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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

Don't Miss Special Supplement to *Tech Trends*

You will notice that this edition of *Tech Trends* contains an insert on **"Innovations in Monitoring and Measurement Technologies"**. Although the focus of *Tech Trends* is usually on innovative cleanup technologies ready for field application, we also want to bring you news of other innovative tools that can assist you in emergency response, remediation and corrective action.

So, we include a special insert that highlights a multimedia lead risk assessment model, a field-portable monitoring system that links up to an onsite computerized locating system and improved metals sampling techniques for groundwater.

Also, don't miss the description of the Cleanup Information Bulletin Board System (CLU-IN) on page 4 of the supplement. CLU-IN is designed for hazardous waste cleanup professionals to use for finding current events information about innovative technologies, consulting with one another online and accessing data bases.

PCBs Destroyed by Combining Thermal & Chemical Treatments

by Paul de Percin,
Risk Reduction Engineering Laboratory

PCBs
Anaerobic thermal processor
Soil and sludge

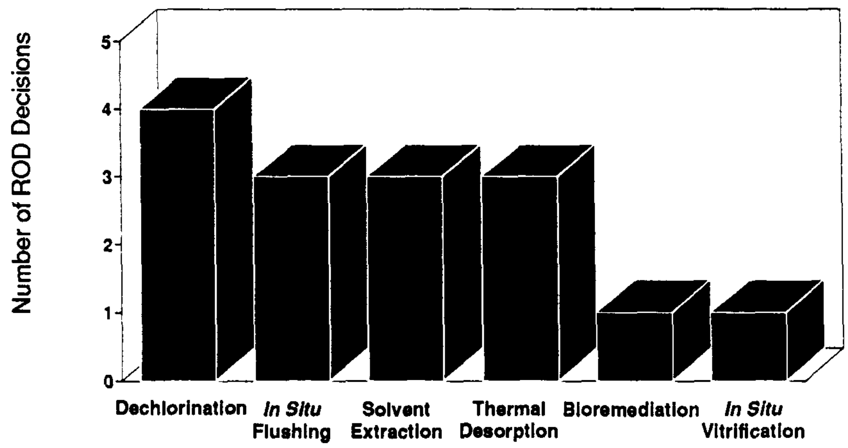
Anaerobic thermal processor (ATP) technology involves a physical separation process that thermally desorbs organics such as polychlorinated biphenyls (PCBs) from soil and sludge. The ATP process is being used in conjunction with dehalogenation to chemically destroy PCBs in the soil at the Wide Beach Development Site in Brant, New York. The technology can also be applied to many other types of organic contaminants. ATP was developed by Alberta Oil Sands Technology and Research Authority and is licensed by SoilTech, Inc.

At Wide Beach, the transportable ATP unit processes about 10 tons of contaminated soil per hour. The ATP system heats and mixes contaminated soils, sludges and liquids in a unit that uses indirect heat for processing. The processor contains four separate internal thermal zones: the preheat, retort, combustion and cooling zones. For this demonstration, the contaminated soils are sprayed with a diesel fuel and oil mixture containing alkaline polyethylene glycol (APEG) reagents before entering the preheat zone. The oil mixture acts as a carrier for the dehalogenation reagents.

In the preheat zone, water and volatile organic compounds (VOC) vaporize. At the same time, the reagents dehalogenate or chemically break down chlorinated compounds (including PCBs). The vaporized contaminants and water are removed via a vacuum to a

*(see **PCB** page 2)*

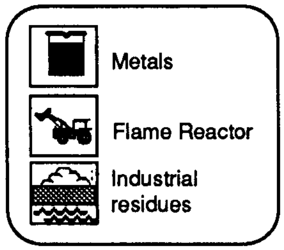
Innovative Treatments Selected for Superfund Sites Contaminated by PCBs



