DOE's $200 billion cleanup market

Telerobotic excavators may aid in the cleanup of weapons manufacturing sites.

Ghost tanks—Beware! Haunted sites could scare you to the poor house

Solid-phase/slurry phase bioremediation
Don't Burn It or Bury It. Recycle It.

Soil Safe, Inc. has become the most cost effective and environmentally preferred solution to disposing of petroleum contaminated soil. We realized early that there are wide varieties of soils encountered when excavating underground storage tanks. We are the only recycling company in the industry that offers a complete recycling process. In order to process the wide variety of soils from USTs, Soil Safe, Inc. designed and built three different plants which produce over five finished products used as subbase for paving. Our process makes quality end products that further reduce construction costs and eliminate the use of valuable landfill space.

Don't be fooled by incineration or asphalt plants. Incineration can be incredibly expensive, often costing several million dollars. They destroy valuable material resources, replacing them with ash and emissions containing a host of toxic heavy metals and organic chemical compounds, which can pollute the air, water and food chain. Depending upon the type of contamination in the soil, the ash may or may not be considered a hazardous waste. It will likely require landfiling and/or stabilization/solidification. A typical "soil incinerator" can only burn approximately 25 tons per hour under ideal conditions.

Mixing contaminated soil into hot-mix asphalt sounds good. The fact is, asphalt plants can only incorporate 4-7 percent of contaminated soil into its hot-mix and still meet its specifications. The other 93-96 percent of material must still be dealt with and generally ends up getting landfilled.

The Soil Safe Recycling Process produces quality end products, eliminates the use of land as a dumping ground and keeps the air we breath clean so we can look forward to tomorrow.

Our Services:
Recycling • Trucking • Loading
• Lab Analysis • Quality Control • Manifest
Each Truck • Site Audit • Inspection,
Testing of Each Truck upon Delivery

Soil Safe Incorporated
4600 E. Fayette Street
Baltimore, Maryland 21224
301-327-6026

Write in 033 on inquiry card.
Dirty Dirt?

 Modules Available (multiple capacities each module):

- VES7 Module: 100 - 300 CFM
- VES5 Module: 100 - 450 CFM
- VES3 Module: 75 - 360 CFM
- VES1 Module: 0 - 220 CFM

Spacesaver Modules: The VES1-S Module is a transportable vapor extraction system designed to be easily integrated into remediation projects designed for the removal of volatile organic compound vapors. The module is specifically designed to perform vacuum pilot studies and complete remediation of small sites such as service stations and underground tank remediation at industrial plants. The VES1-S Module also provides remediation capabilities for small transportation related spills. In addition to standard skids and forklift eyes the VES1 Modules can be outfitted in a two-man portable compartment for security on-site. The VES1-S (side-by-side) "Pilot Study Package" comes with connection hoses, fittings and exhaust stack stowed in the compartment.

Carbon Systems: VES Modules are often supplied with carbon systems integrated for easy connection and start-up. Carbon canister racks are available allowing single lift modules—VES Module with carbon system one unit.

Regenerative Thermal Oxidizers (RETOX): Thermal oxidizers may be more cost effective than carbon systems. The thermal oxidizer offers low power cost, no catalyst to replace and permissible nitrogen oxides discharge.

Remote Telemetry Module: Remote telemetry can substantially reduce long-range sites remediation costs. The remote monitoring capability can be provided with original equipment or as a retrofit.

Ultraviolet Treatment Modules: We offer treatment modules which incorporate an advanced pulsed plasma xenon flash lamp. Tests on organic contaminants demonstrate the effectiveness of this powerful treatment tool on both water and air streams. Call us for a fully integrated treatment system.

Modular Remediation Systems, Inc.
1320 TERMINAL ROAD, INDIANAPOLIS, IN 46217
(317) 784-7731 FAX (317) 782-8516

Write in 096 on inquiry card.
We design and build soil remediation plants

- New Stationary Soil Remediation Plants
- New Portable Soil Remediation Plants
- Back-fit equipment for your existing Rotary Dryers/Kilns
- Used Bins, Dryers and Baghouses

- Custom-Built Portable Plants
- Stationary Rotary Dryers
- Stationary and Portable Baghouses
- Back-Fit Oxidizers for Existing Plants
- Low NOx Oxidizers

Send us information on the following:

- Stationary Soil Remediation Plants
- Portable Soil Remediation Plants
- Thermal Oxidizers
- Plant Operation Controls
- Load-in/Load-out Recordation
- Control Operation Rooms
- Baghouses
- Rotary Dryers/Kilns
- Evaporative Coolers
- Soil Feed Bins
- Permit Applications

NAME

TITLE

COMPANY

ADDRESS

CITY STATE

PHONE FAX

TARMAC Equipment Co., Inc. • Original Equipment Manufacturer
219 N. 7 Highway • Blue Springs, MO 64014

Write in 095 on inquiry card.
Features

6 $200 billion cleanup market
New technology needed to remediate weapons manufacturing sites

8 Ghost tanks
Beware! Haunted sites could scare you to the poohouse
By James Beard

10 Solid-phase/slurry-phase
Transfer of organics to aqueous phase for degradation
By Raymond Loehr, Ph.D.

12 Try a little TLC
Sensitive, rapid, inexpensive analytical technique
By James E. Bruya and Andrew J. Friedman

16 AEHS promotes soil awareness
January 1992 target date for association's peer review journal

18 Ingenious Solutions
Americans have unique suggestions to clean up Saddam's spill

20 Cost-saving investigative techniques
Remediation steps can be taken during closure activities
By Joseph Berin and Michael Jantz

22 Caution: Tank removal can be fatal
Petroleum vapors regenerate even in old or abandoned tanks

28 Way to watch
Personal computer instantly gives readings of site conditions
By Randall D. Seavers

30 What makes a good lab good?
Factors to consider when choosing a laboratory
By Susan Parker

40 When you're not alone
Many contamination events cross property lines and require group effort to remediate
By Jean B. Kulla, Ph.D. and Angelo J. Bellomo

Departments

36 What's new
38 Industry news
39 What, when & where
46 Hotline and Index
Soil cleanup

$200 billion cleanup market

New technology needed to remediate weapons manufacturing sites

Estimates to clean up all the leaking underground storage tank sites range from $20 to $30 billion over the next decade. The estimated cost to clean up radioactive pollution at nuclear weapons sites over the next 30 years is $200 billion. And that estimate discounts a report released by the Congressional Office of Technology Assessment who, after an 18-month investigation, concluded the clean up may take much longer than 30 years, cost much more than $200 billion.

The Department of Energy (DOE), charged with the task of cleaning up hazardous wastes and contamination from more than four decades of weapons production, released a five year plan calling for $34.7 billion through fiscal 1996.

The waste generated by weapons manufacturing represents a unique technical challenge.

Solutions to these environmental problems are being actively sought from the private sector—U.S. industry, universities, other federal agencies—anyone with an idea is welcome.

According to Kathleen Hain, branch chief for the DOE Office of Technology Development (OTD), division of research and development, "industry expertise will be tapped through a variety of formal and informal mechanisms. Informal activities will include laboratory visits, personnel exchanges and scientist-to-scientist interactions. Formal mechanisms include collaborative research projects between industry and the laboratories, consortia, cooperative research and development agreements (CRDAs), user facility agreements, intellectual property licensing or consulting arrangements."

The private sector is being asked to help shape, guide and evaluate the entire program. The OTD exists to find, encourage and implement participation from industrial groups "such as those from the Fortune 500 list...to maximize involvement of the private sector in national waste management and environment restoration issues."

The DOE is starting with five sites across the country. These will be used for integrated demonstrations of a wide variety of technological applications.

Initial screenings at the Fernald Site in Ohio show six pits filled with wastes containing both uranium and thorium, three 80 foot diameter silos containing pitch-blende (radium) residue and metal oxides, 13,000 steel drums of thorium, 44,000 drums of mixed waste containing uranium and thorium. The physical condition and structural integrity of the drums is not well known.

The Hanford Site in Washington contains 149 single-shell storage tanks (SSTs), located in 12 SST farms which have been used for the storage of process liquids and wastes since the early 1940's. In general, the tanks contain liquid, salt cake and sludge. Remediation is scheduled to begin in 1994 and is to be completed by fiscal year 2018. It is not well known what is in the tanks though 66 have either leaked or have been declared "assumed leakers."

Also at the Hanford reservation are some 1,100 'past practices' sites—including ditches and ponds—which need to be characterized and remediation developed and implemented by 2018.

Hanford also has 28 one-million gallon double shell tanks (DSTs) which contain radioactive contamination and toxic chemical constituents dating back to 1970.

More than two dozen separate burial locations at Hanford hold containers of unknown condition.
with partially known radioactive contents.

The Idaho National Engineering Laboratory (INEL) site contains two million cubic feet of hazardous, radioactive buried waste and six million cubic feet of similarly contaminated soil. This waste was received in cardboard boxes, steel drums, plywood boxes and as loose material. The methods used to bury these wastes did not consider future retrieval of the wastes. Sampling wells have indicated traces of plutonium in a bed of soil at 100 foot depth and carbon tetrachloride in subsurface water.

INEL has 11 single-shell stainless steel waste storage tanks containing high-level radioactive liquid and sludge. The tanks do not meet standards for double-wall tanks, there are technical concerns about the seismic stability of five of them and there is a lack of historical corrosion data on all the tanks.

Also at INEL, 2.4 million cubic feet of transuranic waste (waste that is contaminated with alpha-emitting transuranium nuclides with half-lives greater than 20 years and concentrations greater than 100 nanocuries per gram of waste) in various barrels and boxes. Over 90 percent is considered to include excess free liquids, dispersible fines and deteriorated packages.

The Rocky Flats site outside Denver, Colo., has 178 spill, burial and process waste pipe sites thought to contain uranium, contaminated oils, burned oil residues and radioactively contaminated drums. There are five ponds containing sludges with uranium, plutonium and cadmium. The sludges also contain heavy metals. The asphalt liners of the ponds will probably have to be removed as the ponds will need to be eliminated.

There are several old burial sites, consisting of depleted uranium, plutonium, carbon tetrachloride (which has migrated), lithium, sodium and some Americium (a daughter product of plutonium).

The Savannah River Site, in South Carolina, started reclamation and remediation efforts in 1981. The priority effort at Savannah River is the remediation of liquid waste seepage basins which are contaminating the ground water. The seepage basins receive low-level radioactive waste water from the laboratory and other process buildings. The current closure method consists of stabilization of basin liquids followed by backfilling and capping of the basin.

The five reactor areas at the site use earthen seepage basins to dispose of low-level radioactive purge waters from the reactor disassembly basins. There are 14 reactor seepage basins on the site. Seven are inactive. Six of these inactive basins were deactivated and backfilled between 1958 and 1977. Closure options for these basins are being evaluated. The sludge in these basins contains concentrations of radionuclides.

There are 51 high-level carbon steel radioactive waste tanks at Savannah River which have received or are receiving liquid

Continues on page 32→
Ghost tanks

Beware! Haunted sites could scare you to the poor house

By James Beard

The EPA estimate that there are between 2.5 and 5 million underground storage tanks in the United States is not exactly a pinpoint figure. Historically, the casual attitude toward documentation and recordkeeping has left a legacy of unknown “ghost tanks” waiting quietly to ambush new owners, developers and other entrepreneurs.

How many ghost tanks are out there? How many are leaking? What manner of hazardous material is involved? How long have they been forgotten? What contribution are they making to the earth’s contamination? Who will be the next victim?

A Ghost Story

The great American dream—to own one’s own business—usually involves a great deal of risk. The careful entrepreneur tries to calculate risk factors, estimate income and outgo, protect investments, buy insurance and anticipate any possible liability.

Some liabilities, such as payroll expenses or overhead, are known and predictable. Others can only be vaguely estimated. But the third category, the completely unknown liability, can be the most frightening of all.

In January 1983, Mr. A. Nonymous purchased a gasoline station from a major oil company (you would instantly recognize their name) to fulfill his dream of owning his own business. Mr. Nonymous worked hard and he worked smart to build an excellent customer base to produce a steady flow of income.

In 1984, the federal government introduced regulations to limit the environmental hazards associated with leaking underground storage tanks. Mr. Nonymous was not too concerned. His system was only ten years old. And, after all, the facility had been purchased from a large, reputable, famous oil company.

Mr. Nonymous checked his inventory daily and showed no evidence of any loss of product.

