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Write in 199
Crystal ball prevents stockpiles

One developer saves nearly $300,000

By Robert W. Wilhelm

If responsible parties or contractors were able to predict how much petroleum contaminated soil might have to be removed from a site, it could certainly save time and money.

Now, thanks to three-dimensional computer contouring, combined with on-site soil testing, developers can predict the volume of contaminated excavate and develop a soil disposal management plan before excavation begins.

The technique, predictive soil characterization (PSC), eliminates the need for soil stockpiling, rehandling and retesting—which cuts down significantly on the time needed for regulatory approvals. A developer or responsible party can pre-plan financing and contractual arrangements for earthwork and off-site disposal because disposal needs are identified prior to excavation. Also, the responsible party may examine other design options, if necessary, before construction begins.

Predictive soil characterization was developed by Haley & Aldrich, Inc., of Cambridge, Mass. They implemented PSC at the site of a former gasoline service station that was slated to be developed into a four-story hotel and underground parking garage. As is often typical in urban sites, there was no room for stockpiling soil during construction.

The combination of the predictive soil characterization model with the soil disposal management plan was instrumental in streamlining quick state approval for remedial action. At least one month was eliminated from the usual standard of stockpiling contaminated soil, testing and seeking approval prior to off-site disposal. This saved the developer approximately $300,000.

To predict the volume of soil to be excavated at the site, scientists collected volatile organic compound (VOC) data at two-foot depth increments at test borings drilled to assess soil conditions for both environmental and geotechnical concerns. Total VOC headspace data, reflected in the predictive model, was collected by screening soil samples with a photo-ionization detector using jar headspace techniques.

The use of VOC screening for the predictive model was in keeping with the Massachusetts Department of Environmental Protection (DEP) headspace data criteria for making off-site disposal decisions for soils contaminated with virgin petroleum products. Other test parameters could be implemented in states using different disposal criteria.

To create the PSC model, the depths at which the soil samples were collected were converted to their corresponding elevation. Next, the data at the two-foot elevation increments was interpreted using computer-generated contours for equal concentration levels.

Soil categories and respective disposal options were established on DEP disposal criteria and field observations of soil composition (Figure 1, right). To derive a total volume for each, estimates were calculated by multiplying the area between contours by the layer thickness (in this case, two feet) and adding the volumes of each layer. A three-dimensional perspective of the PSC model was constructed by

Robert W. Wilhelm II is an environmental geologist with Haley & Aldrich, Inc., a geotechnical engineering and environmental consulting firm in Cambridge, Mass.
"stacking" the two-foot elevation slices (Figure 2, below).

Contour intervals represented on two-dimensional plots of the total VOCs were selected to coincide with the state's disposal criteria which had been negotiated for the site. Figure 3, page 29, illustrates a two-dimensional plot of the distribution of VOCs at elevation 37. The two-dimensional plots shown were used to calculate contour interval areas and the resulting volume of soil types were derived.

Of the approximately 20,000 cubic yards of soil to be excavated from a 20-foot deep cut needed for the building construction, it was estimated that more than one-half was contaminated significantly with residual petroleum products, primarily gasoline, and required disposal in a lined landfill or recycling facility.

After developing the predictive model, a soil disposal management plan was prepared to define procedures to excavate the soil and dispose or treat it off-site. The disposal plan was used to obtain state DEP approval for remedial action and included these features:

- history and background of contamination
- geologic and hydrogeologic descriptions
- predictive model results
- off-site disposal options by soil categories
- responsibilities of excavation contractor
- contingencies against the unknown.

The disposal plan became a specification guide for the excavation contractor, who used it to plan the excavation and prepare a health and safety program for the workers. The contractor also used the information to solicit bids from disposal facilities.

As indicated in Figure 1, the actual quantities removed in each category—as weighed by the truckload before leaving the site—were in line with the prediction estimates. Variances from the predictive model were:

1) The quantity of Category A soil—less than 50 parts per million (ppm) total VOCs—removed from the site was approximately 30 percent more than predicted as a result of the loss of volatiles during the excavation process and additional excavation that was required for footings and utility lines.

2) Conversely, Category B and C soil with total headspace VOCs greater than 50 ppm were less than the model estimate by approximately 20 and 70 percent, respectively.

The contractor and field monitoring personnel used the disposal plan daily to know which soil categories were to be excavated. The plan enabled the contractor to make arrangements in advance to haul the soil away as it was being excavated. In addition, health and safety

Continues on page 29→
Asbestos laid to rest

How one company solved large scale asbestos disposal problem

By Hsein Chen and Marvin Clumpus

Large quantities of asbestos-contaminated soil pose a challenge to conventional abatement options. Taking an approach from outside conventional abatement —on-site landfilling—for the cleanup of a 65-acre site in Carson, Calif. proved to be environmentally sound and cost effective.

More industry experts will have to begin looking beyond the conventional abatement industry as they are faced with large scale soil cleanups. During abatement operations, the soils located beneath or around a building may become contaminated by asbestos. As building insulation deteriorates or is dislodged, it frequently falls on the soil. Service tunnels containing asbestos insulated pipes often have

Various components included in a typical large-scale asbestos remediation project, not to scale, does not represent actual setup of project discussed in article.
earthen floors that can be contaminated from water leakage, human activity or air movement.

When buried pipes are unearthed for repair or replacement, asbestos-containing insulation has often fallen from the pipe.

Although the Environmental Protection Agency (EPA) has mandated a phaseout of nearly all asbestos-containing products in the U.S., products such as asbestos-clad piping had wide commercial use. For many years, asbestos was considered an excellent source of insulation and fire retardancy until its inherent health hazards were discovered.

With the conventional remedies perfected by the abatement community focusing on contaminated building materials and only small quantities of soils, it is not surprising that a recent search of abatement industry literature uncovered few remedies for large scale asbestos soil contamination.

Abatement industry sources discuss removing asbestos from buildings and their immediate surroundings with conventional remedies that may not accommodate larger projects. Such conventional remedies include either encapsulating or encasing the contaminated materials on site or removing asbestos-containing material for off-site landfill disposal.

As appropriate as these methods may be for the small scale site, costs for larger sites can be prohibitive due to the large amount of soil that must be removed relative to the small amount of asbestos-containing materials.

Enclosing asbestos contaminated materials in a building would mean constructing an airtight, impermeable, permanent barrier to prevent disturbance. For treating soils, one technique places a six-inch cap of uncontaminated soil with vegetation— or 24 inches without. Encapsulating the contamination retards fibers by coating the asbestos with a spray.

Removal to off-site disposal areas is the most common, conventional abatement response to soil contamination. However, disposal costs for asbestos contaminated soil greater than one percent in volume run 10 to 20 times more than normal municipal waste.

As property owners review the potentially high costs of disposal and associated transportation risks, more of them will be examining other options. Also, local governments may not look favorably on large volumes of asbestos contaminated material being transported through city streets. In investigating other remedies, the remediation designer will have to look outside the abatement community. Alternate sources may include the several federal Superfund Records of Decision which involve cleanup of asbestos contaminated soils at large manufacturing operations.

The 65-acre site in Carson, Calif., was used to manufacture mineral wool insulation, asbestos cement pipe, asbestos insulation and polyvinyl chloride (PVC) pipe between 1937 and 1982. In April 1982, all manufacturing activities ceased and the plant was closed. The onsite, aboveground structures were demolished in 1983.