SITE Subjects

Flame Reactor for Heavy Metals

by Marta Richards, Risk Reduction Engineering Laboratory



The Horsehead Resource Development (HRD) Company, Inc., Flame Reactor is a patented and proven high temperature thermal process that safely treats industrial residues and wastes containing metals. As a Superfund Innovative Technology Evaluation (SITE) Demonstration, approximately 72 tons of waste material containing heavy metals from the National Smelting and Refining site in Atlanta, Georgia, were successfully treated with the HRD Flame Reactor. The waste material was a granular secondary lead smelter blast furnace soda slag containing approximately 15.0% carbon, 10.3% iron, 12.2% sodium, 5.3% sulfur, 5.4% lead, 5% silicon, 2.5% chlorine, 0.4% zinc, 0.05% arsenic, 0.04% cadmium and approximately 15.0% water.

For this SITE demonstration the material was dried and passed through a hammermill prior to treatment. This demonstration testing was run with natural gas. At high temperatures inside the HRD Flame Reactor, the volatile metals in the waste were volatilized and the organic compounds were destroyed, leaving a non-leachable slag containing the non-volatile metals and gases, including steam and volatile metal vapors. The metal vapors further reacted and cooled in the combustion chamber and cooling system to produce a metal-enriched oxide that was collected in a baghouse. The resulting metal oxides can be recycled to recover the metals. Results from the demonstration are quite good.

Although samples of raw feed failed the Toxicity Characteristic Leaching Procedure (TCLP) test due to high cadmium and lead levels, all samples of processed waste slag passed the TCLP test for all metals. The processed waste slag can be used as fill material. Lead and zinc were concentrated in the baghouse dust, which potentially could be recycled for its lead content. The process showed better than 90 percent recovery for both lead and zinc. The lead and zinc concentrations in the waste feed, the baghouse dust and the separator slag are shown below.

Total Metal	Waste Feed (% weight)	Slag (% weight)	Baghouse (% weight)
Lead	5.4	0.6	17.4
Zinc	0.4	0.2	1.4

Overall, the weight of the waste was reduced by approximately 30%, largely due to removal of water and carbon during pretreatment and treatment. SO_2, emissions were high due to the amount of sulfur in the waste, but the SO_2 emissions could readily be controlled with the use of a scrubber.

The HRD Flame Reactor technology can potentially be applied to many types of granular solids, soil, flue dust, slag and sludge containing high concentrations of heavy metals and hazardous organics.

An Applications Analysis Report and a Technology Evaluation Report describing the complete HRD SITE Demonstration will be available in the Spring of 1992. For more information now, call Marta Richards at the Risk Reduction Engineering Laboratory on FTS 684-7783 or 513-569-7783.

PCB (from page 1)

preheat vapor cooling system consisting of a cyclone, condenser and a three-phase preheat separator. The noncondensed light organic vapors are hen fed by a blower directly into the combustion chamber of the processor. The oil fraction is recycled to a reagent blending tank, and recovered Hater is sent to the onsite treatment system.

From the preheat zone, the hot, granular solids pass through a sand seal to the retort zone. Here, heavy oils vaporize and thermal cracking of hydrocarbons forms coke and low molecular weight gases. The vapor stream from the retort zone is removed via a vacuum and passes first through a two-stage pair of cyclones to remove entrained particles. These dusts and fines are blended with the treated soil. The vapor is then cooled by oil circulating in two packed columns, acting as a two-stage direct contact condenser for the higher boiling point compounds. The uncondensed vapors are then cooled in a water-cooled noncontact condenser and pass through a three-phase separator. The final noncondensable gases are returned to the combustion chamber. The oil phase is combined with the condensate from the packed columns. This oil condensate is then sent to the reagent blending unit to mix with the APEG reagents. The blend is pumped at a measured rate and is applied to the untreated soils in the feed chute of the processor. Condensed water is pumped directly to the onsite treatment system.

The coked soils pass through a second sand seal into the combustion zone. Here the coked soils are combusted and either recycled to the retort zone or sent to be cooled in the cooling zone. Flue gas from the combustion zone is treated in a system consisting of a cyclone and baghouse that removes particulates, a scrubber that removes acid gases and a carbon adsorption bed that removes trace organics. The treated flue gas is then discharged to the atmosphere through a stack. Treated soils exiting the cooling zone are quenched with scrubber water and are then transported by conveyor to an outside storage pile.