James Beard is director of marketing for the UST Division of Decon International, an environmental contracting firm in Bethel Park, Pa.

“Swiss Cheese” ghost tank surprises owner who paid an extra $125,000 to remove unknown tanks.

In August, 1990, Mr. Nonymous contacted an environmental firm, Decon International, Inc. of Bethel Park, Pa., to look into the cost effectiveness of replacing his system before any problems occurred. After all, Mr. Nonymous reasoned, insurance would be much cheaper with the newer, monitored underground tank systems. He figured he would rather pay a little more while he had the necessary funds, than to pay much more later.

Mr. Nonymous could not only amortize his system within three years, based on insurance premium savings, but also bring his system into compliance with federal regulations.

Some tank owners operate in a wishful, pink cloud dream state that roughly translates, “What I don’t know can’t hurt me.” This attitude, however, can cost big dollars. Cleanup costs easily can range up to one thousand dollars per gallon—not including potential civil and criminal penalties.

Mr. Nonymous showed Decon personnel the diagram map of his tanks he had received during the real estate transaction of 1983 with the really big, instantly recognizable oil company. It showed the locations of three, 4,000 gallon single-walled metal tanks.


As the task of removing all three tanks was nearly completed, a Decon worker noticed additional piping nearby. That discovery was not unusual, except for the fact that the piping was not headed in the direction of the dispensing island. Curiosity led the crew to pick up hand shovels and uncover a bit more information about the mysterious piping.

Approximately two feet beyond the excavation hole, the workers hit a large metal object. Septic system? Sewer or utility system, maybe? Old bomb shelter?

No, indeed, it was another tank—unmapped, un-
charted, unknown—a genuine ghost tank.

Mr. Nonymous, who witnessed the entire event with great concern mustered a jovial attitude to break the tension, “I got more bang for my buck—paid for three tanks and got four—what a deal!”

Decon removed the ghost tank and found severe erosion, particularly in the bottom of the tank. “Swiss cheese,” was Mr. Nonymous’ jovial term.

About that time, another worker screamed, “Over here! More piping!” It hardly seemed possible. Mr. Nonymous’ property had very restrictive boundaries, yet, sure enough, another tank. Forced joviality and whimsy evaporated as this ghost contained gasoline residue. The second ghost was removed.

As excavation progressed, the odor of gasoline grew stronger and the earth became more and more saturated. In an attempt to locate the source, the crew again manned the hand shovels. Again, a large metal object was uncovered—yet another ghost tank.

This third ghost also had product remaining. The earth was even more saturated. By this time, Mr. Nonymous was on the telephone to the administrative offices of the previous owner—the major oil company.

By the time the fourth ghost was discovered, reactions of shock and dismay were fairly dulled. At that point, 75 percent of Mr. Nonymous’ property was excavated. The only non-excavated area left was under the building.

In good faith, Mr. Nonymous purchased a gas station from a major oil company through proper real estate transaction channels. The plot plan at the point of purchase showed three 4,000 gallon underground tanks. After a nightmarish excavation, Mr. Nonymous wound up with a total of seven tanks. The cleanup costs of the four ghost tanks cost Mr. Nonymous an additional $125,000.

Estimates for the nation’s eventual cleanup cost range from 20 to 30 billion dollars over the next decade. How many more billions need to be tacked on to allow for ghost tanks?

Because the unknown can be fatal to a business, it is absolutely critical to assess a property before the purchase is made. Many realtors are becoming more aware of the potential liabilities of environmental contamination, but fewer are aware of the necessary steps to guarantee protection.

Mr. Nonymous will survive. He is still in business. He lost uncounted hours of sleep. And, he will wait a long time to realize amortization on the unexpected additional $125,000 his new system cost. And, while the litigation may drag on for years to come, the legal department of the high profile, major oil company is resolutely dedicated to the task of making sure the $125,000 stays out of Mr. Nonymous’ pocket.

How many underground tanks are yet to be unearthed with potentially insurmountable financial liability? Who will be held responsible for the cleanup? Who is to blame for the unknown?
Bioremediation processes

Solid-phase/slurry-phase
Transfer of organics to aqueous phase for degradation
By Raymond Loeb, Ph.D.

Bioremediation is a managed, active treatment process that uses microorganisms to degrade and transform organic chemicals in contaminated soil and sludges. Bioremediation processes can be categorized as solid and slurry-phase processes.

Solid-phase bioremediation
Solid-phase land treatment is a managed technology that involves controlled application of a waste on the soil surface and the incorporation of the sludge or contaminated soil into the upper soil layer. Land treatment technology relies on the dynamic physical, chemical and biological processes occurring in the surface soil. As a result, the constituents in the applied wastes can be degraded, immobilized or transformed to environmentally acceptable components.

Both surface soil and on-site land treatment processes are common among the bioremediation technologies. Surface soil land treatment bioremediation involves: (a) keeping contaminated surface soils in place; (b) if needed, adding nutrients to assure adequate biodegradation and adjusting the pH toward neutral conditions; (c) tilling the soil to increase the availability of oxygen and nutrients to the soil microorganisms; and, (d) possibly irrigating to assure adequate moisture for microbial degradation.

The rate and extent that the organics in the soil are lost depend on the combined effects of volatilization, sorption and biological degradation. Both degradation and sludge requiring bioremediation to minimize transportation costs and to provide better management of the process. Except for the fact that the on-site unit is constructed above ground, the fundamentals and operation of the on-site unit are the same as for the surface soil unit.

Both surface soil and on-site land treatment systems have been used successfully to bioremediate contaminated soils at spill sites, industrial wastes, in surface impoundments and lagoons.

Slurry-phase processes
Liquid-solids treatment systems are slurry-phase bioremediation systems operated to maximize mass transfer rates and contact between contaminants and microorganisms capable of degrading the contaminants. Because the processes uses reactors, much less area is needed for this on-site remediation process than for land treatment. An advantage of liquid-solids systems using tanks is that regulatory concerns related to the contamination of groundwater may be eliminated.

Liquid-solids treatment is analogous to conventional biological suspended growth treatment such as activated sludge. These units are designed to relieve the factors commonly limiting microbial growth and activity in solid-phase systems, principally, the unavailability of carbon sources, inorganic nutrients and/or oxygen. To achieve this goal, contaminated soil

Raymond Loeb, Ph.D., is a professor at the University of Texas-Austin, specializing in environmental and water resource engineering.

10 May-June 1991 Soils
or sludges are added to water, mixed and aerated. The mixing and aeration also prevent oxygen transfer limitations.

Mixing can be provided by aeration alone or by aeration and mechanical mixing. Aeration is provided by floating or submerged aerators or by compressors and sparges. Chemicals added to liquid slurry reactors can include nutrients and neutralizing agents.

Liquid-solids systems are a relatively new approach for the remediation of contaminated soils and slurries. These systems have been used for the treatment of wood treating, coal-tar and petroleum sludges. The most frequently used process configuration is a simple batch reactor system. The reactor can be an aboveground tank or an existing pit or lagoon.

Liquid-solids systems are suitable for contaminated sludges such as may be in pits, ponds and lagoons and contaminated soils for which land treatment is not feasible. The technology will treat organics such as polyaromatic hydrocarbons, naphthalene, phenols, benzene, toluene, xylene and ethylbenzene. The degree of treatment of a chemical is a function of its solubility in water and its rate of biodegradation.

Extremely contaminated soils and sludges with high oil and grease concentrations (over 30 percent) may create mixing and phase separation problems as well as require extended treatment times.

Because of the mixing and aeration in these systems, volatilization is a significant factor in the removal of organics. Monitoring and management of the gaseous emissions may be necessary at locations where air quality concerns are a factor.

The rate of degradation in both solid-phase and slurry-phase bioprocesses is governed by the mass transfer of organics from the solid phase to the aqueous phase and biodegradation of the aqueous-phase organics. Important design considerations to properly apply liquid-solids systems are:

- physical characteristics of the contaminated soil or sludge;
- the nutrient, temperature and oxygen requirements to achieve optimal biodegradation;
- solids and hydraulic residence times to perform adequate treatment and meet the performance criteria;
- the characteristics of the offgas;
- the degree of mixing energy required to keep the solids in suspension.

There are several bioremediation systems that can be used for contaminated soils and slurries. The benefits of such systems are degradation and immobilization of organics, toxicity reduction, source control and pollution prevention and risk reduction. Both solid-phase and slurry-phase processes are available and are being used with such materials.

Write 357 on inquiry card for more information.

---

**What is it, and where did it come from?**

**Someday you may be asked to clean up someone else’s spill.**

Often, in the mad rush to satisfy state or federal regulators, characterization and identification analyses are overlooked. After the regulators are gone, questions come up like: “Was it all ours?” or “Just how old was it?”

It is usually too late to ask these questions because all of the evidence needed (oil sheens, contaminated soils) has been removed.

Friedman & Bruya, Inc. are experts in the identification and fingerprinting of petroleum products. There are simple, inexpensive tests that can be run to provide information that can be used next year or the year after to figure just what was present and where it came from.

Call 1 - (800) 487-8231 for more information.

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Petroleum Product Identifications  •  Expert Witnesses  •  Soil and Water Testing

Write in 055 on inquiry card.
Thin-layer chromatography (TLC) is widely recognized as a qualitative analytical technique, but its quantitative capabilities have been overlooked. Refinements in the size distribution of the adsorbent particles, uniformity in the layer thickness and size of sample application has caused TLC to evolve into a "new" field called high performance thin-layer chromatography (HPTLC). This "new" field has begun to attract attention as a highly sensitive, precise, extremely rapid and inexpensive analytical technique.

TLC is best used to separate the compounds present in a sample extract into fractions containing compounds having a similar polar characteristic. The system can be designed to separate a sample so one can distinguish between saturated and unsaturated hydrocarbons. The unsaturated hydrocarbons can be further broken down into groups such as two- and three-ring aromatic hydrocarbons, four, five and six-ring aromatic hydrocarbons and greater than six-ring aromatic hydrocarbons. This ability to separate hydrocarbons based on their polarity enables one to identify the type of material.

Because of its ease of operation and low cost, TLC is ideal for rapid analysis of environmental samples for semi-volatile and non-volatile organic chemicals. It can be used as a field screening analysis to rapidly test samples for petroleum contamination. When the type of contamination is known, appropriate standards can be prepared and suitable quality assurance tests run to provide quantitative results. Where the identity of the contamination is not known, TLC can help identify the type of material present and help in the selection of appropriate tests to further characterize a product.

The procedure

Soil samples (five grams) are placed in a glass extraction vial. Soils with high water content are de-watersed by adding granular silica gel prior to the addition of the extraction solvent. Soil and silica gel are mixed to facilitate the adsorption of the water by the gel. The extraction solvent (five milliliters) of hexane, carbon disulfide or methylene chloride is added. Carbon disulfide and methylene chloride are superior when dealing with contaminants with high aromatic content, such as tars and asphaltic materials.

After agitation the extraction vials, an aliquot is spotted on the TLC plate. Standards of different materials or standards of a specific product at known concentrations are also spotted on the same plate. Blanks, duplicates and matrix spikes should also be prepared.

Plates are then placed in a TLC chamber along with the elution solvent. Hexane separates saturated hydrocarbons from the aromatic hydrocarbons. Methylene chloride results in the co-elution of the saturated hydrocarbons and the majority of the aromatic hydrocarbons, but allows for the detection of the more polar components such as oxidized hydrocarbons.

Following elution, spots are visualized with both short and long wave ultraviolet light, then stained in an iodine chamber. Comparison of the Rf levels of the contaminants to those of the standards confirms the types of materials present.

Interpretation of results

In its simplest form, TLC requires high level interpretation from the operator. The operator provides pattern recognition for tentative identification of analytes and comparative density measurements for determining contaminant concentrations. Densitometers and other mechanized or computerized equipment can remove some subjective interpretations.

Limitations of TLC center around its moderate reproducibility, moderate detection limits and moderate resolving capabilities. Variability between operators can be as high as 30 percent. Detection limits in cases where the aromatic content of a material is high can be near 100 parts per billion. It is often not possible to distinguish between similar products such as diesel and jet fuel, however, occasionally it is possible to see differences between the TLC chromatograms of different batches of a product.