Continues on page 10→

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Asbestos, from page 9

and 1985. As a result of the manufacturing activities, soils in some of the areas at the site were found to contain one percent or more asbestos fiber.

Therefore, the site was listed in the California State Expenditure Plan for the hazardous Substance Cleanup Bond Act of 1984 as a Responsible Party Lead Site.

A remedial investigation and feasibility study were completed under the direction of the California EPA, Department of Toxic Substances Control (DTSC).

The remedial investigation had three objectives:

1) Identify the existence and extent of asbestos or other contamination in the site’s soil, air, surface water, storm water channel sediments and groundwater;

2) Assess potential migration pathways of the contaminants;

3) Assess potential environmental and health effects of the site’s contaminants.

The remedial investigation included a complete site characterization following a thorough review of the original layout and operation, as well as aerial interpretation.

The site was divided into 13 plots, with each characterization determined by each area’s previous use. Samples of soil, groundwater, surface water, sediments and ambient air were collected and analyzed to assess the extent of contamination and potential migration pathways. Results of the sampling and analyses showed high concentrations of asbestos in the soils and sediments. However, asbestos fibers identified in the surface water and groundwater, as well as in the air, were below acceptable levels.

The investigation concluded that the potential release of asbestos fibers from the soil was the only significant concern relating to both public health and the site environment. It was determined that daily sprays of portions of the site with a fine mist of water would eliminate this potential risk until remediation was completed.

Five conventional cleanup alternatives were examined on the basis of technical feasibility, regulatory compliance, public health and environmental impact and costs:

1) No action;
2) Capping wastes in place;
3) Onsite treatment/stabilization;
4) Waste excavation and relocation on site with capping;
5) Off site disposal.

In accordance with Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) guidelines, the screening criteria included the following:

- Technical performance, including the ability to satisfy environmental standards;
- Implementability (construction and time required);
- Risk (long term liability);
- Reliability (demonstrated performance, operation and maintenance requirements);
- Potential environmental impacts (health and safety during and after remediation);
- Comparative costs.

On-site treatment stabilization was not considered.

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technically effective. Taking no action and capping the wastes in place was determined to be cost-ineffective, based on the resulting non-productive use of the land. Off-site disposal would have required the excavation, removal and long-distance hauling of approximately 300,000 cubic yards of waste at a cost 50 to 60 times other remedies. Off-site disposal also would have greatly increased the risk of releasing asbestos fibers into the environment.

With the large quantities of asbestos-contaminated soil requiring cleanup, relocating and capping the soil in on-site landfills proved most cost effective. Two landfills were constructed on land formerly used as landfills by the owner.

These areas contained the major portion of the 300,000 cubic yards of asbestos contaminated material, thus limiting the area requiring excavation. One was covered with one-foot thick vegetative cover and the other with a 12-inch thick road base and a nine-inch thick layer of asphaltic concrete.

Upon completion of the remediation, approximately 50 acres of the site (almost 77 percent of the land under examination) were again marketable. The exceptionally heavy asphalt cover over one of the landfills made it suitable for surface storage. A deed restriction was recorded on the property which requires notification to regulatory agencies and implementation of a health and safety plan for future construction activities that may require ground intrusion.

Once this remedial action plan was developed, a detailed engineering design was completed for the implementation of the remedial construction. It included: plans and specifications for storm water run-on and run-off control and for the excavation, backfilling and construction of the landfill covers. Health and safety plans to protect on-site construction workers and neighboring residents were also included—as well as a quality assurance plan to monitor and document construction quality, an import soil plan to define requirements for covering soils, an underground storage removal work plan and maintenance and monitoring plans to assure compliance with all post-closure regulations.

These components were then incorporated into a package to invite contractor bids.

Before construction could begin, approvals and permits had to be obtained from:

1) California EPA Department of Toxic Substances Control (DTSC)—for remedial action plan, negative declaration and remedial design.
2) California Regional Water Quality Control Board—for waste discharge requirements.
3) South Coast Air Quality Management District—for excavation permit.
4) California Occupational Safety and Health Administration (OSHA)—provisional excavation permit.
5) Los Angeles County Department of Public Works (DPW) and the city of Carson—grading permits.

Remedial construction began in October 1989 and was completed in June 1990. Approximately 88,000 cubic yards of asbestos contaminated material and soils were excavated and removed to the two landfills on the property. An additional 108,000 cubic yards of imported soil were used to backfill excavated areas. Imported soil was carefully

Continued on page 39
Inside the regulatory mind

Making the rules: Canada's approach

By Connie Gaudet, Amanda Brady, Mark Bonnell and Michael Wong

Canadian experts have concluded that it is essential to apply a two-prong standard to establishing cleanup criteria for petroleum contaminated sites. They have developed a nationwide program that considers both absolute and relative criteria to assess contaminated sites.

Canada, like many other countries, is beginning to suffer from past mismanagement of hazardous materials and toxic waste. Accidents,
inadequate environmental controls and simply the old age of some storage facilities have put at risk the health of Canadians and their environment. Soil and water contamination has occurred from oil tars, mine tailing wastes, landfill sites and abandoned subsurface leaking waste drums and tanks. Responsible parties and government have addressed the contaminated sites issue on a number of fronts in Canada—consequently there has been a lack of national consistency in cleanup responses. Some provinces have established provincial guidelines or criteria for the remediation of contaminated sites in the context of the current or intended future land use. Since, however, there was no national plan, a program was set up to bring consistency to the approach. The decision-making process they went through offers considerable insight into the regulatory priorities and point of view. In October 1989, the Canadian Council of Ministers of the Environment (CCME) announced plans to initiate the National Contaminated Sites Remediation Program (NCSRP) to clean up high priority contaminated sites. The program was established to promote a coordinated, nationally consistent approach to the identification, assessment and remediation of sites which impact or have the potential to harm human health or the environment. It also provided for funds to remediate “orphan” sites with no identifiable responsible party. And, the program proposed to work with industry to stimulate the development and demonstration of new and innovative remediation technologies.

The NCSRP called for guidance to ensure the remediation of all high risk sites where the responsible party can be held accountable, consistent with the “polluter pays” principle. Finally, the program called for common assessment and remediation criteria for soil and water to be used in the management of contaminated sites.

In April and November of 1990, the CCME held workshops for all stakeholders (industry, government and environmental groups) to discuss key factors in setting priorities and remediation criteria. Recommendations from these workshops included the need for a simple classification system to aid in identification of priority sites, a “two-tiered” approach (generic and site-specific) to the development of remediation criteria and equal consideration of human health and the

“...For high hazard sites, a site-specific risk assessment would verify cleanup goals, whereas for low hazard sites, use of soil and groundwater criteria alone may suffice.”

Continues on page 14

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Write in 204

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A relative, site-specific approach enables cleanup levels to be tailored to a site and may maximize cost efficiency. However, this approach usually requires extensive and expensive site characterization and risk assessment and does not provide a consistent basis for decision-making, especially during early assessment and investigative stages.

An international review of approaches to setting cleanup levels, prepared by Dr. Robert Seigrist of Oak Ridge, Tenn., recommended that a combined approach, incorporating both absolute and relative criteria, was most appropriate—particularly in its consideration of desired land use as well as human health impact. Soil and groundwater criteria are essential to facilitate initial site assessment and establishment of preliminary cleanup goals. Seigrist recommended that for high hazard sites, a site-specific risk assessment would verify cleanup goals, whereas for low hazard sites, use of soil and groundwater criteria alone may suffice. Further, it was recommended that a systematic classification system was needed to screen and classify sites according to their potential hazard.