The ATP unit removed over 99% of the PCBs in the contaminated soil (original concentrations of 50 to 100 parts per million), resulting in PCB levels below the desired cleanup concentration of 2 ppm. The ATP does not appear to create dioxins or furans. Additionally, no volatile or semivolatile organic degradation products or leachates were detected in the treated soil.

For more information, call Paul de Percin at the Risk Reduction Engineering Laboratory on FTS 684-7797 or 5 13-569-7797.

A Supplement to **TECH TRENDS** December 1991

Innovations in Monitoring & Measurement Technologies

Innovative site investigation techniques are of increasing interest to those attempting to reduce the cost and increase the effectiveness of site remediation. This is one of a series of occasional supplements to Tech *Trends*, the applied technologies journal for Superfund removals and remedial actions and RCRA corrective actions.

EPA

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Technology Innovation Office

Walter W. Kovalick, Jr., Ph.D.
Director

Field-Ready Hardware Links Portable XRF with Automated Locating Systems

By William Engelmann,
Environmental Monitoring Systems Laboratory

EPA now has field-ready hardware that links the field portable X-ray fluorescence (FP-XRF) analyzers of inorganic (metallic) compounds with automated locating (geographical-positioning) systems. This link has the potential of truly revolutionizing FP-XRF operations. The analyst can see a "growing picture" of the "hot spots" or "hills" on the contour diagram as it is developed on a computer screen on-site. Further, the ability to gather additional data points, as needed, while still in the field is another major advantage over earlier field screening methods. Thus, the systems can gather field analytical data in real time at the site and keep computer files of the coordinate points of the measurement. The automated locating system was developed earlier by Oak Ridge National Laboratory, which named it the ultrasonic ranging and data system (USRADS).

USRADS is made up of a surveyor's backpack, several tripod-mounted receiver modules and a master receiver-computer system, located in a van or trailer. The backpack, worn by a surveillance member, transmits data ultrasonically to the receiver-computer. Up to

see XRF links, page 3

Lead Risk Assessment Model Helps Set Multimedia Cleanup Standard

By Harlal Choudhury, Environmental Criteria and Assessment Office, Cincinnati, and Christina Haviland, Labat Anderson, Inc.

EPA has developed a Lead Uptake/Biokinetic (UBK) Model that is used to assess human health risk based on multimedia lead contamination. Lead is a common contaminant at Superfund sites. However, it has been difficult to assess health risk from lead because of the complexity of the issues. Now, the UBK model provides a method for predicting blood lead levels in populations exposed to lead through multiple pathways. The

see UBK, page 3

Improved Metals Sampling Techniques for Groundwater

By Robert Puls, Robert S. Kerr Environmental Research Laboratory

EPA has tested sampling techniques for inorganics in groundwater that minimize the disturbance of the subsurface groundwater environment. This has plagued the acquisition of representative and accurate heavy metal concentrations for risk assessments at hazardous waste sites. Intuitively, it makessense to minimize disturbance of the sampling zone to obtain representative and accurate data and excessive turbidity has been the most common manifestation of disturbance. Excessive pumping or purging relative to local hydrogeologicalconditions is the most common cause of artificial turbidity. Aeration and oxidation can be both causes and effects of excessive turbidity.

EPA's Robert S. Kerr Environmental Research Laboratory (RSKERL) has field tested sampling techniques that call for: (1) isolating the sampling zone with inflatable packers to minimize purge volume; (2) pumping at a low flow rate to minimize aeration and turbidity; (3) monitoring water quality parameters while purging to establish baseline or steady-state conditions to initiate sampling; (4) maximizing pump tubing thickness and minimizing length to exclude atmospheric gases; and (5) using filtration for estimating dissolved species and collection of unfiltered samples for estimates of contaminant mobility.