It is best to run the samples and all quality assurance (QA) tests on the same TLC plate. This allows for direct comparison of the sample patterns and intensity to those of the standards. The QA tests should provide all necessary data to confirm that the important distinctions can be made. For example, if it is important to distinguish between 100 and 230 ppm diesel fuel, these standards should be run alongside the samples. If the operator cannot distinguish between these standards, they are then unable to make such a distinction when reporting quantitative results. The level that gives the highest level of safety should be used to report the data.

Duplicate samples should be run to confirm that comparable results can be obtained for the same sample. Matrix spike samples will assure the analyst that

---

James E. Bruya and Andrew J. Friedman are principals of Friedman & Bruya, Inc., Environmental Chemists, Seattle, Wash.

12 May-June 1991 Soils
added contamination can be found. Method blank samples can show that the contamination seen is not a result of the analytical method.

**Underground storage tank projects**

Following tank removal, or during excavation, soil samples can be analyzed by TLC for semi-volatile and non-volatile contaminants. Samples are first extracted into an organic solvent and this extract placed on a TLC plate along with a standard representing the applicable action limit.

After chromatographic separation, the intensity of the spots from the sample extract are compared to those of the standard. If the intensity of the spot from the sample extract is more intense than that of the standard, contamination levels exceeding the action limit are present and further activity is required. If the intensity is approximately the same as the standard, levels comparable to the action limit are present and further cleanup may be needed. If the intensity is less than the standard, levels below the action limit are present and further remediation activity may not be necessary.

One advantage of using TLC as a screening tool in the removal of underground tanks is its ability to distinguish among various petroleum products. Many sites contain fill material, some of which can contain asphalt, which is often a non-regulated waste. Standard analysis using EPA method 418.1 would indicate contamination by petroleum hydrocarbons. However, regulatory agencies generally exempt soils containing asphalt from cleanup criteria. TLC analysis can easily distinguish between asphalt and diesel or motor oil.

Further sampling could confirm the presence of asphalt or the absence of diesel or motor oil.

Occasionally, where a gasoline tank has overflowed, the gasoline has run down the side of the tank, dissolving the tar coating as it moves. The gasoline can then carry this heavy contamination into the soils surrounding the tank where the gasoline evaporates, leaving the tar behind. Again, TLC can identify the tar and variances in cleanup criteria can possibly be determined.

Where free product is found during an excavation, the material can be tested for identification. The results may confirm that the excavated tank had leaked or they may identify another source of the contamination.

Use of TLC as an analytical tool for petroleum products allows a field coordinator to monitor the progress of field activities. During investigative activities, TLC can identify the location of contamination. Because of its low cost, many sampling locations can be screened for possible contamination (PCBs, pesticides and/or petroleum products) and reduce the chance of missing localized hot spots.

Contamination plumes can be mapped and selected samples can be sent for confirmation. During excavation activities, TLC results can limit the amount of material removed for further remediation activity. The location of the contamination at the edge of the excavation can be quickly identified. Surrounding clean material can be removed and stockpiled. Contaminated material can then be removed and the excavation continuously checked to determine when all the contamination has been removed.

**Versatility**

During other remediation activities, TLC can quickly monitor the level of contamination to determine the effectiveness of the process and provide feedback to assist in process management. Bioremediation activities can be monitored to determine when contaminant levels are below action limits and confirmation analyses are required. TLC results can determine when the process has stalled and nutrients may be needed.

One area of great importance is the use of TLC as a tool to manage the analytical results that are returned by an off-site laboratory. Because the federal and most state programs require the use of only a single analytical method for the determination of specific contaminants, these programs ignore the possibility of analyst, laboratory and method errors.

For example, degree of contamination is often a function of the surface area of the particles. If one has two samples with identical masses, the sample with the greatest surface area will show the highest contamination levels. This means that by excluding large grain materials from a sample, the effect will be to bias the results to higher contamination levels. This bias can approach 10,000 percent when the small particles

---

**Continues on page 14**

---

**On Site Contaminated Soil Recycling**

Avoid the Landfill/Superfund Financial Liability

<table>
<thead>
<tr>
<th>PAHs</th>
<th>Virgin TPH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metals</td>
<td>Waste Oil</td>
</tr>
<tr>
<td>Solid Waste</td>
<td>Low Level PCBs</td>
</tr>
</tbody>
</table>

**United Retek Corp.**

1562 Washington St., Box 6057

Holliston, MA 01746

508-429-6220

508-429-6828 (FAX)

A National Leader in On-Site Soil Recycling Since 1987

Write in 056 on inquiry card.

May-June 1991 Soils 13
Try a little TLC, from page 13

are also highly porous. To manage this factor, the field operator can analyze a sample by TLC that is representative of the material present at the site. Any variation of the confirmatory results from this value can be evaluated. Quality assurance results from both sets of analyses can be examined. Sample sizes can be compared. Finally, if significant, unexplained differences persist, the sample extracts can be exchanged re-analyzed. TLC can be used with organic vapor analyzers to provide a rapid screening of samples. Vapor analyzers

---

**Characteristic TLC results**

**ASPHALT**

Often a residue from petroleum refining. Consists primarily of polynuclear aromatic hydrocarbons (PNA) and alkylated PNA, as well as highly polar compounds. TLC pattern, using hexane as the eluting solvent, will resemble an elongated teardrop stretching from Rf 0.0 to Rf 0.5 and will be visible under both short and long wave ultraviolet light. At high concentrations, this teardrop will extend from Rf 0.0 to 0.8 and at low concentrations from 0.0 to 0.2. This band is visible with iodine staining. A band at Rf 0.9 will sometimes appear which consists of saturated hydrocarbons left in the product.

**CRUDE OIL**

Crude oil consists of thousands of individual compounds. Major groups include saturated alkanes, alkenes, benzene, alkylated and aryl benzenes, polynuclear aromatics, naphthalene aromatics and hetero atom substituted alkanes, alkenes and aromatics. Different types of crude will show different ratios of these compound types. The TLC pattern, using hexane as the eluting solvent, will show a continuous streak stretching from Rf 0.0 to Rf 0.9. There is often a large spot at Rf 0.9 and a tail of material stretching to the origin. Portions of the tail will often be seen under short and long wave ultraviolet light and crude oils can often be differentiated using the ultraviolet pattern.

**DIESEL FUEL**

Diesel is primarily a mixture of saturated hydrocarbons and aromatic hydrocarbons (naphthalenes, anthracenes and phenanthrenes). Various types of diesel fuels will tend to have TLC patterns that are different from each other and can be seen in the aromatic portion of the TLC chromatogram. The ratio of saturated hydrocarbons to the PNA will vary from batch to batch. Heavier diesel fuels will tend to have higher levels of moderate and heavy PNAs. The TLC pattern, using hexane as the eluting solvent, will show two spots, one oval shaped with an Rf of 0.9 (hexane) visible with iodine staining and a second at about Rf 0.5 (hexane) visible under short wave ultraviolet light and iodine staining. Heavy diesel fuels will also contain material having an Rf of 0.3 to 0.5 (hexane) visible under short and long wave ultraviolet light, as well as iodine staining. The relative intensity of the saturated hydrocarbon spot to the aromatic hydrocarbon spot will vary from batch to batch.

**ENGINE OIL**

Most engine oils are petroleum based materials comprised primarily of saturated hydrocarbons. Their TLC pattern using hexane as the eluting solvent, will show one main oval shaped spot at Rf 0.9, visible with iodine staining. There may also be a faint tail stretching from Rf 0.9 to the origin Rf 0.0. Specific additives may also show up as individual spots on the TLC plate.

**USED ENGINE OIL**

As an oil becomes used, it breaks down to give a wide variety of oxygenated and aromatic hydrocarbons. The TLC pattern of used oil will resemble that of fresh oil with the added presence of these polar breakdown products. It will show a large oval spot at Rf 0.9 (hexane) visible with iodine staining and a thin streak stretching from Rf 0.9 to 0.0. Some heavy PNA with an Rf of 0.0 to Rf 0.3 may be visible under ultraviolet light. The ratio of saturated hydrocarbons to the aromatic hydrocarbons will depend on the degree to which the oil has degraded.
are widely used to provide information on the potential for contamination by volatile compounds. TLC can provide information on semi- and non-volatile contaminants. With suitable quality assurance testing, TLC results can provide detailed information on the identification and level of contaminants.

Write in 358 on an inquiry card for more information.

**GASOLINE**

Gasoline is a highly volatile product comprised primarily of light hydrocarbons, alkenes, benzene and alkyl substituted benzenes (toluene, xylenes, ethylbenzene). TLC analysis of this material is generally unsuccessful because most of the gasoline will evaporate from the TLC plate during the spotting procedure. Material that remains on the plate is residue and is often as little as 0.1 percent of the amount initially placed on the TLC plate. Gasoline contamination is easily detected by its odor. Using hexane as the eluting solvent, the TLC pattern may show two spots, one very light spot at Rf 0.9, visible with iodine staining, and comprised of saturated hydrocarbons. A second spot is sometimes seen at Rf 0.8 under short wave ultraviolet light and is comprised of benzene and the alkylated benzenes. This spot will disappear after a short time. Occasionally a sulphur band is visible with highly degraded gasolines and appears as a spot just below the saturated hydrocarbons and is visible with iodine staining.

**HYDRAULIC FLUID**

There are two general types of hydraulic fluid, petroleum based and synthetic. Petroleum based materials are comprised mostly of saturated hydrocarbons. Specific additives are generally added to the base material. The presence and amounts of these additives varies by manufacturer and by batch. The TLC pattern, using hexane as the eluting solvent, will appear as a single large oval spot at Rf 0.9 with iodine staining. The additives will appear as smaller spots with an Rf from 0.1 to 0.8. Some of these spots may be visible under ultraviolet light as well as with iodine staining. The synthetic hydraulic fluids are often esters and can appear as single spots. Additives will show up as single spots. The TLC pattern of synthetic oils will often show up as a single spot with an Rf between 0.8 and 1.0.

---

**CHAMA Drilling Systems**

CHAMA manufactures hydraulic drilling attachments for your pick-up truck, skid loader, backhoe, or boom truck, to provide versatile, economical, customized options for observation / monitor well drilling.

CHAMA Screen Placement System puts the flyinging inside...

Maintains

"Displacement Integrity"

- One step installation with a borehole that fits the O.D. of well casing
- Eliminates borehole collapse
- Vertical, diagonal or horizontal drilling capabilities for maximum versatility
- Ability to drill in confined areas
- Enclosed auger with 2" tapered cutting edge (for a 4" well) as the only exposed moving part
- Installs 2", 4", 6", or 8" diameter wells
- Installs cathodic protection (bag or canister)
- Manually removable/ adjustable well seals
- Spill recovery capability
- Undisturbed soil sampling options
- Various boring/digging jobs to 36" dia.

CHAMA ALSO SUPPLIES:

- PVC SCREENS
- INSERTA-PLUGS
- TOP LOCKS AND LABELS
- HOLLOW STEM AUGERS
- SOIL SAMPLING KITS

For more information, CALL:

CHAMA 800/232-4262

INDIANA 219/672-2082

Write in 044 on an inquiry card.

May-June 1991 Soils 15
AEHS promotes soil awareness

January 1992 target date for association’s peer review journal

The Association for the Environmental Health of Soils (AEHS) is a clearinghouse for discussion of technical and regulatory information on soil issues, including chemistry, geology, hydrogeology, engineering, modeling, toxicology, regulatory science and the law.

January 1992 is the target date for the first peer review journal from AEHS. In addition to the journal, the association produces a semi-annual newsletter, bibliographies and offers members discounts on scientific books and other publications.

AEHS was formed in September 1990 by Paul T. Kostecki and Edward J. Calabrese, of the University of Massachusetts-Amherst.

“AEHS recognizes that the eventual solutions to the challenge of contaminated soil can only be found through the proper integration of sound scientific disciplines within the context of societal and political judgement,” says Kostecki.

“As the first devoted exclusively to issues of contaminated soils, our organization is responding to a very high interest level,” Kevin Loughrey, executive secretary, says.

“We are negotiating with other publishers of scientific works to develop the most complete source center available for soil contamination information,” says Loughrey.

Plans for national and international workshops, seminars and conferences are also underway.

“We are delighted with initial response to the formation of AEHS,” says Loughrey. “An unexpectedly high percentage of our membership consists of company presidents and executive officers, as well as technical people—middle managers and project managers.” Within the first six months, the association has attracted over 250 members from federal and state government as well as industry.