The NCSRP plan encompasses a combined approach to establishing cleanup criteria, marrying the strengths of absolute and relative criteria in order to target cleanup efforts as effectively as possible to protect human health and the environment.

The framework is based on a series of screening and assessment tools to ensure effective decision-making in the development of cleanup goals.

The approach encompasses a National Classification System that is simple and flexible, risk-based and uses existing or generally available site information. It places equal emphasis on human and environmental health and classifies sites into general categories of concern (sites are not ranked). It functions as a general screening process, is traceable in terms of decision-making and provides a nationally consistent method to evaluate sites.

A review of classification systems from Britain, France, Germany, Holland and the U.S.—as well as from the Canadian provinces—revealed that there are three general types of classification approaches:

- an additive factor approach, where a variety of site characteristics are considered and a score for each is added to reach an overall site score;
- a risk/hazard approach where in-depth investigation and assessment is undertaken and probabilities are considered;
- an “ad hoc” approach where only professional judgement is used.

Based on this review, a classification system was proposed, which used factors developed in the Canadian provincial systems and added environmental factors considered by the U.S. EPA. The factors were organized into a risk pathway approach with consistent and defensible scoring. An additive model was proposed because this type is a widely used method of multi-attribute decision-making. It is simple to use and understand and has been used by most of the provinces. The scores can be rationalized and documented for review by funding agencies (primarily the NCSRP) if required.

Though the system is simple, a defined amount of site characterization information is required for a site to be classified using the system.

The classification system is organized in such a way that the user assesses an event—a contaminated site—through evaluation of the hazard of that event, the potential for release of contamination, potential pathways and potential receptors. The framework of the classification system reflects this hazard pathway (Figure 1, above). The evaluation factors within the system are grouped in categories of:

a) contaminant characteristics (including hazard, quantity and physical state of contaminants);
b) exposure pathways (including groundwater, surface water, direct contact and air);
c) receptors (human and environmental, through drinking water, other water uses, land uses).

Accompanying the system is a comprehensive “User’s Guide,” method of evaluation and scoring guide, which explains the rationale for each evaluation factor. A worksheet is included to document each factor. The system permits systematic, rational and consistent evaluation of contaminated sites across Canada using existing or generally available site information.

Once the total site score is determined, sites are grouped.
Figure 2: Site Classification Categories

<table>
<thead>
<tr>
<th>Class</th>
<th>Site Score</th>
<th>Risk Potential/Action Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1</td>
<td>70—100</td>
<td>Risk potential is considered high and action is required (action may consist of further investigation or site assessment)</td>
</tr>
<tr>
<td>Class 2</td>
<td>50—69</td>
<td>Risk potential is considered medium, action likely required</td>
</tr>
<tr>
<td>Class 3</td>
<td>38—49</td>
<td>Risk potential is considered medium-low, action may be required</td>
</tr>
<tr>
<td>Class N</td>
<td>&lt;37</td>
<td>Risk potential is considered low, action not likely required</td>
</tr>
</tbody>
</table>

into one of four general categories according to site score. (Figure 2, above). The definitions of these classes are purposely vague to reduce the likelihood of abuse of this system, which is designed only as a tool to aid in the evaluation of contaminated sites. It provides scientific and technical assistance in the identification of sites which may be considered “high,” “medium” or “low” risk. This system does not address technological, socio-economic, political or legal factors. Additional investigations are usually required to finalize remedial designs or regulatory requirements.

These criteria, adopted on an interim basis, are numerical limits for contaminants recommended to protect, maintain or improve current and future uses of soil and water at contaminated sites.

The assessment criteria are approximate background concentrations or approximate analytical detection limits for contaminants in soil or water. These are numerical values that, when exceeded, indicate investigative action is needed to assess the extent of contamination and to determine the scale and urgency of further action.

The criteria do not address site-specific conditions and are considered generally protective of the environment and human health with respect to agricultural, residential, parkland and commercial industrial land uses.”

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Canada's approach from page 15

second approach uses site-specific risk assessment.

Some of the types of information that will be considered when validating interim criteria are: physical-chemical data, contaminant behavior in the environment, ecotoxicological, phytotoxicological and epidemiological data, aesthetic information, pathway information for receptors of interest, criteria for other media and environmental fate modelling.

It is anticipated that approximately five contaminants will be evaluated each year.

The criteria-based approach and the risk assessment approach will each be considered for establishment of remediation objectives at a site, dependent on site-specific circumstances. Both approaches may be seen as part of a single overall strategy for the establishment of remediation objectives that maximize protection of human health and the environment.

In order to ensure effective and consistent implementation of the common scientific tools developed under the national program, the second phase of NCSRP will focus on scientific validation of the interim quality criteria and the development of guidance documents for establishing site-specific objectives and protocols for human health and environmental risk assessment.

Write in 519 for more information

European market news

• The 12 nations that make up the European Community met last December to step up development of common regulations and standards favoring the environment. Over the past 20 years, the group has developed about 300 environmental regulations.

Industry watchers project increased environmental spending, possibly totaling over $100 billion by the year 2000, especially to clean up contaminated soils. ECOTEC Research & Consulting Ltd., of Birmingham, U.K., predicts the soil cleanup market to grow at a rate of 18 percent per year. The 1990 spending on soils was $1.3 billion.

The group amended their voting procedures to eliminate selected veto powers of member companies that have sabotaged many new proposals in the past. They also proposed an enforcement agency to try to function more like the enforcement procedures used by the U.S. Environmental Protection Agency.
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How to get your free listing in *Soils* magazine buyer’s guide

Respond by April 1 to be included in Remediation Services Guide

Soils magazine announces plans to develop an industry Buyer’s Guide, to be published in the June/July 1992 issue that will be devoted to service firms that provide remediation of contaminated soil. A green postcard has been inserted into this issue of the magazine to make it as simple as possible to get your firm’s information to us. Any firm that wishes to be included in this valuable reference is encouraged to fill out and mail the card to Soils magazine immediately. If more space is needed, a one- or two-page fax is also welcome, outlining the following basic information: company name, address, city, state, phone, fax and category heading—choose from the following list: Excavation, Recycling, Soil Venting, Soil Flushing, Stabilization, Soil Washing, Bioremediation, Thermal Treatment, Thermal Desorption. Include the name of a contact person for additional information, if needed.

The final deadline to get information to us is April 1, 1992. The format will not permit us to publish any photographs. If you wish to schedule advertising space in the guide, please contact us for rates and information as soon as possible. The final deadline to reserve advertising space for the June/July Remediation Services guide is April 30, 1992.

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Write in 146

18 March 1992 Soils
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*US Patent # 4,804,050. Other US & Foreign patents pending
Divide and conquer

New soil washing technique arrives from Europe—separates waste stream into efficiently-treatable fractions

By Michael Mann and Jill Besch

A leading European environmental firm, Heidemij Reststoffendiensten BV of Arnhem, the Netherlands, has developed an innovative soil washing technique that separates the waste stream into fractions for efficient treatment.

Geraghty & Miller, Inc., of Plainview, N.Y., has formed a joint venture with Heidemij to introduce this technology to the U.S.

