leaving room for PRPs with an interest in innovative technologies to pursue additional pilot tests to demonstrate an alternate approach that is both innovative and potentially cost-effective. The OSWER/ORD Technical Support Centers and the SITE Demonstration Program will provide RPMs with technical support for evaluation of PRP work. When considering a tandem ROD, the region should consult with ORD concerning the scope of effort required for the evaluation.

If, after testing and evaluation, the innovative technology is chosen for implementation but the process has caused significant delays to the schedule, the region may consider the engineering problems of making the full-scale unit operational when assessing stipulated penalties. That is, in limited cases, stipulated penalties should not be imposed if the delays are the unavoidable result of the use of an innovative process.

4. Removal Program Initiative (Superfund)

It is OSWER policy to further the use of innovative technologies through the removal program. The relatively small waste volumes and streamlined contracting procedures of the removal program provide an opportunity to complete clean-up projects and provide documentation on lessons learned .

The potential of the removal program for these applications has not been realized because time constraints often favor excavation and off-site disposal or treatment and also because of the absence of clear legislated goals regarding the use of new technology. This directive is meant to clarify EPA s position on this issue and to encourage the use of innovative technologies for all actions, including time-critical actions, where feasible. These projects are expected to fulfill an important role in adding to our knowledge on promising new technologies.

5. RCRA Corrective Action and Closure Innovative Technology Initiative

This initiative encourages the regions to conduct treatability or technology demonstration studies at corrective action and closure sites to gain additional information on the use of innovative treatment for contaminated soil and debris.

EPA is developing best demonstrated available technology (BDAT) treatment standards for contaminated soil and debris at CERCLA and RCRA corrective action and closure sites. These sites present unique treatment problems that were not considered when developing the current BDAT standards which were based on data from the treatment of industrial process wastes. There is general agreement that wide scale use of incineration is not appropriate for soil and debris and there is a need to explore alternative approaches.

The current schedule is to promulgate a rule for the treatment of debris in May 1992 and for soil in April 1993. Prior to publication of these final rules, a site-specific treatability variance process (40 CFR 268.44 (h)) is available for contaminated soil and debris to establish an alternative standard for specified waste at individual sites. The variance process, along with applicable treatment guidance levels, is described in Superfund LDR Guide #6A (OSWER Directive 9347.3-06FS, July 1989), and is intended to be used as an interim approach until final standards are established.

The regions should work with owner/operators to select pilot-scale projects that can provide data on the capability of technologies and the treatability of different wastes. Projects should be carefully selected to maximize the utility of data and likelihood of success.

Authority for issuing site-specific variances for contaminated soil and debris has been delegated to the regions. The facility and EPA, in collaboration with the state, can implement variances for on-site demonstrations through two mechanisms: temporary authorization under the Permit Modification Rule, or 3008(h) orders for interim-status facilities.

6. Demonstration Projects at Federal Facilities (Superfund, RCRA, and UST)

EPA is exploring the use of Federal Facilities for both site-specific technology demonstrations and as test locations for evaluation of more widely applicable technologies. Regions are encouraged to suggest innovative approaches and to be receptive to proposals for innovation from Federal Facility managers, *e.g.,* by building timing and performance flexibility into compliance agreements in acknowledgment of the uncertainties associated with innovation. Federal Facilities often have characteristics that make them desirable for applying innovative approaches: large area, isolated locations, controlled access, numerous contamination problems, and increasingly active environmental restoration programs.

The Of&e of Federal Facilities Enforcement (OFFE) and the Technology Innovation Office (TIO) will work with the regions to identify locations for test and evaluation activities and to develop policies and guidance to ensure that support for innovation is congruent with other program and environmental objectives.

7. Federal Technology Transfer Act

During the clean-up planning and implementation process, PRPs or owner/operators should be reminded of the opportunity to engage EPA in evaluation studies or other arrangements (at their expense) to determine whether an innovative technology would be operative in the situation they are facing or other similar situations. Under the Federal Technology Transfer Act (FTTA) of 1986, cooperative agreements related to research, development, and technology transfer will allow the PRP to reimburse EPA for facilities, support services, and staff time spent in joint evaluation of early technology treatability or pilot studies.