The utility industry has been especially supportive with the Edison Electric Institute’s Utility Solid Waste Activities Group and Wisconsin Power and Light becoming the association’s first benefactors.

“The value of such monetary support in these initial stages of the association’s development cannot be overstated,” says Kostecki. “But aside from the money, these groups will form the foundation of AEHS.”

“Because of our many activities in the soil contamination arena, I receive ten to 25 phone calls each week from all sorts of people who are seeking information,” says Kostecki. “For example, I have received a call from the mother of an 8th grade student who needed information for a class project. On the other end of the spectrum, I have received inquiries from the environmental minister of Mauritius, a country on the west coast of Africa.”

AEHS welcomes membership and inquiries from anyone interested in soil contamination. Annual dues are $50 for an individual member. Student, lifetime and corporate memberships are also available.

Association headquarters are in Amherst, Mass.

Write in 359 or inquiry card for more information.
ALLIED ENVIRONMENTAL SERVICES
...YOUR SINGLE SOURCE FOR ALL
PETROLEUM CONTAMINATED
SOILS REMEDIATION

- INCINERATION - TRANSPORTATION - RECYCLING

- Site Supervision  - Immediate Quotations  - 24 Hour Approval
  - Offices in Principal Cities.

Call 1-800-969-DIRT

Write in 082 on inquiry card.
American ingenuity is alive and bulging out of mail sacks in the office of Robert Hiltbrand, Ph.D., at the U.S. Coast Guard Office of Research and Development in Groton, Conn. Hiltbrand responds to all the creative ideas and suggestions Americans have for cleaning up oil spills. Immediately after the Persian Gulf spill, Hiltbrand fielded some 40 letters per week, but now, that number has reduced to a trickle of two or three a week. Still, Hiltbrand answers them all—some 800 in the last 18 months, since the Exxon Valdez spill.

“We welcome ideas from anyone,” Hiltbrand says. The suggestions tend to fall into categories: dispersants, absorbents and what might be called engineering hardware.

“So many have ideas that work in a bucket, or on a small scale, but have no concept of how it would be applied on the huge scale of the wave action in the ocean,” Hiltbrand says.

“And, according to the National Contingency Plan, you cannot sink the oil. This weeds out a lot of the suggestions,” Hiltbrand adds. The oil will sink by itself as particulate matter from sandstorms weighs the droplets.

Among the more interesting absorbents suggested are corncobs and chicken feathers. “Corncobs are a great absorber,” Hiltbrand says. A problem with the absorbent category is the shortage of good suggestions of what to do with millions of oil saturated corncobs, or with several million tons of oil
saturated chicken feathers.

Some people try to suggest ways to squeeze out and reuse the oil from the absorbent. Others suggest burning or burying the mess. But just moving the spill from one place to another is not necessarily a solution.

One visitor to Hiltabrand's office was so determined to demonstrate the effectiveness of his absorbent, he brought in a glass tank and filled it with oil. The absorbent worked perfectly. Then, the visitor announced the absorbent would also clean oil from the coats of animals and pulled a live guinea pig from a box to dip in oil for that demonstration. Hiltabrand and his supervisor did stop the visitor before he could saturate the animal. The result of the visitor's demonstration was a glass tank full of oil that posed a hazardous waste disposal problem for Hiltabrand and his staff.

Hiltabrand and the Coast Guard research and development office encourage people with innovative ideas to write. The department tries to protect proprietary information by warning people that under the Freedom of Information Act, anyone could petition for the department files. "So don't tell us what you don't want people to know..." warns Hiltabrand.

Hiltabrand estimates some 15 percent of all natural absorbents proposed is clay, making it the most popular suggestion. "Clay has the highest surface area of any natural material known. Some plans propose adding chemicals to it to increase the absorbency even more," Hiltabrand says. The drawback is the original problem of sinking the oil. "The trick is to find a way to keep it from sinking," says Hiltabrand.

Lard and butter are popular suggestions. Hiltabrand says of all the over 800 letters he has received, the one that comes to his mind first is the sincerity and earnestness of a West Virginia homemaker who wrote to suggest that lard would attract the oil out of the sea. Hiltabrand says the woman's suggestion came from her efforts to launder the clothes of her husband, who worked in the oil fields.

According to scientific information on volumes, it would take some five million gallons of butter to collect the Persian Gulf spill. Not many good suggestions are flooding in on how to dispose of five million gallons of butter congealed with oil. And, "how are you going to apply it? What are you going to use, a knife?" asks Hiltabrand.

Another category is from people with some ambitious or dramatic inventions to cope with the spill. These have to do with "Buck Rogers things" to patch holes in tankers with stickum or coagulating the oil into a solid gel in the water. Many involve cannons that shoot nets or other devices out over the spill. And certainly there are those who offer the spectacular in situ approach of burning the oil from the sea with napalm or flame throwers to ignite the blaze. The Coast Guard is working with the Environmental Protection Agency and Minerals Management to develop plans for experimental burns to collect data on pH, toxic fumes, plume density, ignition and extinguishing.

Many writers focus on prevention. Indeed, according to Hiltabrand, prevention research attracts more funding than cleanup technology. A most popular suggestion is double hulls for ships and tankers. Better vessel traffic systems is another offered by retired sailors, naval engineers and others who have written.

Testing some of the ideas is a problem. Cleanup technology is expensive and there are few customers. Industry is reluctant to spend money for methods that may be used rarely, if ever. A testing facility is scheduled to open in mid-1991 outside Edison, N.J. It is an enormous saltwater tank, about the size of a football field, in which some of the booms, skims, patching devices and the like will be tested.

Write in 365 on inquiry card for more information.
Cost-saving Investigative techniques

Remediation steps can be taken during closure activities

By Joseph Berlin and Michael Jantz

Underground storage tanks (USTs) are being removed throughout the United States for a variety of reasons: they are too expensive to keep underground because of the costs to maintain and comply with state and federal laws; the potential liability of negative environmental impact is great; owners are required to remove on-site USTs to sell or transfer property.

No matter the reason to remove an UST—first on all owner or operators' minds is the cost. Second on their minds is time, especially in land transfers when loan approval often hinges on a "clean" closure.

Often, owner operators plan a tank removal as just a removal, even though the fact the majority of USTs leak—up to 80 percent by some estimates. Of over 100 UST removals we have managed in the past three years, over 90 percent had some type of documented release.

Many owners hire both a contractor to remove the USTs and a consultant to monitor the activities, collect verification samples and document the closure. If a release is documented during removal,

Joseph Berlin is an engineer and Michael Jantz is a project engineer for WW Engineering & Science of Grand Rapids, Mich.

... work must stop until decisions are made on the next steps. This usually causes the contractor and consultant to demobilize. Additional costs soar as schedules are interrupted.

In some cases, the contractor is instructed to remediate by removing soils. The excavation is usually left open and decisions delayed until laboratory results are in hand—often a month or more. This approach, known as the "dig and haul" method, is regarded as the most time efficient. However, "dig and haul" may not be the surest way to remove all contamination. And, in cases of extensive soil removal and disposal, it may not be the most cost-effective remedial option either.

Closures of USTs generally fall into three categories:

• "Clean" removal of an UST with no detection of impact to the environment.
• "Minimal impact" limited to soils in the excavation zone.
• "Extensive impact" to soils in excess of the excavation zone and/ or impact to groundwater.

If consultants knew which of the three categories an UST closure would fall in before removal started, they could orient a cost-effective, time-efficient work plan. Because it is never possible to know, "what if..." preplanning is critical.

• What if contamination is encountered? Do we have authorization to proceed with reporting requirements and removal?
• What if contamination is massive? Do we continue excavating?

Although many owners do not want to think in terms of the "worst case" the consultant or contractor must be prepared and at least try to educate the owner.

To be cost-effective and time-efficient, every UST removal work plan should have contingencies that allow immediate implementation of corrective action measures.

In a "worst case," once a release is documented, the owner needs to submit a work plan to determine the horizontal and vertical extent of contamination and a corrective action plan to the regulatory agency. With preplanning, a consultant can include many of these tasks with the original UST removal work plan.

A removal work plan would include a contingencies option with the cost of UST removal if contamination or a release is discovered. It should include the cost to prepare:

1) initial response notification
2) initial abatement measurement reports
3) initial site characterization report
4) free product removal report

Continues on page 35
We’re Helping Clean Our Environment From the Ground Up.

Soil Purification Incorporated (SPI) is a company dedicated to ridding our environment of oil contaminated soil. Permitted in several states, SPI can process soil on-site, or at one of two off-site facilities. Self-contained, portable SPI plants can be up and operating in as little as three days and can process up to 60 tons of soil per hour. SPI handles soils contaminated with gasoline, kerosene, diesel and jet fuel, as well as #6 fuel oil. SPI can process soil to less than 5 ppm total hydrocarbons. No other soil purification company provides the broad range of services offered by SPI. To find out how SPI can help you, call or write today.

SPI...The Natural Choice.
Tank closure

Caution: Tank removal can be fatal

Petroleum vapors regenerate even in old or abandoned tanks

Many people underestimate the potential dangers and complications of removing old tanks.

Item: A Snellville, Ga. man died April 17, 1990 when a 10,000 gallon underground gasoline storage tank (UST) exploded at Dry Storage of Georgia. The tank was declared safe one-half hour before the explosion occurred. The worker was a five-year employee of Westinghouse Environmental and Geotechnical Services, a company that specializes in removing underground tanks. This was the third death in Georgia in less than a year’s time involving a tank closure.

Item: Two men were cutting the fill pipe from the top of a recently unearthed UST that contained a trace of water and some residual fuel. The metal saw sparked and ignited the gasoline vapors and caused an explosion. The blast blew the five-foot end off the tank. The flying metal disk traveled 20 feet and decapitated a co-worker.

Item: A 26-year old man was killed while emptying a tank inside a building in East Syracuse, N.Y. The tank exploded, blowing him through the roof of the building.

Item: A Milwaukee, Wisc. farmer died when a tank exploded while he was cutting it up with a saw. Sparks from the saw ignited fumes from fuel that remained in the tank.

Apparently, the dangerous, explosive characteristics of petroleum vapors in underground tanks are not clearly understood by everyone.

If UST removal were routine or easy or straightforward, it wouldn’t kill people. There are two particularly good guidelines in the industry for safe tank closure. One is the American Petroleum Institute (API) recommended practice 1604. The other is a program prepared by the New England Interstate Water Pollution Control Commission (NEIWPCC) of Boston, Mass., called, “Tank Closure Without Tears: An Inspector’s Safety Guide.”

Most UST removals involve flammable vapors from products stored in the tank and from accumulated residues left in the tank even after it has been pumped dry. It is important to understand that even though vapors are thought to be vented, a tank can continue to regenerate additional flammable vapors from product trapped in the sludge and walls of the tank. This is also true of an abandoned or scrap tank. Any vapor-freeing technique is temporary and must be continuously monitored and repeated as necessary.

The API recommendation cautions that when high concentrations of vapors are inhaled, dizziness, excitement or even unconsciousness can result. Benzene, a common component of petroleum, is linked to various human blood disorders. Tetraethyl lead is also commonly found in petroleum products and can cause diseases of the nervous system, kidney and blood.

However, the highest human health risk factor associated with UST removal/closure is in accidental death as a result of vapor explosion.

The NEIWPCC guide reminds workers that fires and explosions need three source points: fuel, oxygen and an ignition source. “Safe tank removal requires continuous attention to these three elements to eliminate the risk of explosion.”

The first step is to eliminate all potential sources of ignition (smoking, non-explosion-proof electrical and internal combustion equipment, use only non-sparking tools, secure traffic, locate and mark all utility lines on site).

Another less understood source of ignition is static electricity. Static electricity is generated by moving liquids, air or solids. Static results from liquid dropping into a tank during deliveries, liquid flowing through a hose from compressed gas or air released into the tank atmosphere.

Continues on page 26→
Thermotech Systems...

Soil Remediation Equipment
That's Setting Industry Standards!

Most Widely Used System
to Clean up America

Portable and Stationary Plants

Plants Available to Remediate 25 to
100 TPH of Soil Contaminated
with Petroleum Hydrocarbons

The Ultimate in Remediation Technology
with Over 50 Years of Thermal Process
Machinery Experience

THERMOTECH SYSTEMS CORPORATION
5201 N. Orange Blossom Trail - Orlando, FL 32810 • (407) 290-6000 • FAX (407) 578-0577
Write in O83 on inquiry card.
There is a lot of important information buried in this ad.