The Heidemij technique is a physical/chemical process to remove contaminants that reside in specific grain-size domains. The process separates the waste stream into “cuts” and focuses treatment appropriate to the contaminant/grain-size relationship. Heidemij opened a $7 million plant in Moerdijk, near Rotterdam, in November 1991 to perform the soil washing technology.

Here's how it works: prior to treatment, oversize materials are separated from the contaminated soil with a series of vibrating screens. The rest of the soil is mixed with water to form a slurry and pumped to the hydrocyclones. The hydrocyclones mechanically separate the slurry into two streams: the underflow, which contains coarse-grained material (sand and gravel) and the overflow, which contains the fine-grain material and water.

The underflow from the hydrocyclones is directed to the froth flotation cells where it is washed with surfactants. The flotation cells are mechanically aerated and the combined effects of aeration and surfactant washing generate a heavy froth that floats to the top of the cells.

Both organic and inorganic contaminants in the soil demonstrate a preference to move with the froth when appropriate surfactants and residence times are provided. The froth, which is skimmed from the units and concentrated is generally hazardous waste. Soil exiting the froth flotation units is normally non-hazardous—will pass the Toxicity Characteristic Leaching Procedure (TCLP)—and can be returned to the site.

The overflow from the hydrocyclones, that is, the fines and water, is treated much like an industrial effluent. The waste
The process separates contaminated soil into four process streams: oversize material, clean sand or gravel, sludge and concentrated froth so each stream can be processed or disposed efficiently.

stream is directed to a sludge basin where solids are allowed to settle. The resulting sludge is dewatered using a belt filter press and may then be further treated or disposed.

The main advantage of the system is that it substantially reduces the volume of material requiring further treatment or off-site disposal. Contaminated soil is separated into four process streams:

1. Oversize material, which is typically about five percent of the feed, is often non-hazardous and can be turned around.
2. Clean sand and/or gravel, about 85 percent of the feed volume in a typical application, can also be returned to the site.
3. Sludge from the belt filter press (approximately eight percent of feed volume) must be disposed as a hazardous waste.
4. Concentrated froth from the flotation unit, about two percent of the feed volume, must also be disposed as a hazardous waste.

The plant is modular and transportable. Setup takes about two weeks at a typical site and requires about 1.5 acres of laydown space. The unit runs on 480 volt, three-phase electrical power and requires a water source. Much of the process water is recycled during the operation and there is no wastewater discharge from the system. In its basic configuration, the plant can process 15 to 30 tons per hour with a five person crew.

From an economical viewpoint, the Heidemij process works best when the remedial alternatives are available, a volume of more than 20,000 tons is required. On projects where conventional alternatives are limited by unusual site conditions or wastes, that minimum volume may decrease.

A wide spectrum of contaminants can be treated with the soil washing system, including semi-volatile organics and inorganics including polynuclear aromatics (PNAs), pesticides, polychlorinated biphenyls (PCBs), chlorinated hydrocarbons, heavy metals and cyanides.

This technology has been used successfully in the Netherlands in Heidemij's full-scale production plant, which has been operating for over three years and has processed more than 200,000 metric tons of contaminated soil.

The new Moerdijk plant is expected to handle about 44,000 tons in its first year. The plant can recycle 80 to 90 percent of organic and inorganic wastes, particularly heavy metals. It is the forerunner of similar plants Geraghty & Miller is considering to build in the U.S. this year.

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"This wet soil cleaning method costs somewhere in the range of $150 to $250 per ton, depending on quantities treated...a volume of more than 20,000 tons is required for a soil washing job to compete with conventional alternatives."

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Write in 520 for more information
In most cases, a bioprocessing treatment “train” or sequence of biotreatment operations is necessary to remediate a site.

There is no single bioprocess applicable to all spill sites. The technology is applied by adapting and engineering a known biotreatment system to a specific application. Selection is determined by local situation, contaminant type, concentration and location within the site.

Process selection and design is also influenced by complementary physical or chemical treatment techniques used in the remediation effort—for example, removal of heavy metals, which are not biodegradable. Thus, in many contamination events, bioremediation continues to grow in popularity as one of the least costly and most environmentally sound site remediation alternatives. Biological methods convert spilled material to carbon dioxide, water and harmless cell protein—usually on site.

The same organic substances (including, for example, most petroleum hydrocarbons and fuels) can be both a food source and a poison to oil-loving microbes, depending on their concentration. The plots shown in Figure 1 (page 23) represent the growth response of microbial populations to two classes of substances, noninhibitory and inhibitory, as it relates to their concentration. Domestic wastewaters, brewery wastes, glucose and other food processing wastes tend to be noninhibitory at commonly encountered concentrations. Microbes respond to these wastes by growing more rapidly as the concentration rises, with the growth rate approaching a maximum at a higher concentration, characteristic of such waste.

Inhibitory compounds are materials such as petroleum hydrocarbons, phenols, cyanides, creosote. These substances are easily biodegraded when the concentration is low enough. The microbial growth rate first rises with concentration as with noninhibitory substances. However, as the concentration increases beyond a certain point, the growth rate attains a peak, then decreases.

This behavior contrasts sharply with that of noninhibitory wastes. The characteristics of inhibitory materials, which include most petroleum hydrocarbons, must be considered in

By R.D. Bleam and T.G. Zitrides

R.D Bleam is manager of technical services for Bioscience Inc., of Bethlehem, Pa. T.G. Zitrides is president of Bioscience and of the Applied Biotreatment Assn., Washington, D.C.
the design and operation of bioremediation systems.

For heavily contaminated soils, this may mean dilution, spreading of “hot spots” or some other means of controlling the amount of contaminant to which the microbial population is exposed.

There are three general categories of site bioremediation in widespread use. The in situ (Figure 2, below) approach involves pumping contaminated groundwater to the surface for treatment in an aboveground reactor. The effluent from the bioreactor, containing oxygen and acclimated microorganisms, is then percolated or injected back into the ground in order to clean the contaminated soils associated with the groundwater.

In some cases, a variety of materials can be added to stimulate microbial growth on the contaminants in situ. In other cases, the treated water is

Continues on page 24→

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Write in 101

March 1992 Soils 23
PRIORITY POLLUTANT BIODEGRADABILITY

This is the list of hazardous compounds developed by the Environmental Protection Agency (EPA) under Resource Conservation and Recovery Act (RCRA) authorization. The biodegradability of these organics is classified as follows:

A — Readily biodegradable.
B — Degradable with acclimated cultures.
C — Partially degraded with acclimated cultures.
D — Biologically refractory with adapted populations.
E — Readily degraded by selectively adapted, enriched cultures.
F — Degraded by selectively adapted, enriched cultures.
G — Partially degraded by selectively adapted, enriched cultures.
H — Biologically refractory in studies conducted to this time.
I — Specific data not available.