The abovesampling techniques were evaluated at three geologically-different sites. The Pinal Creek Site in Arizona, contaminated with copper mining wastes, is an upland, extremely heterogenous alluvial aquifer with sediment sizes ranging from fine sand to coarse gravel. The Saco, Maine, Site, contaminated with chromium waste from a leather tannery, consists of glacial till deposits underlain by a sloping fractured bedrock surface. The Elizabeth City, North Carolina, Site, contaminated with acidic chromium wastes from a chrome plating shop, is on Atlantic coastal plain sediments characterized by complex and variable sequences of surficial sands, silts and clays. Results showed that, in wells deeper than 30 feet, a bladder pump was most successful in producing representative and reproducible results, regardless of filter pore size. In shallow wells less than 30 feet deep, a peristaltic pump consistently produced the most reproducible results. Pumping rate was the single most important parameter affecting equilibrated turbidity values and contaminant concentrations. Equilibrated turbidity levels observed at the three sites ranged from 1 to 58 nephelometric turbidity units. Turbidity differences were strongly related to geology and water chemistry.

A down-hole camera was used during purging and sampling to evaluate the disturbance caused by pump tubing emplacement and pumping downhole. Little impact was observed when a peristaltic pump was turned on after both the pump tubing and the camera had been left in the screened interval over night. Emplacement of the camera itself created the greatest turbidity and required overnight reequilibration in the absence of pumping.

The demonstration results strongly argue for dedicated sampling equipment and techniques. For more information, call Bob Puls at RSKERL on FTS 743-2262 or 405-332-8800.

UBK from page 1

blood lead levels can then be used to guide risk assessors in determining cleanup levels that will protect current and future populations at the site.

Infants and young children are the most vulnerable populations exposed to lead and are the focus of EPA's risk assessment efforts. Both behavioral and environmental data are needed to run the model. Behavioral data include the time the population spends indoors vs. outdoors, gardening habits, the consumption of produce grown on site and pica behavior. Environmental data include lead concentrations in indoor air, outdoor air, drinking water, soil and dust. Several age-specific default parameters are used including breathing volume, soil intake and percent lead absorption via different pathways. These default values along with the site specific data are used to calculate route-specific lead uptakes. The sum of all these route-specific uptakes is the total lead uptake, which is applied to the model's curve to predict blood lead levels.

The UBK model has been tested at several Superfund sites since its inception, including the Bunker Hill Site in Region X. Bunker Hill is an inactive smelter site located in a residential area. Lead contamination has been found in the soil as well as in area homes. Media-specific lead concentrations are being used with the UBK model to define an appropriate remedial design for the site.

The UBK model is under EPA Science Advisory Board review, and draft copies are available for use at Superfund sites through the EPA's ten Regional offices. For more information, contact Harlal Choudhury at EPA's Environmental Criteria and Assessment Office at FTS 684-7536 or 513-569-7536.

XRF Links from page 1

15 tripod-mounted stationary units can be set up around the perimeter of the site. Each has an ultrasonic receiver and a radio transmitter. Any one of these modules can receive ultrasonic data signals and each has a unique radio-transmitting frequency to allow the master receiver to identify which unit received the ultrasonic signal. The master receiver has 15 radio receivers, each tuned for a corresponding stationary module. Finally, a transceiver allows voice communication between the surveyor who walks the site and the receiver-computer operator in the mobile van.

This advanced version of USRADS can link up with other analog analytical devices as well. In addition, another interface within the master receiver allows connection to any personal computer without the need for a computer interface card. This allows any IBM-compatible computer to be directly connected, including lap top portables (most of which have no expansion slot for plug-in interface cards).

The advanced prototype of the USRADS is expected to be delivered to EPA's Environmental Monitoring Systems Laboratory-Las Vegas (EMSL-LV) by late 1991. For information, contact William Engelmann, EMSL-LV on FTS 545-2664 or 702-798-2664.