Because the environment is no longer a hidden issue, O/C Tanks – especially our double-walled Fiberglas® tanks – make more sense than ever.

**Fiberglas® tanks never rust.**

When steel tanks rust – inside or out – they can leak.

Fiberglas® tanks – first introduced by Owens-Corning 25 years ago – never rust. So they never leak from corrosion.

And all O/C double-walled tanks come with a 30-year warranty against structural failure.

**Double-walled tanks for our changing environment.**

As environmental concerns grow, local laws and codes are changing.

In fact, the American Petroleum Institute's guidelines recommend secondary containment for underground tanks when potable water wells or sole-source aquifers are within 300 feet of the tank.

In these environmentally sensitive areas, our double-walled tanks are the perfect solution.

And our standard double-walled tanks will not only
contain petroleum-based fuels, they are also recommended for methanol blends—even 100% methanol.

These units offer state-of-the-art containment in one single cost-efficient product. And to fully protect against potential leakage, O/C double-walled tanks actually monitor themselves.

Continuous precision testing. All O/C double-walled tanks come with a hydrostatic monitor.

This provides continuous monitoring and precision testing of both inner and outer tank walls, and can detect a leak as small as 0.05 gallons per hour. No other underground petroleum storage tank can give you more protection.

Fiberglas* double-walled tanks protect the environment, reduce liability risk, and make sense in a changing world. With O/C Tanks, you won’t bury a mistake.

For more information, call 1-800-OC-TANKS* (1-800-628-2657) or clip the coupon below.

A SUBSIDIARY OF OWENS/CORNING FIBERGLAS

Protect us from costly clean-ups and liabilities from rusting, leaking tanks.

☐ Send me a copy of O/C Tanks’ “Underground Tank Protection Kit.”
☐ I can’t wait that long. Have a salesman call me immediately.

Name__________________________

Company________________________

Address__________________________

City__________________________State__________________________

Zip__________________________Phone__________________________

Send to C.K.M. Meeks, O/C Tanks Corporation, P.O. Box 10025, Toledo, OH 43699-0025.

Write in 053 on inquiry card.
Caution: Tank removal, from page 22

It is important to provide a conductive path for the continuous, safe discharge of static electricity by bonding or grounding equipment and vehicles. Equipment is bonded by connecting it with a wire to something that is grounded. Equipment is grounded by connecting it to the earth.

One particular cautionary point made by NEIWPCC is that plastic (PVC) pick up tubes on the stripping lines of vacuum trucks are especially prone to accumulating static charges.

Purging the tank helps control the fuel source point of the fire/explosion triangle. Purging (ventilating) the tank replaces or dilutes the flammable vapors with air. Inerting the tank displaces the oxygen in the tank with a non-reactive gas such as nitrogen or carbon dioxide to control the oxygen sources point of fire/explosion.

There are two basic purging techniques. In the first, a diffused air blower pumps air (not to exceed five psi) into the tank through the extended fill pipe (drop tube). Since petroleum vapors are heavier than air, air must be introduced as low into the tank as possible to stir up product vapors sufficiently so they move upward and out of the tank.

The other technique is to use an eductor-type air mover, often driven by compressed air, to draw vapor out of the tank and fresh air in.

Exhaust fumes from purging should be vented at a minimum height of 12 feet above grade and three feet above any adjacent roof lines. The atmosphere at ground level should be tested periodically while purging is in progress to be sure vapors are being vented into the upper atmosphere and not collecting at ground level.

Again, purging is a temporary process. Product trapped in bottom sludge and wall scale regenerates flammable vapors inside the tank, in the excavation and at ground level—especially near the vent.

It is necessary to test with a combustible gas indicator (CGI) to measure the concentration of flammable vapors when purging.

Readings from most CGIs or explosion meters give the percent-age of the lower explosive limit (%LEL) of the vapors present in an atmosphere. For example, gasoline’s flammable range is 1.4-7.6 percent by volume in air; thus 1.4 percent is the LEL for gasoline. Below 1.4 percent, not enough fuel vapors are available to burn.

When purging a tank, the goal is to reduce the concentration of flammable vapors to zero or as close to zero as possible. The lower reading gives more margin of safety in the time it will take for flammable vapors to regenerate. CGI readings of ten to 20 percent are considered to be practical target readings within the petroleum industry.

Inerting reduces the concentration of oxygen in the tank, commonly by introducing either carbon dioxide or nitrogen gas.

Carbon dioxide gas can be generated by crushing and distributing dry ice evenly over the greatest possible area in the bottom of the
tank before the openings are plugged.
Or, nitrogen gas can be pumped into the tank from a hose that passes through the fill hole to the bottom of the tank. Nitrogen is lighter than air, so its introduction low in the tank is essential. Bonding or grounding the nozzle to prevent static build up is recommended.

Of the two methods, use of nitrogen gas is more expensive than using dry ice, but the nitrogen gas distributes inert gas more evenly.

NEIWPCC cautions it is important to understand that inert gas (whether CO2 or nitrogen) does not “neutralize” flammable vapors—the inert gas only displaces the oxygen. Vapors will still present an explosion hazard if oxygen is reintroduced into the tank—which could easily occur if all holes are not effectively plugged.

Some flammable vapors will be displaced by inert gasses and so exhaust fumes should be vented as in the purging technique—at least 12 feet above grade and three feet above any adjacent roof lines.

To test the effectiveness of the inerting procedure, an oxygen indicator is used. When inerting a tank, the goal is to reduce the oxygen to below the level necessary to support combustion. The theoretical limit below which combustion will not occur is 11 percent oxygen. Most petroleum products need at least 12 to 14 percent oxygen by volume for combustion. Oxygen readings of one to ten percent are safe for most petroleum products. A more conservative safety rule of thumb is to target a reading that represents 50 percent of the lowest level of oxygen necessary to support combustion.

Bob Renkes, executive vice-president of the Petroleum Equipment Institute (PEI) in Tulsa, Okla., says “it is important to look for an experienced contractor. The lowest bid doesn’t necessarily mean people know what they’re doing. People don’t understand how hydrocarbon vapors regenerate. I’ve heard stories about people who light a match inside a tank in order to see if there is gas left.”

Steve Klesic, vice president of Petroleum Industry Maintenance of Sewickley, Pa., agrees. “There are a lot of fly-by-night or unknowledgeable people out there who don’t know what they’re doing. A typical excavator does not know the hazards. The safest thing is to try to get a PEI member contractor.”

Also, people often underestimate the complications involved in disposing of an old tank. On-going liability for the content and consequences of a tank make disposal options important. API cautions that tanks with internal linings or external coatings may not be accepted by scrap processors.

Klesic says as far as he knows, his company has the only permanent facility in Pa. that disposes of tanks for clients. They steam clean old tanks at their facility, scrape out the petroleum sludge and package it for processing, then cut the steel tank for scrap to be recycled.

Write in 361 on inquiry card for more information.

---

The new choice for Soil Remediation

MOBILE RECLAIM, INC.

See us at Booth #1516 at HazMat International 1991
June 12-14 in Atlantic City.

For further information please call or write
Mobile Reclaim, Inc., 3615 NW 13th St., Gainesville, FL 32609
(904) 373-4614, Fax (904) 373-4628

* 25 Tons/br * Gasoline, Diesel Fuel, Aviation Fuel, Kerosene * 2 hr Set Up *

Write in 097 on inquiry card.

May-June 1991 Soils 27
A remote monitoring system is an innovative tool that gives an environmental manager or staffer the ability to manage one or many systems virtually on-site—without leaving the office. It doesn’t matter where in the country the site is, as long as the telephone company can get a standard telephone line to it.

An environmental manager spends a large percentage of his or her day “monitoring”—just keeping track of government regulations is a full time job—so frequent trips to check sites can easily add up to a 200 percent day. Remote systems lessen this load.

Or, if a company adds to staff to operate and maintain remote sites, personnel costs can soar, while frequent trips are still necessary for training and management.

It is not a matter of deciding whether or not to run monitoring systems: regulatory agencies require periodic reporting of information, results, progress and statistics from contaminated sites. For these reasons, growing numbers of companies are turning to computer-based remote monitoring systems for efficient, cost-effective site monitoring.

At a corporate office in Pittsburgh, Pa., a manager types a command on an IBM PC-compatible computer and within a minute is looking at a real time (as it happens) graphical picture of the operation of a remediation site about 60 miles outside Little Rock, Ark. The screen shows a drawing of a well containing a pump. As the water level in the well rises, the screen shows a blue region, representing the water, rising proportionally. Next to it is a number indicating the water level in inches. As this value reaches a preset number, the pump on the screen changes color, indicating that the real pump has started. The drawing of the pipe on screen turns blue to represent actual water flow at the site.

With a few keystrokes, another screen displays a report of the past 30 days of accumulated flows from that well. A touch of the print button generates a hard copy of the report from the printer.

Then, with a few more keystrokes, the screen displays current data from a site in northern Minnesota.

Later, the manager receives a phone call. From the other end, a computerized voice announces, “This is station number three—group seven—alarm.” Station three is an automatic phone dialer on a site in Virginia. The manager pulls up that site on the computer and takes a quick look at the overall process before going to the “Group Seven Alarms” screen where the alarm is pinpointed to a specific aspect of the system. Since this alarm is not critical, the manager calls a contracting firm located near the site and arranges to have them diagnose and repair the problem within the week.

Next, a high water alarm is called in from a west coast site. When the manager checks this site on screen, the on-site rain gauge registers an unusually high amount of rainfall. The manager resets thealarm, the water is pumped down to a normal level by the next day and the system continues to function normally.

Though this scenario demonstrates how remote monitoring can be used effectively for a number of scattered small sites, a system can also be useful to someone managing just one remote site. It is often used to monitor automatic, unattended sites, or as a backup to monitoring by local personnel.

Remediation systems are excellent candidates for remote monitoring because of their need for effective continuous performance.

One picture being, as they say, worth a thousand words, the graphic display is easily understood. Any value that can be measured electronically at the site can be displayed remotely on a graphic screen. This can include well levels, instantaneous and cumulative flows, temperatures, pH, pressures, counts, equipment on/off status or any other process variable. The display can be in the form of simple text, a tank which actively fills or empties, a simulated round needle gauge, a vertical thermometer-style gauge, or combinations of these and others. All sensors are tied directly to the programmable logic controller and used for control of the system, displays and/or record keeping.

Another useful feature of remote monitoring is its reporting capability. A continuous record of a site’s activities and performance is kept in these systems so instantaneous or historical data can be displayed on the computer in the form of a report. One keystroke can generate a printed hard copy, which can serve as an accurate and time-saving submittal to meet regulatory requirements.

And, the system can instantly generate a computer data file that can be imported directly to industry-standard spreadsheet or data-

Randall D. Seavers is a project electrical engineer and systems administrator for R.E. Wright Associates, Inc., an environmental consulting firm in Middletown, Pa.
Colorful screens display real time site conditions.

base programs for manipulation and advanced reporting.

Remote monitoring systems are available now and are being used as an effective management tool by a number of American companies. Such systems can greatly reduce the time it takes to generate reports and eliminate many unnecessary trips to sites to read gauges, reset non-critical faults, or just check up on systems.

If a situation does arise that demands immediate attention, the system offers the manager the advantages of quick notification, and the ability to know enough about: the nature of the problem to assure maintenance personnel can arrive at the site better equipped to perform corrective action.

By eliminating some trips and making necessary trips more efficient, great improvements in cost and time management are realized.

When considering the addition of a remote monitoring system to an existing site, or building one into a new site, add airfare, car rental, lodging and other travel costs saved to the savings in on-site personnel to see how quickly the remote monitoring system can pay for itself.

Write in 362 on inquiry card for more information.

Soil Reclamation—safe and economical
with Midland Portable Cold Mix Plant

FAST ON THE JOB...

- Contaminated Soils
- Cold Mix Asphalt
- Cold Recycling
- Blend 2 Aggregates
- Soil Stabilization

Featuring
- All Hydrostatic Drives
- Rugged Tubular Frame
- 200-700 Tons Per Hour

FAST TO THE JOB...

Making both large jobs and small jobs more profitable!

Call Today 1-800-2 GET-MMC
(800)243-8662

"The most portable pugmill available anywhere,"

MIDLAND MACHINERY CO., INC.
101 Cranbrook Ext., Tonawanda, NY, USA 14150

Write in 081 on inquiry card.
Choosing a laboratory

What makes a good lab good?