Acenaphthene — D, F
Acrolein — D, F
Acrylonitrile — D, E
Benzene — B, E
Benzidine — D, F
Carbon Tetrachloride
(Tetrachloromethane) — A, E
Chlorobenzene — A, E
1,2,4-Trichlorobenzene
Hexachlorobenzene — C, G
1,1-Dichloroethane — B, F
1,1,2-Trichloroethane — C, G
1,1,2,2-Tetrachloroethane — C, F
Chloroethane — B, F
Bis (chloromethyl) Ether — I
Bis (2-chloroethyl) Ether — I
2-Chloroethyl Vinyl Ether (mixed)
— A, E
2-Chloronaphthalene — C, F
2,4,6-Trichlorophenol — F
Parachlorometa Cresol — A, E
Chloroform (Tetrachloromethane) — B, F
2-Chlorophenol — B, E
1,2-Dichlorobenzene — C, E
2,3-Dichlorobenzene — C, E
1,4-Dichlorobenzene — C, E
3,3-Dichlorobenzidine — G
1,1-Dichloroethylene — A, E
1,2-trans-Dichloroethylene — B, E
2,4-Dichlorophenol — E
1,2-Dichloropropane — B, F
1,3-Dichloropropylene (1,3-
       dichloropropene) — B, F
2,4-Dimethylphenol — E
2,4-Dinitrotoluene — B, F
2,6-Dinitrotoluene — B, F
1,2-Diphenylhydrazine — B, F
Ethylbenzene — E
Fluoranthene — B, F
4-Chlorophenyl Phenyl Ether—D,G
4-Bromophenyl Phenyl Ether D, G
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Write in 213

March 1992 Soils 25
Microbial strategies, from page 25
b-Endosulfan-Beta — I
Endosulfan Sulfate — I
Endrin — I
Endrin Aldehyde — I
Heptachlor — I
Heptachlor — I
Heptachlor Epoxide — I
α-BHC-Alpha — I
b-BHC-Beta — I
r-BHC (lindane)-Gamma — I
d-BHC-Delta — I
PCB-1242 (Arochlor 1242) — C, F
PCB-1254 (Arochlor 1254) — D, G
PCB-1221 (Arochlor 1221) — A
PCB-1232 (Arochlor 1232) — A
PCB-1248 (Arochlor 1248) — H
PCB-1260 (Arochlor 1260) — H
PCB-1016 (Arochlor 1016) — C, F
Toxaphene — I
2,3,7,8-Tetrachlorodibenzo-P-dioxin (TCDD) — G

disposed off site. The biotreater is often complemented with a physical or chemical treatment system to separate insoluble materials and to remove pollutants not amenable to biological treatment.

Biotreaters can be operated in an aerobic, anoxic (absence of the molecular form, but presence of ionic forms of oxygen) or anaerobic mode if necessary. Some pollutants, such as chlorinated solvents or nitrate ions are most readily degraded under anaerobic or anoxic conditions.

Slurry processes are modified versions of batch or semi-batch, activated sludge processes used in most municipal and industrial wastewater treatment plants. (See “Here's How it Works,” page 42). They are best suited to treatment of sludges and highly contaminated soils (greater than 10 percent organics). Depending on soil type and waste concentration, a 10 to 20 percent solids content is a reasonable working range.

The contaminated soil or sludge is fluidized with water. Bioreactors can be built above ground or by excavating a basin and installing a liner. Surface aerators are typically used to provide mixing and aeration for bacterial growth.

A wood-treating operation in the southeastern U.S. had a large impoundment containing creosote-contaminated sludges and soils. A bench-scale study indicated the feasibility of applying bioremediation. Four, in-ground, semi-batch bioslurry reactors were constructed. A total of 100 tons per week of soils and sludges were decontaminated in these reactors.

Typical contaminant reductions in the site solids were (combined) phenanthrene and anthracene, reduced from 300,000 parts per million (ppm) to 65 ppm; benzo-a-pyrene down from 1,100 ppm to nondetectable levels (less than three ppm); pentachlorophenol from 13,000 ppm to 140 ppm.

The decontaminated water used for fluidization was discharged to a

Continues on page 28→
Figure 3: Biofarming remediation of contaminated soil where No. 2 diesel leaked from an underground tank. The soil was stockpiled and spread out about 18 inches deep on a plastic liner. Total petroleum hydrocarbon (TPH) contamination was 1300 mg/kg of soil. Ammonia, phosphorus salts and pH adjustment chemicals were added to optimize conditions for microbial growth. A surfactant was added to enhance solubilization of the hydrophobic petroleum hydrocarbons. Addition of hydrocarbon degrading bacteria enhanced breakdown of hydrocarbons. The soil was worked and conditions maintained for about three months. Target levels for TPH were 200 mg/kg. After three months, TPH levels in the treated soil were 33 mg/kg. The treated soil was retained and used for backfill at the former tank location.

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Write in 156
Microbial strategies, from page 27

municipal sewer under modified National Pollution Discharge Elimination System (NPDES) permit. The decontaminated site solids (about five percent of the original concentrated sludges) were returned to a Resource Conservation and Recovery Act (RCRA) impoundment and closure completed.

Biofarming is performed in a semi-solid medium. In this connection, it is similar to composting in which soils are physically and chemically manipulated in order to stimulate breakdown of target organisms by resident microbes. See Figure 3, page 27.

As application and experience with bioremediation continues to grow, more firms are providing full, turn-key services—analyzing the problem, installation, permitting, operating and closing the site. With appropriate design and engineering assistance, a spill generator can often perform bioremediation for smaller spills using in-house personnel and equipment.

Many bioremediation companies and contractors are members of the Applied BioTreatment Association, P.O. Box 15307, Washington, D.C., 20003. The Association can supply a list of firms in your area. It also publishes a compendium of case studies and other materials dealing with bioremediation of various types of spills.

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personnel used the disposal plan to identify hot spots and upgrade health and safety protection as needed prior to excavation.

Predictive soil characterization methodology has also been effectively used by Haley & Aldrich at a petroleum release site near a wetland, where the local conservation commission did not allow stockpiling due to concerns about runoff.

The methodology also was applied to a large redevelopment project where the premium costs of disposing the contaminated soil exceeded the budget and required limitations on the amount of excavation.

And, the predictive model was used to identify hot spots at an urban development site where underground storage tanks were suspected. The contractor was able to anticipate buried tank locations.

A PSC model may not be technically feasible for every site. For example, the complexity of geologic, hydrogeologic and contaminant conditions—including heterogeneity in stratigraphy, multiple contamination sources and different types or mixtures of contaminants must be considered. A limited data set may make it impossible to accurately predict subsurface conditions.

A PSC subset model is best suited to sites with a single contaminant source and relatively homogeneous geologic and hydrogeologic conditions. The model, combined with a soil disposal management plan can remove potential stumbling blocks and streamline the construction and regulatory process at appropriate sites.

Write in 517 for more information.

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Write in 227

March 1992 Soils 29
Insurance...who is going to pay for all the UST cleanups?

Looking ahead at UST insurance

By Richard Turrin

Are state governments capable of funding financial assurance programs? Will they be able to administer the programs and handle claims in a timely manner? On the other hand, can the private insurance marketplace provide coverage that fulfills the government regulations? These are the questions on minds of many in industry who continue to wonder who is going to pay for the thousands of cleanups mandated by Subtitle I of the Resource Conservation and Recovery Act (RCRA).

RCRA financial responsibility requirements are already in effect for the majority of underground storage tank installations. RCRA requires that owners and operators of underground storage tanks (USTs) provide financial assurance for corrective actions and for liability against claims made by neighbors for pollution migrating off-site in the form of insurance, guarantee, surety bond, letter of credit or financial test for self insurance.

In response to these regulations, states have established their funds through fees or taxation to provide tank owners with the coverage required by the regulations. While almost all 50 states provide state funds or are investigating their feasibility, there is some debate over whether the state funds are an effective means of providing financial assurance to tank owners.