Since this program is conducted in the research and development arena, it offers an opportunity for non-adversarial interaction outside the regulatory context. This opportunity should be especially advantageous to (1) PRPs and owner/operators capable of early planning for technology options at a few sites and desirous of early EPA input, as well as (2) PRPs and owner/operators that will be faced with a number of similar waste sites in the future-under Superfund, RCRA Corrective Action, and the UST program-who want to develop more uniform, cost-effective technology proposals for such sites.

Implementation

The first six initiatives involve field testing new technologies that may benefit from technical assistance from ORD. ORD represents an objective third party that can easily be accessed through the existing OSWER/ORD support structure. This structure consists of five laboratories that constitute the Technical Support Centers (both for Superfund and newly established for RCRA), the Super-fund Technical Assistance Response Team (START) Program, the Bioremediation Field Initiative, and the Superfund Innovative Technology Evaluation (SITE) Program. OSWER has asked ORD to give priority to requests for technical assistance under this directive.

Broader Application of Existing Policies, Available Resources, and Tools

Furthering Innovative Remediation at Leaking UST Sites

State and local UST programs have identified 100,006 confirmed leaks, and this number may triple in the next several years. Most site remediation involves pumping and treating ground water and excavation and off-site treatment of contaminated soils. Regional offices should increase their efforts to make state and local managers and staff, as well as clean-up consultants and contractors, more familiar with non-traditional but proven technologies. Headquarters will continue fostering the development of new tools and techniques and should increase its support of regional efforts to achieve broader use of improved technologies.

Further Enabling State Innovative Technology Leadership

The CERCLA core funding program provides an opportunity to assist states in establishing innovative technology advocates. Cooperative agreements with state response programs may be a vehicle to support and promote the use of innovative technologies in state CERCLA programs, with spinoff benefits for their RCRA and UST programs as well.

In addition, regions should be open to assisting states interested in furthering technology development and encourage state applications for authority for RCRA R&D permitting, permit modification, treatability exclusion, and Subpart X permitting. States may also want to work directly with Federal Facilities in developing pilot sites for innovative technologies. For the reasons discussed in the section on Federal Facilities above, these sites are often good candidates for such development projects.

Model RI/FS Work Plan and PRP Notice Letter Demand for Innovative Options

Some regions have issued special notices containing a Statement of Work and administrative order language requiring the responsible party to evaluate the use of innovative technologies at a particular site. This procedure

should receive broader use at Superfund sites where alternatives for remediation are being considered for analysis in the RI/FS and where prerequisite treatability studies are required. This requirement in the special or general notice letters will help facilitate the development and use of innovative treatment technologies by the private sector. Specific language for this approach can be developed from OWPE s guidance document entitled Model Statement of Work for RI/FSs Conducted by PRPs (OSWER Directive 9835.8).

Advocacy and Funding of Treatability Studies

Superfund program policy requires that treatability studies be conducted to generate data to support the implementation of treatment technologies. Funds are budgeted annually in the SCAP based on expected need. Data and reports should be sent to Glen Shaul at RREL for inclusion in the ATTIC database. The correct protocol and format for these reports is in EPA s Guide for Conducting Treatability Studies Under CERCLA (EPA/540/2-89/058). Oversight funding for evaluating a PRP-lead treatability study should also be requested through the SCAP budget process. Oversight of PRP-lead treatability studies may be funded through the enforcement budget. If a PRP recommends use of an innovative treatment at a site, but current treatability study data on the technology are insufficient, EPA policy allows the Agency to conduct and fund technology-specific treatability studies. Cost of these studies are recoverable under Section 107 of CERCLA.

Tracking and Expediting SITE Demonstrations

OSWER is encouraging greater participation in the SITE program in response to a recent Inspector General audit of the program that focused on delays in matching Superfund sites with technologies. ORD management has also agreed that SITE demonstration projects must be more responsive to regional needs for treatability data.

The SITE program will make the design of technology evaluation sufficiently flexible to meet the regional offices needs for treatability studies before remedy selection is made. Based on an ORD internal management review of the SITE program, changes are underway to make the program a more integral component of regional Superfund site activities.

Existing Program Efforts

OSWER has several other ongoing efforts directed toward furthering the application of innovative alternatives. These represent important resources that should continue to be used by the UST, RCRA, and Superfund Programs.