By Susan Parker

A n immediate response to a release of petroleum product into the soil is to seek analytical laboratory testing to characterize the contamination. Not surprisingly, finding a reliable, economical laboratory facility can be a complex process.

Because of the liabilities and expenses involved with a contamination event, finding a reliable analytical laboratory is just as important as finding reliable contractors to execute the clean up.

In the past year, the Environmental Protection Agency (EPA) has suspended five sample analysis laboratories for falsifying test reports and one for submitting fraudulent data. One lab tested samples containing volatile organic compounds after the government’s ten-day deadline had expired, then backdated the documents. This discovery has shaken the reputation of test laboratories and the validity of thousands of Superfund site analysis results.

In today’s litigious climate, it is imperative to know all lab work is defensible in court.

According to D.J. Carty and J.F. Artiola of K.W. Brown and Associates, Inc. of College Station, Texas, analytical results often differ when split samples are analyzed by different laboratories. Possible causes for these differences include: (1) differential sample preparation, (2) subsample, technician, procedural, standard matrix and instrumental variations, (3) inaccurate documentation and calculation, (4) inadequacy, misunderstanding or misuse of quality assurance/quality control (QA/QC) protocol.

Connie Van Dyke, supervisor of the chemical analysis section in the Missouri Department of Natural Resources, fields numerous requests for information from consumers. Along with Phillip Clark, a chemist in the department, Van Dyke says the first step toward choosing a lab is to verify they use appropriate Environmental Protection Agency (EPA) methods.

David Pease, president of Resource Analysts, Inc. of Hampton, N.H., says a quick way to know if a lab is up to speed on EPA methods is to ask, “What deliverables do you normally provide?” If there is any puzzlement or hesitation over that question, proceed with caution.

At ABB Environmental Services, our bioremediation expertise provides innovative solutions.

Take advantage of ABB Environmental Services’ experience designing and implementing cost-effective bioremediation programs. Our programs have successfully addressed soil and groundwater contamination resulting from petroleum hydrocarbons, coal tar, wood-treating wastes, chlorinated solvents, and chemical mixtures.

- Site Investigations
- In Situ Aquifer Restoration and Vadose Zone Treatment
- Onsite Treatment of Contaminated Soils
- Fate, Transport, and Treatment Simulations
- Field and Laboratory Analysis

Focused on Solutions.

ABB Environmental Services, Inc.
Bioremediation Systems Division
Corporate Place 128
107 Audubon Road • Building III • Suite 25
WAKEFIELD, MA 01880
617/245-6606 • 617/246-5060 (Fax)
Offices in the United States

Write in 037 on inquiry card.

30 May-June 1991 Soils
“Deliverables” is the EPA term for “report.” If personnel aren’t familiar with this elemental fact, beware.

There is no clear national certification for laboratories. There are over 75 individual accreditation and certification programs. Some states have a certification program.

California’s is the most comprehensive. Texas has none. Kansas stopped certifying labs four years ago to minimize their legal liability.

Perhaps the closest to a national statement about labs is the EPA sponsored Contract Laboratory Program (CLP) for Superfund contracts. This is not a certification program, nor an endorsement of any kind. This is simply a group of some 100 labs across the U.S. who hold contracts to perform work for the federal government. Yet, in spite of the EPA position that CLP labs are not in any way certified by EPA, there is unavoidably a certain prestige associated with a CLP lab.

The EPA does have a water supply performance evaluation and a water pollution standard labs can achieve.

The American Association for Laboratory Accreditation (A2LA) uses the International Standards Organization Guide No. 25 to certify labs who ask for certification. Under this program, a lab has to prove it uses certain calibration procedures, keep specified training records, meet equipment guidelines and generate certain levels of reporting.

The National Voluntary Laboratory Accreditation Program (NVLAP) is a program within the National Institute of Standards and Technology (NIST) within the United States Department of Commerce. Labs may also be asked to be certified under this body.

There are so many certification bodies, there is even talk of a group to “certify the certifiers.” The National Environmental Laboratory Accreditation Coalition (NELAC), of Research Triangle Park, N.C., is working to consolidate a national program into a single model so data users would have a reliable

**CONTINUES ON PAGE 44**
The Affordabe Manufacturer

Asphalt Drum Mixers, Inc.

ADM has recognized what you needed and responded with what you wanted.

ADM REMEDIATING SOIL PLANTS
$200 billion, from page 7

wastes. Nine of the tanks show signs of leakage into secondary containment catch pans. There are also an estimated 24,000 drums in interim storage.

The hazardous and mixed waste generated by the Savannah River facilities are comprised of tritiated oil, sludge, mercury, lead, cadmium, silver, benzene, scintillation fluid, contaminated laboratory wastes, salts and salt cake, radionuclides, aluminum and transuranic waste.

There are five soil-related projects ongoing in 1991: cleanup of volatile organic compounds in saturated soil at Savannah, S.C.; cleanup of volatile organic compounds in unsaturated soil in Hanford, Wash.; cleanup of nonvolatile organic compounds in arid soils at Sandia National Laboratory, N.M.; cleanup of plutonium contaminated soil at the Nevada test site; and cleanup of uranium contaminated soil at Fernald, Ohio.

These projects will address scoping, site characterization, remedial action, closure and post-closure monitoring technologies.

The project at Savannah River for the cleanup or organics in saturated soil will develop and evaluate technologies for faster, better, safer and cheaper removal and destruction of organic contaminants from sites with saturated soil and groundwater.

The first phase was to perform a field demonstration of in situ air stripping, a process that combines vapor extraction and air injection. The process was tested using paired horizontal wells. The procedure consists of purging volatile contaminants from groundwater using a horizontal well installed below contaminated groundwater and removing purged materials along with residual contaminants in the vadose zone through a vacuum extraction horizontal well.

A preliminary, numerical multiphase model of the air injection process was developed in order to select optimum flow rates, frequency of data sampling and locations for the post-characterization boreholes. The entrapment of VOCs by low permeability layers was also investigated.

Many new directional drilling systems have been developed specifically addressing the needs of environmental restoration projects. In particular, the evaluations will include downhole mud motors and ultrasonic radius water jets.

Characterization technologies to be tested include discrete depth sampling using subcore analysis, cone penetrometer with sensors, cone penetrometer with soil gas and water sampler, soil gas surveys and surface geophysics.

In the in situ bioremediation test, indigenous microorganisms will be stimulated to degrade trichloroethylene (TCE) in situ by the addition of nutrients to the contaminated zone and by surface treatment of contaminated off-gas and water.

The horizontal wells that form the basis for the process are expected to provide increased surface area that will allow better delivery of nutrients and easier recovery of gas and water, as well as minimize clogging and plugging. The principal nutrient to be supplied is methane, at a low air concentration.

Following an initial methane injection, periodic addition of other nutrients, such as phosphate may be pursued to further stimulate the indigenous microorganisms.

Preliminary results from air stripping tests indicate that using a pressurized horizontal well below the aquifer, coupled with a reduced pressure well above the aquifer, will provide a significant gain and can be accomplished with excellent stripping efficiencies when compared to traditional pump and strip operations. Heated air will be injected into the pressurized horizontal well to measure the amount of enhancement as a function of temperature.

After heated air stripping, steam stripping will be tested as a mechanism to further enhance stripping efficiency. Data will also be taken for ambient air stripping, heated air stripping and steam stripping using fractured horizontal wells similar to...
$200 billion, from page 32

those designed for enhanced gas recovery.

A second bioremediation technology under development uses microbes that are immobilized on support material. "Super hydrophobic" materials are being pursued as mechanisms to efficiently separate non-polar (TCE) substances from hydrophilic material.

The DOE Office of Technology Development has also released a Robotics Technology Development program (in three volumes) to characterize the potential for remotely operated manipulators and other equipment to work at these sites. Given the toxic and radioactive composition of material at these sites, reduced human exposure becomes a matter of survival. In addition, automation of some repetitive tasks could result in increased speed and productivity of operations.

One company with a sharp eye on the DOE plans is Kraft Telerobotics, of Overland Park, Kan. Kraft is poised to offer several robotic applications to hazardous cleanup situations.

The key to their technology is force feedback which allows the operator to "feel" what is being held by the manipulator as it does its work. For instance, if the manipulator is outfitted to dig with a shovel, the pistol-grip controller resists the operator's hand with the weight of the dirt moved. Through the hand control, the operator can "feel" the weight of the load lifted. And, in excavation work, the control allows the operator to instantly "feel" buried objects such as utility lines, pipes and rocks.

Kraft’s remotely-operated, track-mounted excavator and material handling system, "Haz-Trak," uses force feedback technology to operate a backhoe shovel as well as barrel handling and other manipulative tasks. In the case of the thousands of DOE barrels in unknown degrees of deterioration, the Haz-Trak force feedback barrel handler actually allows the operator to apply the minimum force of grip necessary to pick up the barrel.

Brett Kraft, president of Kraft Telerobotics, says force feedback is not a new idea—it has been used for years in the nuclear power industry—but those systems were primarily mechanical, not electrical.

The hand controller to operate Haz-Trak is an intuitive system that instantaneously mimics the operator’s hand, wrist, arm and shoulder movements. "If you can move your arms, you can operate one of these manipulators," says Steve Harbur, director of product development for Kraft.

Haz-Trak is equipped with two fixed color cameras for peripheral vision and a single pan and tilt mounted color work camera. The operator of Haz-Trak sits at a carefully designed console station with three color monitors to provide a panoramic view of the work environment.

Task recall is an enhancement that enables the operator to "teach" the arm routine or repetitive tasks for playback execution.

Kraft's remote manipulator systems have been used extensively by the offshore gas and petroleum industry in remote-controlled minisubs that inspect and maintain the underwater structures of oil drilling platforms. "Undersea work is a very hostile environment for any kind of machine," Harbur says. "Our manipulators are built to withstand that kind of environment."

The system works so well underwater it is being used to recover millions of dollars worth of gold coins from the wreckage of a steamship that sunk off the coast of South Carolina during a hurricane about 150 years ago. The manipulator arms, mounted on a remote-controlled minisub, can reach out and pick up gold coins lying on the ocean floor 8,000 feet below the surface.

Kraft's force reflecting controllers will also be used as part of NASA's flight telerobotic servicer (FTS) program, which is now in the development stages. The end result of FTS will be what Harbur describes as a "robot astronaut" which will be used for assembly, maintenance and inspection in unpressurized areas of the space shuttle and a planned U.S. space station. NASA researchers are now using Kraft technology to evaluate some of the capabilities of state-of-the-art manipulators.

Kraft's technology is also being used in a futuristic power utility truck developed by Aichi Sharyo Co. Ltd., one of Japan's largest manufacturers of aerial lifts and special purpose vehicles for Japan's utility industry. Hydro-Quebec, one of the largest power companies in North America is also incorporating Kraft manipulator technology in a power line service truck.

But, according to Harbur, U.S. companies are taking a "wait and see" attitude, although Kraft is willing to license their technology to large U.S. manufacturers.

"What we need is to have a few big companies recognize the value of our manipulator system so they can be produced in quantity for all kinds of different applications," Harbur says. "Right now, our manipulators are being produced in small quantities, so they're fairly expensive. But if you build them in quantity, they become very cost effective. The larger the market opportunity, the cheaper things become."

Harbur says Kraft plans to deliver eight Haz-Trak units at a cost of $525,000 each over the next 18 months.

DOE's Hain says the OTD is looking for technology that does not yet exist to clean up the hazardous weapons production sites. The DOE wants private industry to develop partnerships with the government to address these challenges. Innovative companies like Kraft Telerobotics developing futuristic technology are needed to step up to the line to reclaim our damaged environment.

Write in 355 on inquiry card for more information.
5) soil and groundwater investigation work plan
6) limited excavation of impacted soil

A rule of thumb used to quantify a limit of impacted soil is to calculate the volume of soil in the excavation zone and add 50 percent.

The UST removal work plan should itemize the contingency costs so they are easily differentiated from the tank removal itself.

The most common method of investigation is the drilling of soil borings and placement of monitoring wells. Phase I investigations cost from $6,000 to $25,000. At $16 to $60 per cubic yard for disposal of impacted soil, a lot of soil can be dug and hauled for the same cost as an investigation.