The most fundamental argument leveled against the state funds is that they do not foster the general intent of the federal law to minimize the potential threat to the environment from USTs. Many state funds offer protection to all UST owners without regard to the risk presented by the individual tank—unlike a private program which would charge in proportion to the risk presented by each tank. This results in an inefficient allocation of risk across the regulated community which rewards the owners of older installations with low cost coverage, reducing their overall operating costs.

This reduction helps owners of older USTs, which pose the greatest threat to the environment, to extend the tank’s serviceable life.

Concurrently, owners of newer USTs or owners who have recently cleaned up at their own expense, are penalized to the same degree as operators of old tanks or owners who have delayed cleanup are rewarded.

While there is some merit to this argument, to try to evenly distribute the costs—at the onset of the regulations, some insurance carriers were comfortable with providing the full scope of coverage required by the regulations—but at rates that proved unacceptable to the industry due to the huge costs of cleaning these sites.

A survey of the Petroleum Marketers Association showed the average cost for petroleum cleanups in 1990 was $151,000 per event. Given the magnitude of the potential of exposure, (think how expensive auto coverage would be if the average cost of each claim was $151,000) insurance companies had a difficult time pricing a policy that included first party cleanup. This situation left an opening for the creation of the state funds.

A second argument brought against the state funds is that they have virtually eliminated a market response to the problem of how to best provide financial assurance and automatically moved the burden of cleanup costs from UST owners to the consumer. Most state funds are based on a petroleum tax which petroleum marketers pass along directly to the consumer. With this system, the consumer is paying for the UST owner’s liabilities with little direct contribution from the UST owner.

Petroleum marketing trade associations argue that the liabilities associated with environmental cleanup are so great that the cleanup costs cannot be borne by the industry alone. They feel that even without a direct tax, the additional costs to the industry to comply with the regulations would be passed on to the consumer in the form of increased prices. This implies that consumers will receive the greatest benefit from the use of state funds, which, at least initially, offer the lowest cost for the mandated coverage.

There are areas where state funds and the insurance industry compliment one another. In Texas and Florida, for example, state funds provide coverage only for corrective actions, while leaving coverage for liability claims to the insurance industry. This approach allows an opening for insurance companies to write the third party liability risks to which they are most familiar—while the state funds take the actual cleanup.

This type of program still leaves the states with the question of how to pay for the program, since corrective action claims (assumed by the state) comprise the major portion of the total claims.

Critics worry about the ability of the state funds to cover the claims against them—since several states already show claims far in excess of reserves. While it is highly unlikely that any state funds will actually default, the amount of tax increase the public will support to pay for the cleanups and the speed with which states will be able to pay claims is issues. Public support for environmental issues remains high, however, and the support for public intervention to clean the environment may neutralize these concerns.

What can the UST owner expect in the future of UST coverage? First, at least for the short run, the state funds will continue to be a dominant industry force. They are likely to continue to provide a major portion of the insurance requirements for compliance.

Richard Turrin is strategic analyst for Commerce and Industry Insurance Co., member company of American International Group, Inc., New York, N.Y.

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with the federal regulations, but will see increasing competition from private insurance companies in niche markets. Revenues generated by the funds should generally remain lower than those required by private industry, reinforcing the states’ position as a tough competitor for private insurance companies to beat on price, but limiting their ability to service their customers.

The recent withdrawal of several private companies from the market bear witness to the immediate pressures facing the industry.

Second, insurance companies will continue to become more comfortable assuming first party risks as the amount of claims information will undoubtedly be in the speed and quality of service delivered to the insured. Smaller vendors who are more likely to be placed at peril by the loss of funds or a delay in reimbursement should factor this distinction into their decision. Larger petroleum vendors will most likely stay with the state funds unless they begin to show clear signs of poor service or solvency. These vendors will benefit from the lower prices offered by the state, with the impact of any possible delay in reimbursement being (at least partially) offset by the savings.

Third, regulatory enforcement will provide a major force in the upcoming market. To date, enforcement of the financial assurance section of the

---

**Enter property transfer coverage**

The insurance industry is offering a new type of coverage to protect owners, consultants and lenders against the risk of pre-existing, undetected contamination as property changes hands. It is known as environmental remediation insurance (ERI) or property transfer liability coverage and it pays, subject to policy terms and conditions, to clean up undetected contamination that was present on the property before the purchase.

"No responsibility is assumed for the discovery and elimination of hazards which could possibly cause accidents or damage." This or a similar disclaimer usually accompanies an environmental audit and is intended to relieve consultants from obligations associated with undiscovered hazards on client’s property.

This means that when you engage or perform an environmental audit to support the purchase of real estate, there is no guarantee that all the environmental hazards have been detected, even when the most sophisticated remote sensing devices are used.

In the case of underground storage tanks (USTs), undetected tanks ("ghost tanks") can result in costly legal battles which can cause an owner to turn as white as a ghost if the consultant's errors and omissions coverage does not include environmental claims.

Enter the banks, who have a newfound appreciation for managing environmental risks, given the poor performance of their real estate portfolios—and the evolving case law in this area which allows banks to be held liable for environmental damages on properties on which they hold the mortgage. Under a worst case

Continues on page 40.

increases. This will result in more competitive rates for their products, especially to the owner of new or upgraded facilities.

In addition, coverage will become more readily available as an add-on to existing classes of business so that carriers can fully service their clients. This will allow UST owners to choose between state funds and the private sector for their coverage.

The primary advantage of private sector competition over the state funds regulations has been lax. And, the recent extension of the deadline (to December 31, 1993) for category four UST owners to comply with the financial assurance regulations indicates a strict enforcement program should not be anticipated soon. When strict enforcement does kick in, UST owners will pay much closer attention to their insurance requirements which should stimulate the market for private sector coverages.

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Write in 194

March 1992 Soils 31
Cables sound alarm

High-tech leak detection cables cut down on the guesswork

By Sam Berkman

Direct contact leak detection systems are one of many options available to protect against releases. Leak detection options available can be categorized as:

- liquid contact detection cable (continuous cable probe monitoring)
- external systems (groundwater and vapor monitoring)
- internal systems (automatic tank gauging)
- volumetric and nonvolumetric tank tightness testing (manual tank gauging)
- interstitial and pipeline systems (periodic monitoring, testing or check valves)
- statistical inventory reconciliation methods.

Choosing a method requires weighing dozens of site specific factors, ranging from product characteristics, tank and line age and type, soil characteristics, desired detection accuracy, desired response time, independent test results and cost.


Direct contact leak detection systems are used by such companies as Exxon, Mobil, Motorola and Westinghouse. Such systems are capable of detecting hydrocarbon and water/chemical leaks at distances up to 4,000 feet.

Direct contact systems originated twelve years ago in Japan when Junkosha, a subsidiary of W. L. Gore & Associates, Inc., discovered that the combination of expanded polytetrafluoroethylene (PTFE) insulation plus an expanded PTFE jacket on a coaxial cable was not only waterproof, but allowed hydrocarbons to permeate the protective jacket and the expanded PTFE insulation. (See Figure 1, next page).

This discovery led to the development of a cable which can be buried, is waterproof and can detect hydrocarbons, such as gasoline, oil, solvents and jet fuel.