Technical Support and Information Management

EPA maintains several computer database that may be accessed for information on treatment technologies. These databases include the Alternative Treatment Technology Information Center (ATTIC), the Cleanup Information (CLU-IN) Bulletin Board, the ROD Database, the Hazardous Waste Collection Database, and the Computerized On-Line Information System (COLIS). These systems include information on the application of innovative technologies and may be used to aid networking among OSCs and RPMs.

Technical assistance is available to Superfund and RCRA staff through ORD s Technical Support Centers and the Environmental Response Branch of OERR. Part of this effort involves networking among project managers through the Engineering and Ground Water Forums. In addition, as part of an initiative to provide direct technical support to OSCs and RPMs, the Superfund Technical Assistance Response Team (START) has been established to help evaluate the potential use of technologies.

Bioremediation Field Initiative

Begun in the fourth quarter of FY 1990, this program is intended to provide more real-time information on the field application of biotechnology for treating hazardous waste. The major focus of this initiative is to furnish direct support in evaluating full-scale cleanup operations and technical assistance for conducting treatability and pilot-scale studies.

Eliminating Contract Impediments

Under the Federal Acquisition Regulations, firms are restricted from performing both the design and construction of a project. EPA has determined that this applies only to the prime contractor responsible for the overall design, and not to the subcontractors performing treatability studies.

Innovative technology is considered a special exception from general conflict of interest guidelines. EPA will permit contractors and/or subcontractors who perform evaluation of innovative technologies for the Agency to later work for the PRPs in as many instances as possible.

Additional Information

Copies of the policy (OSWER Directive 9380.0-17) and additional copies of this fact sheet are available from:

National Technical Information Service (NTIS)
Springfield, VA 22 16 1
Phone (703) 487-4650

Agency and State employees may obtain copies of the directive or this fact sheet from the Superfund Document Center, U. S. Environmental Protection Agency, Room 2514,401 M Street S.W., Washington, DC 20460. The telephone number is FTS or 202/382-5628.

ATTIC

Out of the ATTIC

Photochemical Oxidation Reduces Organics

by *Curtis Harlin, Office of Research and Development*

In our series of articles in "Out of the Attic", we try to give you a sense of the kinds of information you find when you access the Alternative Treatment Technology Information Center (ATTIC) database. ATTIC divides its innovative treatment technologies into five areas: physical, thermal, solidification/stabilization, biological and chemical. In this issue, we highlight chemical treatment technologies which make up 17% of the database that now contains more than 1,600 abstracts. The chemical treatment processes included in ATTIC range from dechlorination to precipitation to photooxidation.

Currently, ATTIC contains 25 abstracts with information about innovative photochemical oxidative destruction technology. These abstracts may be obtained by searching with keywords such as oxidation, photomicroelectrochemical, ultraviolet (UV), photolysis and laser stimulated photochemical. Searching by these keywords produces abstracts on projects such as those described below.

One project, reported by the California Department of Health Services, treated aqueous waste containing pesticides, herbicides and halogenated hydrocarbons using ultraviolet and ozone treatment. Total organic carbon was reduced from 42 parts per million (ppm) to 4 ppm, including BTX (benzene, toluene and xylene) and ethylbenzene reduction by 99%. Trichloroethylene was reduced from 69 parts per billion to below detection level.

Photochemical oxidation technology was used at the Lorentz Barrel and Drum site in San Jose, California. Groundwater that contained volatile organic chemicals (VOCs), trichloroethylene (TCE) and vinyl chloride was treated by an Ultrox system using a combination of ultraviolet radiation, ozone and hydrogen peroxide. TCE was reduced more than 99% from initial concentration levels of 100 µg/L. Vinyl chloride, which had initial concentrations of 40 µg/L, along with VOCs, was reduced by 90%. (Note: the Ultrox system was a feature article in the December 1990 issue of *Tech Trends*.)

When you access ATTIC, abstracts give you the name and phone number of the project or site contact. For example, the California Department of Health Services contact is Mike Vivas at 916-324-0352. The Lorentz contacts are David B. Fletcher at 714-545-5557 and Norma Lewis at 513-569-7665 or FTS-684-7665.

There are other examples of innovative chemical treatment technologies in the ATTIC database including ion exchange, electro-osmosis, high-energy electron radiation and electro-coagulation. If you would like further information on these technologies, please contact the ATTIC System Operator at 301-670-6294. To access ATTIC online by modem, dial 301-670-3808.