CLU-IN

Cleanup Information Bulletin Board

November 1991 EPA

The Cleanup Information Bulletin Board System (CLU-IN) is designed for hazardous waste cleanup professionals to use for finding current events information about innovative technologies, consulting with one another online, and accessing databases. CLU-IN is used by those involved in the cleanup of Super-fund and Resource Conservation and Recovery Act corrective action sites, including EPA, other Federal Agency and State personnel, consulting engineers, technology vendors, remediation contractors, researchers, community groups, and individual citizens.

Features of CLU-IN

- **Electronic message** capabilities (which may be communicated to large audiences or to individual users, depending on the preference of the sender)
- **Bulletins** that can be read online (such as summaries of *Federal Register* notices on hazardous wastes, descriptions and listings of EPA documents, a calendar of EPA training programs, directories of EPA experts on hazardous waste cleanup, and articles from *Tech Trends,* EPA's newsletter on innovative technologies)
- **Files** that can be downloaded for use on the user's own computer (directories, databases, models, a listing of National Priorities List sites, and documents such as abstracts of selected Superfund directives and reports and the Innovative *Treatment Technologies Semi-Annual Status Report)*
- **Online databases** that can be searched on CLU-IN (such as a databases of EPA technical experts and training course announcements)

Special Interest Group Areas

CLU-IN also has a number of special interest groups (SIGs) or sub-areas with all the capabilities listed above, but limited to a specific subject. Some SIGs are open to all users while others are limited to a specified group of users. Security is determined by the SIG Moderator. Examples of SIGs currently on CLU-IN are:

- Groundwater and Engineering Forums
- On-Scene Coordinators/Removal Actions
- Innovative Technologies

How to Log On

To log onto CLU-IN, 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 LAN system or data switch, contact the System Operator (SYSOP) at 301-589-8368.

The CLU-IN Bulletin Board was formerly known as the Office of Solid Waste and Emergency Response (OSWER) Bulletin Board.

Number: 301-589-8366
Help line: 301-589-8368
9am-5pm EST

U.S. Environmental Protection Agency
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Walter W. Kovalick, Jr., Ph.D., Director

For more information or to make suggestions about the content of the BBS, contact Dan Powell, the project officer, at FTS-678-8827 or 703-308-8827 or leave a message on CLU-IN.

Out of the ATTIC

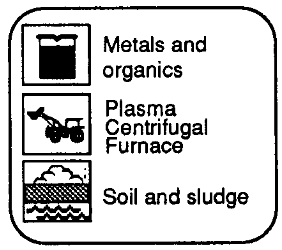
Bioremediation Information in the ATTIC

by Curtis Harlin, Office of Research and Development

Chris Hibberd is a project manager for BIOREM Corporation. BIOREM works in collaboration with the Microbial Biotechnology Laboratory at the University of Waterloo to develop and enhance the unique biodegradation capabilities of microorganisms for the bioremediation of toxic organic wastes. Chris frequently checks ATTIC for any new information on bioremediation or related topics. He recently contacted ATTIC to find information on slurry biodegradation and was able to download many abstracts regarding slurry biodegradation as well as a Superfund Engineering Bulletin. Slurry biodegradation has been shown to be effective in treating highly contaminated soils and sludges for a wide range of organic contaminants including pesticides, fuels, creosote, PCP, PCBs, and some halogenated volatile organics. BIOREM maintains a file library of bioremediation information obtained from ATTIC and other sources for use in its research. Chris also checks the Bioremediation Special Interest Group on the ATTIC Bulletin Board to keep track of new technologies and ideas. If you would like to access ATTIC online, dial 301-670-3808 or contact the System Operator at 301-670-6294.