In the early 1980s, this cable was installed on a 29 mile pipeline delivering jet fuel from a coastal storage area to Tokyo’s Narita Airport. In the first year alone, the system detected five separate leak locations along the pipeline.

W.L. Gore & Associates has enhanced the cable with a microprocessor-based moni-
Hydrocarbon detection cable, above and super cable that detects hydrocarbons in water.

A sensing unit that can locate a leak in minutes and immediately report it on a liquid crystal display and trigger an audible alarm. The unit works by sending thousands of energy pulses per minute down the detection cables. Reflections of these pulses return to the monitoring unit. When the cable becomes wet, there is a change in the insulation quality between the two conductors causing a rise in the cable’s capacitance and a decrease in its impedance. This electrical change is recognized by the microprocessor and the system enters alarm mode.

After a leak is confirmed, a new reference is taken and reflections of the wet cable are stored in the unit’s memory as part of a new map. This new map becomes the baseline for the system so it can continue to monitor for leaks. Upon repair of the leak and the drying of the cable, the microprocessor unit automatically reverts to the original reference.

In addition to the hydrocarbon cable, a water and chemical cable is available, as well as a "super cable" that differentiates between hydrocarbons and water-based chemicals.

One advantage of the cable system is continuous detection sensing over the entire length of the cable. The hydrocarbon cable detection test results (Figure 2, page 34) show detection of gasoline at 2,000 feet or less in one minute.

Direct liquid contact leak detection systems are being used in underground storage tanks and pipes, aboveground storage tanks, pipelines and industrial chemical storage and movement applications. Including a leak detection system on a new underground tank installation is a simple procedure.

Liquid contact detection systems can be installed in aboveground tank applications by boring under the tank and pulling a slotted tubing into the bore. The detection cable is then installed in the tubing. An alternate method is to install a false bottom in the tank and incorporate a leak detection cable under the false.

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Cables sound alarm, from page 33

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Data tested underwater for 21 months, aboveground for five years at Northern Arizona University. Detection times vary with hydrocarbon viscosity.

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THE PROBLEM

The former Johnson Steel and Wire Company site in Worcester, Massachusetts, presented a challenge to both the Massachusetts Department of Environmental Protection (DEP) and Intransit Container, Inc., who wanted to develop the site as a major intermodal rail terminal in Worcester. The soil was contaminated with both petroleum products (fuel oil) and high levels of lead. American Reclamation Corporation (AmRec) was contacted and asked to solve the problem.

THE SOLUTION

Through the AmRec Process, AmRec demonstrated that the soil from the site could be recycled into an environmentally safe asphalt paving. After review and approval by DEP, over 4,000 tons of soil and 8,000 tons of other recyclable materials were screened, crushed and blended to produce 12,000 tons of asphaltic concrete. Then, about 14 acres of the site were covered with the recycled paving made from the AmRec Process. By using the recycled asphalt, not only was $800,000 saved in paving costs, but a major environmental problem was transformed into a safe and productive site!

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short takes

• Global Technologies, Inc. of Milwaukee, Wis., has been selected by Mobil Oil Corp., to supply vacuum extraction and catalytic oxidation systems to clean soil contaminated by leaking underground tanks.

• The Texas Water Commission has granted certification of closure to the first in-situ bioremediation project approved in Texas. That site and three others were managed by the Biochemical and Environmental Services Division of Sybron Chemicals, Inc., of Birmingham, N.J.

Sybron's augmented bioreclamation approach uses naturally occurring bacteria which have been selectively adapted, but not genetically engineered, to break down contaminants at an accelerated rate.

• BioVac Environmental Services, Inc., of St. Charles, Mo., announces a multimedia aerobic degradation process designed to address contaminated vadose zone soils and groundwater. It is a low profile technique, suited to congested sites such as service stations, high traffic plant access roads and other commercial, industrial sites.

• William Cutcliffe, president and CEO of Dunn Geoscience Corp., Albany, N.Y., announces the firm has changed its name to Dunn Corp. to call attention to the fact they are expanding from geological services to environmental consulting, engineering, geology, hydrogeology and mining and minerals.

• Zimpro Passavant Environmental Systems, Inc., of Rothschild, Wis., announces that the Twin Cities' Metropolitan Wastewater Treatment Plant in St. Paul, Minn. and the Lakeview Water Pollution Control facility in Mississauga, Ontario are the champions in their 1991 plant excellence competition. Companies using Zimpro Passavant equipment are eligible to compete for the annual award.

• BH&E, Inc., a full-service environmental consulting firm headquartered in Cincinnati, Ohio, announces the opening of a new branch office in Annapolis, Md., under the direction of Kenneth Wiswall, P.E.
PRI unveils microwave recovery processor

Progressive Recovery, Inc., Dupo, Ill., has developed the PRI-VAC™ electromagnetic thermal desorption recovery process to heat soil or sludges and vaporize organics which are distilled off in a reduced pressure environment. The vapors are condensed into liquids and collected for reuse. The technology has successfully remediates soils, paint solids, ink coatings, sludge, resin wastes and others.

Write in 524 for more information

Clean Soil introduces “do-it-yourself” unit

Clean Soil, Inc., of West Columbia, S.C. has developed a trailer-mounted steam-stripping processor which can be handled by two people trained by Clean Soil. The unit sets up in two hours and can clean approximately 50 yards of soil per day. Monthly rent ranges from $3,500 to $5,000. Bart Lehman, president of the company, says firms using this approach save 50 percent or more on cleanup costs.

Write in 528 for more information
what’s new

SRI’s new GC features built-in purge & trap
SRI’s new transportable gas chromatograph is designed for on-site and laboratory analysis using EPA methods 502.2, 601, 602, 604, 608 as well as 8010, 8015 and 8020 protocols. Three detectors (FID, PID, ELCID) plus built-in EPA style purge & trap and a data system kit permit analysis of compounds to less than one ppb sensitivity, says the company.

"Mucksucker" by any other name...
The Mucksucker™ from Norton Performance Plastics of Wayne, N.J. is a syringe-type Teflon® sampler that safely collects product from 55 gallon drums. It works on a wide range of viscosities and is suited to safely test drummed material for transport and disposal, says the company. Both top and bottom seal to hold the sample until it is expelled. The unit disassembles for decontamination and sterilization. All parts are replaceable.

Hand-operated auger kit offers versatility for tight places
Clements Associates, Inc. of Newton, Iowa, manufacturers of hand-operated sampling equipment, announce a four-auger kit that enables sampling in cramped locations, says the company. The nickel-plated, carbon steel augers include one for use in sand, one for clay, one for mud and a general purpose auger. The kits are available in two- or three-inch diameter with extension lengths of 34 inches or 45 inches. The set comes in a padded case.
Asbestos, from page 11

screened for potential waste constituents.

The waste placement and backfill operations were monitored and documented by Quality Assurance/Quality Control (QA/QC) personnel to comply with soil compaction specifications. The entire remedial operation was also conducted under constant surveillance of permitting regulatory agencies.

Personnel in the work zone were required to wear Level C personal protective gear. A personnel decontamination trailer and equipment decontamination ponds and pads were set up. Work zone boundaries, which normally extended beyond the actual field of remediation activities, were established and reviewed with site workers on a daily basis.

A meteorological station was installed at the site prior to excavation and operated throughout the remediation to monitor wind speed and direction to locate emissions air sampling stations at the perimeter. Sirens sounded at these stations when wind speed was greater than 15 miles per hour. Such conditions temporarily halted the excavation.