PCB-Lime

from page 1

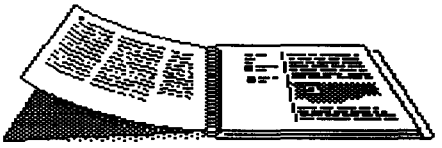
quicklime effects. What RREL and EMSL found is that the PCB losses were largely due to steam stripping and volatilization.

RREL and EMSL conducted their tests using a silica matrix spiked with 1,300 parts per million (ppm) each of three pure PCB congeners and commercial quicklime. Upon addition of water, heat generated by quicklime slaking raised the mixture temperature to about 180° C. In open reactors, up to 85% of he dichlorobiphenol was lost after 24 hours. Steam stripping and volatilization were extremely sensitive to experimental conditions such as temperature and air sweep velocity. However, testing in closed-reactor tests revealed that significantly less removal was due to steam stripping and volatilization. The previous laboratory study did not account for losses to the atmosphere.

Some decomposition of PCBs by quicklime was observed, amounting to an estimated 5% of the starting material. Products were mainly hydroxy-substituted PCBs and lesser-chlorinated PCBs; some methoxy derivatives were also formed. A tetrachlorodibenzofuran was detected in the reaction mixtures at concentrations up to 14 ppm, representing up to 1% conversion of the hexachlorobiphenyl source compound to this product.

What does this mean for those of you in the field? While some limited decomposition of PCBs by quicklime occurred, the rates and extent of dechlorination were low; and, the results of this study refuted earlier claims. For the next round, RREL's immediate focus is on key issues related to the possible deleterious effects of using quicklime-based materials to solidify PCB wastes for handling in removal actions. This common practice is probably environmentally safe; but, the possibility of volatilization and/or chlorinated dibenzofuran formation needs to be examined. Current field applications of quicklime-based materials typically use less calcium oxide (CaO) and a shorter reaction time. Aged complex mixtures of PCB congeners that are associated with actual soils containing organics and clay constituents are less likely to steam strip or volatilize. Obviously, air monitoring would be a prudent practice. We will up date you on our future research and the resolution of these issues.

A three-page progress report on the RREL/EMSL research is available. A final report is currently undergoing peer review and will be published by the end of September 1991. For more information, call John Convery at RREL on FTS-684-7896 or on 513-569-7896.



New for the Bookshelf

Accessing Federal Data Bases for Contaminated Site Clean-Up Technologies. A series of profiles describing EPA, DOD and DOE information systems which contain descriptions of innovative hazardous waste treatment technologies. Document No. EPA/540/8-91/008.

Bibliography of Federal Reports and Publications Describing Alternative and Innovative Treatment Technologies for Corrective Action and Site Remediation. References with order information for reports produced by Roundtable member Agencies on research concerning the application of innovative and alternative hazardous waste treatment options. Document No. EPA/540/8-91/007.

Synopses of Federal Demonstrations of Innovative Site Remediation Technologies. A compendium of abstracts documenting the results of demonstrations of hazardous waste treatment technologies conducted by Federal Agencies involved in Superfund remediation and RCRA and UST corrective actions. Document No. EPA/540/8-91/009.

Slurry Biodegradation. Discusses potential of slurry biodegradation as a cost-effective technology for aerobic treatment of soils or sludges with high concentrations of soluble organic contaminants. Document No. EPA/540/2-90/016.

Solvent Extraction Treatment. Overview of use of organic chemicals as a solvent for organic waste. Document No. EPA/540/2-90/013.

Recent EPA publications are available from ORD's Center for Environmental Research Information (CERI) in Cincinnati. You can order them electronically on the CLU-IN Bulletin Board or directly from CERI. To contact CERI's Publications Unit, call FTS 684-7562 or 513-569~7562. You must have the EPA document number or the exact title to order a document

Chemical Dehalogenation Treatment: APEG Treatment. Presents chemical dehalogenation system applicable to aromatic halogenated compound treatment and destruction in soils, sediments, sludges or oils. Document No. EPA/540/2-90/015.

To order additional copies of this or previous issues of *Tech Trends*, call the publications unit at CERI (513) 569-7562 or FTS 684-7562 and refer to the document number on the cover of the issue.

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Tech Trends welcomes readers' comments, suggestions for future articles and contributions. Address correspondence to: Managing Editor, Tech Trends (OS-110W), U.S. Environmental Protection Agency, 401 M Street, S.W., Washington, DC 20460.

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