Heavy Metals in Soils and Sludges Removed with Plasma Centrifugal Furnace

by Laurel Staley, Risk Reduction Engineering Laboratory



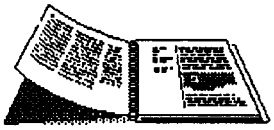
The Superfund Innovative Technology Evaluation (SITE) Demonstration program recently evaluated Retech, Inc.'s plasma centrifugal furnace at the Department of Energy's Component Development and Integration Facility in Butte, Montana Retech's process is a thermal technology that uses heat generated by a plasma torch to decontaminate soils and sludges containing heavy metals and organic hazardous compounds by melting metal-bearing solids. In the process, it themrally destroys organic contaminants. The molten soil, when cooled, forms a hard, glass-like non-leachable mass. At the demonstration in Butte, the waste consisted of soil from the Silver Bow Creek Superfund Site spiked with contaminants for the demonstration. Contaminants were at or above the following levels: 28,000 parts per million (ppm) zinc oxide and 1,000 ppm hexachlorobenzene mixed in a 90/10 weight ratio with No. 2 diesel oil. The zinc oxide was added as a tracer metal to determine the leachability of the slag. Hexachlorobenzne was the Principal Organic Hazardous Constituent (PGHC) used to determine organic destruction.

The major components of Retech's process are the plasma torch a rotating reactor well, an afterburner, a secondary combustion chamber and an off-gas treatment system. contaminated soil is placed in a bulk screw feeder and gradually fed into the rotating reactor well. At Butte, the soil was fed to the furnace at the rate of approximately 120 pounds per hour. Solid material was retained in the tub by centrifugal force while a plasma arc heated the material to about 3000° F. At this temperature, organic contamination was volatilized from the soil. Any combustible gases remaining after volatilization and oxidation were incinerated by the afterburner located downstream of the reactor well. At the end of the process, the molten mass of treated solids flowed through the secondary chamber and into a slag collection chamber.

The exhaust from the furnace is passed through a gas treatment system that consists of a quench tank, a venturi scrubber, a packed-bed scrubber and a demister. A mildly caustic solution is supplied to the quench tank and scrubbing unit to help remove acidic gases and particulates in the off-gas. Moisture droplets entrained in the flow are removed by the demister. A stack blower maintains a vacuum on the system and draws the clean gases into the exhaust stack.

The destruction and removal efficiency of the POHC was greater than 99.99% (based on detection limits) in all of the tests. The solidified treated soil was non-leachable for both organic and inorganic compounds that were leachable in the waste feed. A high percentage of the metals from the feed soil were captured and retained in the vitreous slag. An average of 0.374 grains per dry standard cubic foot (dscf) of particulate were emitted in the stack gas throughout the three tests. This exceeds the Resource Conservation and Recovery Act regulatory limit of 0.08 grains/dscf; so, additional air emission controls would have to be used. Additionally, NOx controls may be required.

A Technical Evaluation report and an Applications Analysis Report describing the complete demonstration will be available in the Summer of 1992. For more information now, call Laurel Staley at the Risk Reduction Engineering Laboratory on FTS 684-7863 or 513-569-7863.



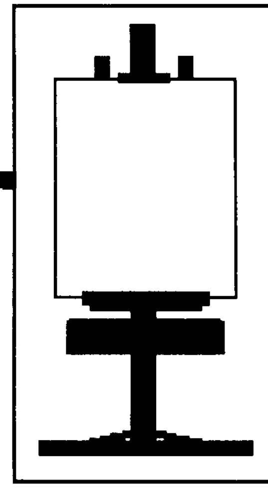
New for the Bookshelf

Innovative Treatment Technologies: Semi-Annual Status Report. Documents the selection and use of innovative treatment in the Superfund program.
Document No. EPA/540/2-91/001

Fate of Polychlorinated Biphenyls (PCBs) in Soil Following Stabilization with Quicklime. Reports on EPA investigation conducted to verify claims that use of quicklime alone can promote decomposition of PCBs.
Document No. EPA/600/2-91/052

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 664-7562 or 513-569-7562. You must have the EPA document number or the exact title to order a document.

Conference Alert



Bioremediation Satellite Seminar

January 9, 1992

Together with the Hazardous Waste Action Coalition, and in cooperation with EPA, the Department of Energy, and a number of other professional organizations, the Air and Waste Management Association is producing a video conference on bioremediation which will be sent via satellite to more than 80 video conference sites across the U.S. and Canada. You can register to attend at a site near your office. For more information, phone Bob Hurley, Air and Waste Management Association at 412-232-3444.

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.
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