The DTSC certified the site in July, 1990, one month after the cleanup was completed, stating that the remediation was conducted in accordance with the approved remedial action plan. The site was simultaneously delisted from the State Expenditure Plan.

With disposal costs rising, on-site treatments may prove an effective alternative to conventional asbestos abatement. Incidents of pipe containing asbestos which contaminates surrounding soils are likely to increase. As asbestos-contaminated soils are found at larger sites, remedial actions must meet changing needs. Potential remedies should go beyond conventional options to select the most environmentally sound and cost-effective approaches. Risk avoidance must become an important consideration to identify remedial actions.

Write in 518 for more information

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Property transfer coverage, from page 31

scenario, the bank can be held liable for a substantial portion of the cleanup, even if the owner has not been forced into bankruptcy. In less severe circumstances, the property which serves as the security for the loan can be sharply devalued, causing the loan to be reevaluated.

To protect both the property owner and the bank from environmental risks associated with real estate transfers, several insurance companies, including American International Group’s Commerce and Industry Insurance Co. of New York, N.Y., ERIC Group of Denver, Colo., and Reliance’s Environmental Compliance Services (ECS) of New York, N.Y., are marketing this new ERI coverage.

Through ERI insurance, the risk of unknown contamination on the site may be transferred to the insurance company and substantially reduce the possibility of financial losses due to unknown environmental liabilities. Policies are generally available naming the bank or lender as an additional insured with no or minimal additional charge so the lender can also be protected. The policies do not cover contamination on the site caused by operation of the facility after the purchase. This is a key point since this prohibits the policy from being used to clean up spills or other mishaps caused by the insured after the initial environmental audit.

When buying an ERI policy, there are several key variables to compare other than the cost of the premium. These include policy term, loss limits, deductible, trigger and cancellability. It is best to consult your broker to see that your specific needs are met.

The term or duration of ERI policies generally ranges between two and three years and may extend up to five years. The longer duration policies afford a longer period to discover hidden environmental problems.

The loss limits are the maximum amount the insurance policy will pay. They can be quoted as an aggregate limit, the total limit over the policy period and the limit per individual claim. Policies differ in limits, with some companies offering aggregate limits ranging from $2 to $10 million and others offering aggregate limits combined with per claim limits around $2 million.

The trigger for ERI policies varies with some triggered by discovery of contamination on site by the insured and others by a third party claim against the insured by a neighbor or regulatory agency. This difference may be significant, depending on the regulatory climate in the insured’s state, since policies with a third party trigger may require that the local regulatory agency generate a cleanup order before the policy will pay.

Deductibles range from $0,000 to $50,000. Cancellability of an ERI policy allows the policy holder to cancel the policy before expiration with the return of a significant portion of the premium. This can be useful if there is the possibility the property might be offered for sale before policy expiration and is not included in all ERI policies.

Some insurers require that only environmental audits conducted by an approved consultant are acceptable, while others require that the audit document itself pass certain criteria and can be produced by any consulting firm. While the approved consultant requirement sounds restrictive, additional consultants are added to these lists regularly as ERI sales expand. An important point is that if insurers using either requirement find your environmental audit deficient, you should consider working with your consultant or get a new one to get the audit up to standards.
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Soil slurry treatment is an above-ground, aerobic biodegradation process in which contaminated soil is suspended in water. Nutrients and air are added to the slurry to enhance microbial degradation of materials sorbed to the soil. These solid-liquid contactor systems are usually operated in a batch, sequencing batch or continuous mode. After waste levels have been reduced to acceptable levels, the soil-water slurry is removed from the reactor, dewatered in a clarifier and the soil is returned to the land. Key factors that influence the performance of this process are mixing, oxygen transfer rate (usually controlled by air sparging) and nutrient addition.

Wastes that can be treated include mud pit slurries containing petroleum hydrocarbons (oil and grease); soil containing hydrocarbons, chlorinated compounds and pesticides; concentrated organic liquid wastes that can be diluted with soil or other bulking agents. Use of soil-slurry bioreactors is limited to wastes containing smaller hydrocarbon molecules. Medium chain length alkanes and aromatic fractions are degraded nearly completely, while polynuclear aromatic hydrocarbons (PAHs) are degraded very slowly (0 to 10 percent total). The presence of salts and/or metals may inhibit microbial activity. Typically, the reactor is either a stirred tank (open or closed), lined pit or pond configured with aerators and mixers. Care may need to be taken with an open reactor to monitor possible air emissions. Typical waste concentration ranges from five to 20 percent by weight as oil and grease; 200 to 2,000 parts per million for other compounds. Routine sampling of the solid and liquid phases needs to be performed to determine biodegradation rates. Optimum operating temperatures range from 20 to 30°C. Cost estimates range from $100 to $200 per cubic yard. This information taken with permission from the Shell Oil Co., Soil Remediation Workshop Handbook, Houston, Texas.
According to Xerxes Corp., the primary advantage of the multi-compartment tank is the ability to store three petroleum products—typically unleaded, premium and diesel—in one tank and potentially save on 'per tank' regulatory fees, permits and insurance premiums. Installation of one multi-compartment tank is cheaper than installing two or three separate tanks and installation of common piping can reduce costs even more, says the company. Tanks are fiberglass, U.L. listed, and compatible with all fuel types, including alcohol blends. The tanks are available in single- or double-wall models. Several states, including Florida, Maine, Massachusetts, New York, New Hampshire and Vermont, now mandate secondary containment for new installations. Tanks are available in eight- and ten-foot diameters in two- or three-compartment design. Capacities range from the smallest eight-foot, dual-compartment model, which stores three thousand gallons each of two products—to the largest ten-foot, triple-compartment size, which stores 20,000 gallons in the center compartment and 8,000 gallons in each side compartment. In all, the tank is offered in 130 different proportional size arrangements. Vent lines can be run from each compartment to a common outlet. says the company.

Write in 526 for more information
Modular Remediation’s Vapor Extraction Module

- Modular Remediation System’s transportable vapor extraction module can pull vapors out of contaminated soil at a rate of up to 1000 cubic feet per minute, says the company. The unit can be housed at the site with extraction wells, or ex situ by using extraction headers in stockpiled soils. The motor pulls the vapors into the water trap demister canister, which removes water from the airstream. The vapors are filtered as they are drawn up and out of the demister canister, across, then down to the exhauster canister which is fitted with impellers that push the dewatered, filtered vapors up and out the exhaust stack. Direct discharge of volatile organics is allowed in some locations under strictly controlled conditions. The modules can be equipped with monitors to assure direct discharge regulatory levels are met. In other areas, the module can be equipped with either vapor phase carbon canisters or thermal oxidizers. The modules are available in one to 50 hp to suit high-medium- or low-demand site needs ranging from a service station to an industrial plant or refinery facility. High-demand sites can be outfitted with low-demand modules to perform final cleanup of lower residual contaminants.

The company says the modular design of the unit minimizes field construction costs. System design is eliminated, allowing engineers to concentrate of field investigation of soil characteristics and contaminant concentrations. Airtight, steel construction of the unit eliminates air loss due to leaks and poor fit up. The unit is equipped with gauges to monitor inlet temperature, vacuum pressure, discharge pressure and discharge temperature. Spark-resistant exhausters and NEC wiring assure operating safety, says the company.

Write in 527 for more information
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