To save time and money, there are two techniques to investigate and define the extent of contamination that can be used during the tank removal.

The four trench method is most effective in soils with low permeabilities. First, try to document a release prior to tank removal and submit a work plan for the investigation to the regulatory agency. The release can be confirmed by hand augering and collecting samples at each end of the UST. In this way, the release is confirmed so that methods to investigate and remediate contamination can be done during tank removal.

Determine the edge of the tank and define excavation zone limits by using the locations of fill lines and the size of the tank. Generally add three feet to the sides of the tank for calculating the volume of soil in the excavation zone.

Locate the four trenches, using the midpoints of the sidewalls. Define the horizontal and vertical extent of contamination by screening the soils removed from the proposed trenches. Typically limit the trenches to ten to 15 feet in length and 14 feet deep.

Calculate the volume of soil within the defined limit of the excavation zone plus the soil amount defined by the limit of the trenches.

Once the tanks are removed and contamination is found to extend beyond the excavation zone, the trenching begins. Samples are analyzed with a photoionization detector using a headspace test as trenching progresses. Once these samples are below detection limits, verification sampling can begin.

The verification sample procedure begins by steam-cleaning the excavator bucket to ensure the integrity of the samples. The samples are collected from the bucket using a sampling trowel to get a representative sample. These samples are then analyzed, on-site, if possible, using a field gas chromatograph. If cleanup criteria levels are met, the horizontal extent is determined.

If the extent of contamination is defined to be within the area defined by the trenches, this soil can be removed and disposed. If samples from the trenches are still

Continues on page 43

---

**When it Comes to Soil Gas Testing, We Can Get to More Places.**

![Image of a truck with the text: When it Comes to Soil Gas Testing, We Can Get to More Places.

Even a trace indication of subsurface VOC contamination can be the tip of a liability or groundwater contamination iceberg. That makes Enviroscan's unique soil gas testing service critical to you and your clients.

**Get to more places.**
Enviroscan's 4-wheel drive van is equipped with a specially designed probe driving unit. A one-man crew can take 15 to 20 gas samples a day — many more than is possible with manual probes. That means better quality samples, more samples per field day, and more quality data per project dollar. Analytical results can be available in as little as 48 hours.

**Get to lower detection.**
Enviroscan soil gas analysis is carried out to lower levels of detection than is offered by field-based instrumentation. Samples are collected in adsorption tubes and processed through a special thermal desorption/gas chromatograph system. It's done under controlled laboratory conditions by qualified chemists following stringent QC procedures for the most accurate, sensitive and reliable analysis available.

**Get to more VOCs.**
In addition to an analysis that detects contaminants down to sub-parts per billion, Enviroscan can also check for a much broader range of subsurface VOCs. Something most portable or field units just can't do.

No one can afford the potential cost of undetected subsurface contamination. So if you want to get the most from your preliminary site investigation dollar, ask about our soil gas testing services. Just call 1/800-338-7226 (SCAN) or FAX 715/355-3221.

**Environmental and Analytical Services**

303 West Military Road
Racine, WI 54474

Write in 086 on inquiry card.

May-June 1991 Soils 35
New system available to remove VOCs from enclosed areas

The new G3B1000 air purification system is designed to remove VOCs or odoriferous compounds from enclosed spaces, says the manufacturer, Carbtrol Corp., Westport, Conn.

For more information, write 367 on inquiry card.

Here and there on AC lines

A gas monitoring system has been developed for toxic and combustible gases which transmits the data from remote-mounted sensors over regular AC power lines, says International Sensor Technology (IST), Irvine, Calif.

The system provides monitoring for over 100 gases and has optional software that provides automatic calibration, data archiving, curve plotting and calculations.

For more information, write 369 on inquiry card.

Mobile Soil Remediation Unit from PEMCO

Petroleum Equipment offers new thermal treatment plant

A new Mobile Soil Remediation Unit (MSRU) is available from Petroleum Equipment Maintenance Co. (PEMCO), Portland, Ore. This thermal treatment plant uses a diesel-fired rotary kiln linked to a low-cloth-to-air-ratio baghouse and high efficiency afterburner, says the company. The kiln, baghouse and afterburner are all mounted on one trailer. A screening unit with belt scales feeds the MSRU. The feed rate is 12 to 20 tons per hour and the set up time is about six hours, says PEMCO.

For more information, write 370 on inquiry card.

JAVCO Inc. will assist you in meeting your remediation needs.

Our services include:

- Soil Borings
- Groundwater Monitoring Wells
- Soil Sampling
- Vapor Recovery Wells

We are a fully insured company. Our experienced crew has received the 40 hours of training required by OSHA 29 CFR 1910.120.

Javco Inc.
840 N. Ninth Street
De Pere, WI 54115
414-337-4990
800-236-1196

Write in 059 on inquiry card.

36 May-June 1991 Soils
The 5.5 pound, stainless steel/Teflon® centrifugal pump can be used for purging or sampling groundwater wells and has a variable flow rate from nine gpm to 100 ml per minute, says the company. It can be used in wells two inches or larger and has an operating depth of 250 feet, says Environmental Instruments.

For more information, write 371 on inquiry card.

**ECC offers seamless secondary containment system**

The ULC-2000, an under dispenser secondary containment system, is available from ECC & Associates, Orlando, Fla. This is a two component, elastomeric coating which cures by chemical reaction. The result is a monolithic seamless liner that conforms to all substrate irregularities. The product withstands temperatures within a range of -65° to 180°F and meets or exceeds all state and federal regulations for under dispenser secondary containment compliance, says ECC.

For more information, write 373 on inquiry card.

**Instant gratification?**

Fast results are what you get with this new soil gas analyzer. The portable gas chromatograph and total hydrocarbon analyzer uses preprogrammed calibration libraries to give instant, on-site screening, says Sentex Sensing Technology, Inc., Ridgefield, N.J. The battery-operated unit features a lap-top PC which stores the results on disk. The data collected can be printed or transmitted to a storage computer. Because the unit is computer controlled, it can be programmed to automatically detect UST leaks and fuel oil and gasoline spills and to perform site assessments and soil gas analyses, says Sentex.

Equipped with a photo-ionization detector (PID), it can sense thousands of compounds in the one ppb range, says the company.

For more information, write 372 on inquiry card.

---

**USED AND NEW EQUIPMENT FOR SOIL PROCESSING**

KILNS  DRYERS  BAGHOUSES  SCRUBBERS  CONTROL SYSTEMS  FEEDERS

We offer the nation's largest selection of soil processing equipment...new, used, rebuilt, standard or custom designed. Call us for immediate quotes on parts, major components or complete systems.

Gen-Tec®
12611 Townepark Way
Louisville, KY 40243

**CALL TOLL FREE 1-800-826-0223**
(Outside the U.S. and in Kentucky call 1-502-245-1977)

Write in 001 on inquiry card.

May-June 1991 Soils 37
AVOID ENVIRONMENTAL AND FINANCIAL DISASTER!

More than 1,000 cubic yards of soil was contaminated (see above) even though the UST passed periodic tightness tests. Frequent monitoring of petroleum vapors in the soil gas assures early detection and prevents such disasters.

Use KVA’s Fluted Rotary Heftly System for soil gas analysis
- First soil auger system available with pneumatic hammer
- Simple and inexpensive

Injests low cost
- Shield Points* (vapor monitors)
- Shield Screens* (product screens)

Soil gas and Water Sampling Kits are also available


Call KVA - the leader in soil gas sampling equipment

KVA
ANALYTICAL SYSTEMS
281 MAIN STREET - PALMOUTH, MA 02550
TEL: (508) 540-6561 FAX: (508) 457-9053

WEST COAST OFFICE
165 E. SAVARONA WAY
CARSON, CA 90745
TEL: (213) 724-6900 FAX: (213) 724-7656

For more information, write 375 on inquiry card.

Industry news

Earth Tech makes appointments
The Earth Technology Corp., Long Beach, Calif., recently announced two appointments.
Michael H. Novak was named president of Alternative Ways, Inc., a wholly-owned subsidiary of the Earth Technology Corp., Bellmawr, N.J. He will also serve as senior vice president of the corporation. Novak will be responsible for corporate development, strategic planning and overall operations of the subsidiary.
Samuel R. Rothermel was appointed senior hydrogeologist at Earth Technology’s Portland, Ore., office. Rothermel holds a master’s in geology from the University of Arkansas. He is a certified ground water professional and professional geologist and has published professional papers and two research books in hydrogeology, hydrochemistry and ground water contamination, says the company.

Law Environmental elects new VP
Dale H. Twachtmann has been selected as vice president of Law Environmental, Inc., Kennesaw, Ga. He has full responsibility of Florida operations and is in charge of putting together a comprehensive solid waste program for all Law Environmental offices.

ECC names new geosciences director
Paul J. Jones was recently appointed director of geosciences at Environmental Consultants and Contractors (ECC), Inc., Fairfax, Va. Formerly with NUS Corp., Jones will direct all hydrogeologic services, including groundwater assessments and UST services.

Madia new board member of Geosafe
William J. Madia, Ph.D., has been elected to the board of directors of Geosafe Corp., Kirkland, Wash. Madia is corporate senior vice president of Battelle where he heads the company’s worldwide technology development activities and oversees the practical application of technology for more than 1,800 industrial and government clients, Geosafe says.
Read all about it

• NSI Environmental Solutions, Inc., Research Triangle Park, N.C., has a catalog of their complete line of EPA certified organic solution standards. The catalog lists the standards alphabetically and by the EPA protocol they support.

• NSI also announced six authorized distributors for their standards: Absolute Standards, Accustandard, Alameda Chemical & Scientific, Alltech, Cambridge Isotope Labs and Ultra Scientific.

For more information, write 376 on inquiry card.

• The new 1991 catalog is now available from Buffalo Tank Corp., Jacksonville, Fla. The 32-page catalog features the company’s full line of underground and aboveground storage tanks, accessories and monitoring devices and includes photographs, charts, diagrams and submittal sheets for specifying tanks.

For more information, write 377 on inquiry card.

• The standards, specifications and recommended practices approved by the board of directors of the Steel Tank Institute (STI), Lake Zurich, Ill., are now available on five electronic data bases.

The data bases and their providers are:

• Construction Criteria Base (CCB)—the National Institute of Building Sciences, Washington, D.C.

• Electronic Spec-Data (ESD)—the Construction Specifications Institute, Alexandria, Va.

• IHS International Standards and Specifications—Information Handling Services, Englewood, Colo.

• Standards & Specifications—the National Standards Association, Inc., Bethesda, Md.

• Construction Information (CONI)—CAD Information Systems, Inc. (Cadis), Englewood, Colo.

For more information, contact the STI, 570 Oakwood Rd., Lake Zurich, Ill., 60047, 708-438-TANK.

What, when & where

The 1991 Hazardous Materials Management Conference and Exhibition/International (’91 HazMat International) is scheduled for June this year at the Atlantic City Convention Center. For more information, contact the Tower Conference Management Co., 800 Roosevelt Rd., Bldg. E, Ste. 408, Glen Ellyn, Ill., 60137-5835, or call 708-469-3573.

• June 12-14: Atlantic City, N.J.

Contracts that reduce liability exposures are the focus of this addition to the continuing series of loss prevention seminars sponsored by the Association of Engineering Firms Practicing in the Geosciences (ASFE), Silver Spring, Md.

For more information, contact ASFE, 8811 Colesville Rd., Suite G106, Silver Spring, MD, 20910, or call 301-565-2733.

• June 14-15: Washington, D.C.

• July 12-13: San Francisco, Calif.

• July 26-27: Chicago, Ill.

The 84th Annual Meeting & Exhibition of the Air & Waste Management Association, Pittsburgh, Pa., will have as its theme “Bridging to the 21st Century.” For more information, contact the Air & Waste Management Association, P.O. Box 2861, Pittsburgh, PA, 15230, or call 412-232-3444.

• June 16-21: Vancouver, British Columbia

Two Environmental Management Expos are scheduled for September and October. For more information on either exposition, contact Environmental Management Expo, 243 W. Main St., F.O. Box 308, Kutztown, PA, 19533, or call 215-683-5098.


• October 28-31: Chicago, Ill.

Wanted: Existing Soil Burning operations or locations available to place units. Call Mark Pascek at 412-776-1922.

FIELD TLC KIT
(Thin layer Chromatography - per Friedman/Bruya - this issue)

• Complete Chromatography kits

• Field Testing Kits and Supplies

• Specialized Lab Supplies for Soil Analyses

ALL-WORLD SCIENTIFIC
5515 - 186th P1 SW
Lynnwood, WA 98037
(206) 672-4228
1-800-289-6753

Write in 088 on inquiry card.

The Hazardous Materials Control Research Institute (HMCR) has three more conferences and exhibitions scheduled for 1991. For more information on any of the following, contact HMCR, 7237 Hanover Pkwy., Greenbelt, MD, 20770-3602, or call 301-982-9500.

• July 10-12: Boston, Mass. GENSEM Conference and Exhibition


• December 3-5: Washington, D.C.

GERAGHTY & MILLER, INC.
Environmental Services

• Hydrocarbon Recovery

• Environmental Engineering

• Underground Storage Tank Services

• Site/Soil/ground Water Investigation

• Environmental Site Assessments

• Pollution Prevention Services

1-800-225-8419
Offices Located Nationwide

Write in 014 on inquiry card.

WILLIAM ENGINEERING and Testing, Inc.

• Licensed Environmental Engineers & Hydrogeologists

• Site Assessments

• Monitoring and observation well design and installation

• Soil and water sampling and monitoring services

• Geotechnical Engineering

1-800-255-WINN
1-800-255-TEST
Fax: 903-756-2701

Write in 041 on inquiry card.

May-June 1991 Soils 39
Potentially responsible parties

When you’re not alone
Many contamination events cross property lines and require group effort to remediate

By Jean B. Kulla, Ph.D. and Angelo J. Bellomo

Often remediation of contaminated sites becomes a group effort, requiring the joint participation of several potentially responsible parties (PRPs). The benefits of cooperative efforts rather than defensive strategies among PRPs are most cost-effective.

For example, a developer needing to aggressively proceed with a site investigation may find prior owners or adjoining neighbors less enthusiastic about the process of recognizing a problem to which they may all have liability.

However, persons who have any chance of finding themselves involved as party to a contamination situation need to consider adopting a more proactive and cooperative posture in multi-party cleanups.

Often, cost-recovery actions proceed on the basis of site investigations and cleanup that were designed and funded by a single motivated party. This party may have a distinct advantage in defining the magnitude and contributing factors to the problem, as well as the approach taken to resolve it. It is reasonable to expect the originating party to have designed and selected the investigation and remedial approach to best suit its goals. Therefore, other PRPs may find themselves arguing against the findings of an investigation they had no part in designing.

For this reason, many PRPs, regardless of how minor their exposure may seem, are finding it in their interest to participate in the design of investigations and the selection of remedies.

In addition, there is a growing awareness among PRPs of the need to proactively initiate work on a site before the incident becomes government-driven.

A company that has historically delayed work on a site to the point where the work becomes agency-driven may well find itself paying substantially more, including the costs of the many government employees assigned to oversee the work.

Due to growing backlog of contaminated sites many state agencies are developing policies to encourage PRPs to work on these sites proactively without state agency involvement.

Working under such an arrangement gives PRPs the opportunity to collaborate and plan a more cost-effective and equitably-shared remediation.

A cooperative approach places appropriate emphasis on planning to ensure the efforts of the group are tied to unified goals. Interim and individual actions can be reviewed for consistency with each other and with the projected final remedy.

Early planning and collaboration among parties also tends to uncover individual needs from the beginning to ensure any “fatal flaws” can be dealt with early.

A cooperative approach also improves the prospects for the group to develop a set of cost allocation criteria before the investigation is undertaken. It is much less likely that the group would accept criteria for allocating responsibility and costs associated with the problem after the remedial investigation is completed and the facts are known by all. When allocation criteria are developed up front and accepted by the group, necessary investigations can proceed to gather the facts. In this way, odds are better for an equitable allocation of costs.

Finally, a proactive and cooperative relationship among the parties will minimize extensive negotiations and litigation between them and with the governmental agencies, thus reducing overall costs of remediation.

In apportioning liability among multiple PRPs, the percent of contribution from each source must be delineated and differentiated. The investigation should be geared to address such factors as:

- specific contaminants historically associated with each PRP source
- historic operations and practices which may have affected release of contaminants
- estimated amounts of specific contaminants from each source
- contaminant migration pathways and distances from original sources
- chemical alterations to original contaminants which may have occurred over time
- heterogeneity of contaminant plume and concentrations and total amount of each contaminant in the plume.

Continues on page 42→
ONSITE TREATMENT
HYDROCARBON CONTAMINATED SOILS

HYDROCARBON CHARACTERISTICS

IN SITU TECHNOLOGIES
- Volatilization
- Bioremediation
- Soil Leaching
- Isolation/Containment
- Vitrification
- Passive Remediation

EX SITU TECHNOLOGIES
- Surface Bioremediation
- Enhanced Bioremediation
- Low Temperature Thermal Stripping
- High Temperature Thermal Stripping
- Beneficial Reuse
- Chemical Extraction
- Solidification/Stabilization
- Isolation/Containment

COST GUIDELINES

REMEDIATION SELECTION METHODOLOGY
- Situation Characterization
- Technology Screening
- Potential Problem Screening
- Technology vs. Costs Ranking
- Regulatory Screening
- Investigation Planning
- Cleanup Criteria

RISK ASSESSMENT GUIDELINES

APPENDICES
- Detailed Remediation Descriptions
- Regulatory Status
- References

STATE-OF-THE-ART MANUAL
OF REMEDIAL TECHNOLOGIES

Prepared by:
ENVIRONMENTAL SOLUTIONS, INC.

SEND ORDER TO:
ENVIRONMENTAL SOLUTIONS, INC.
21 Technology Drive
Irvine, California  92718

Price: $100.00 per copy

For More Information Call:
(714) 727-9336

Name ____________________________
Title ____________________________
Organization ______________________
Type of Business __________________
Address __________________________
City ______________________________
State _______ Zip Code ____________

Check Enclosed.
Invoice Organization.  (P.O. No. ________ )

Write in 034 on inquiry card.
Potentially responsible parties, from page 40

Once relative amounts of each contaminant and magnitude of source contribution to the plume have been defined, alternative cleanup technologies and costs can be considered. If the contaminants are different and from different sources, assessing proportionate costs may be relatively easy. But if the contaminants are the same or similar and from similar sources, assessing costs is more difficult.

In some cases, documentation of a PRP's history of spills, leaks or fires or other historical research may be necessary. Chemical fingerprint typing, stable isotopes, trace metal indicators and other techniques may be warranted to correlate contaminant plumes to the correct sources. Transport modeling may be used to help delineate the relative contribution of contamination to the plume.

There is growing recognition that state and federal Superfunds are not and should not be considered the sole solution to clean up this country. The role of government needs to be reevaluated and much greater responsibility placed upon PRPs. Regulatory policy should be further developed to encourage proactive cooperation among PRPs.

Write in 364 on inquiry card
for more information

What do 2 CEO's, 19 presidents & 14 Vice Presidents with environmental concerns have in common —
(other than making "THE BIG BUCKS"?)

MEMBERSHIP IN AEHS

They make the right decisions. They've all joined AEHS in the last 6 months.

The Association for the Environmental Health of Soils (AEHS) was created to facilitate communication and foster cooperation among those concerned with effectively dealing with the challenges of contaminated soils.

Membership provides a linkage for all concerned with soil contamination including those in the scientific, regulatory, industrial and public sectors.

Whether you are a CEO or just starting out, AEHS invites you to make the right decision...

Name: ____________________________
Company: _________________________
Address: _________________________
Telephone: _______________________

Write 090 on inquiry card.
samples are obtained for laboratory analyses prior to backfilling.

The auger method allows investigation in areas where continued excavation may impact the structural integrity of structures or excavation is difficult due to site constraints. It does not generate waste. It allows quick backfilling of the area as well as sampling under buildings and highways without having to core bore or interrupt regular use. But, it is important to remember, it only samples point locations.

While they are not appropriate to every UST removal project, these methods are well-suited in situations where it is likely that the contamination is contained within the immediate area of the excavation zone and impact to groundwater is unlikely. The soil boring/monitoring well costs can then be used to investigate and remediate.

Write in 360 on inquiry card for more information.

Rotron blowers provide soil solutions.

EG&G Rotron regenerative blowers have proven themselves in years of environmental service to be quiet, compact, and reliable. These direct-drive low-maintenance blowers require no lubrication. They have explosion-proof motors, spark-resistant construction, and adaptable vacuum performance curves. Environmental applications include:

- Soil remediation.
- Landfill degassing.
- Aeration.
- Bio-remediation.
- Radon removal.

Rotron also has accessories such as moisture separators available. Call or fax a request for a copy of a Consultant's Guide to Environmental Applications.

Write in 091 on inquiry card.

EG&G ROTRON

Industrial Division
Rotron Inc., North Street, Saugerties, NY 12477.
Telephone: 914/246-3408; Telefax: 914/246-3802.
What makes a good lab, from page 31

method to evaluate credentials. There is a need for a national proof of compliance or certification program to protect and guide consumers.

About all a client can do is ask a prospective lab about certification, then contact the certifying body and try to establish a level of confidence in the certification process.

Carte and Artiola propose a need for referenced soil and soil/waste standard performance samples. The lack of standard performance samples explains how different reputable labs can legitimately obtain different results from the same samples.

The ultimate goal would be to generate confidence that all analytical laboratories participating in a program would be expected to achieve the same analytical results on the same samples.

In the absence of a clear, national certification standard, the consumer must first establish what regulations apply to the contaminated site. The laboratory must clearly demonstrate their understanding of the operative regulatory climate. Different states have different regulations that address different possible tank contents.

A laboratory’s QA/QC program is a pivotal benchmark to analyze. According to Elaine Carino, laboratory director for Environmental Laboratories, Inc. (ELI) of Ansonia, Conn., “The accuracy of a laboratory is only as good as its QA/QC program. To assure that samples are collected, analyzed and reported correctly and that personnel are instructed as to proper analytical techniques. Most laboratories can provide a copy of their QA/QC manual on request.”

Pease says the QA/QC manual should carry a fairly recent date, update or revisions to demonstrate that it is current. It should contain considerable detail about the chain-of-custody and documentation of the sample. It should explain how QA/QC is handled organizationally, staff assignments and responsibilities.”If it’s not in the manual, it’s not anywhere,” cautions Pease.

It is not necessary for a client to understand every element in a QA/QC document, but it should be looked over to get a sense of a lab’s commitment and organization.

How a lab is equipped is important. Again, it may not be possible for a client to know whether a lab is well equipped or not.

“All laboratories should be equipped with state-of-the-art equipment to assure the most accurate results possible,” Carino says. “A list of laboratory equipment is usually available on request."

Pease says you have to be an insider to judge equipment. And, he has seen labs who have excellent reputations get top-notch, accurate results with older, seeming desperate, equipment.

Rick Gates, organic laboratory manager for the Oregon Department of Environmental Quality says there is no magic formula to find a competent lab. For a client who must start from scratch, he suggests contacting several labs directly and asking about their work. Take basic steps as in finding any kind of professional service: check the Better Business Bureau, ask for references, visit the lab to get a sense whether their focus is narrow or more broad-based. Do they seem to operate on a shoestring, or do they have a sense of established permanency?

The services provided by analytical labs, the costs and the liabilities associated with environmental cleanup are too important to leave to chance.®
9th Annual Presentation

HazMat™

International

Hazardous Materials Management Conference and Exhibition/International

June 12-14, 1991
Atlantic City Convention Center • Atlantic City, New Jersey

North America’s Largest and Most Authoritative Conference and Exhibition in the Hazardous Materials and Hazardous Waste Management Industry

The Exhibition:
See, compare and evaluate the industry’s newest products and services for Hazardous Materials Management, Pollution Abatement, Environmental Remediation, Emergency Response, Asbestos Abatement and much more... on display in over 600 exhibit booths. See the advanced technology for the packaging, handling, transportation and disposal of all Hazardous Materials and Wastes.

Held concurrently with Lab-Tech ’91, the Industrial and Environmental Laboratory Conference and Exhibition, Crossover privileges to attend both Expos!

The Conference Program:
Wide-ranging Conference Program covers current industry issues, new technology and the latest regulations. More than 150 papers in 30 sessions PLUS Tutorials, hands-on Workshops, Certification Exams—and more!

It Pays to Attend HazMat/International ’91
From equipment displays to in-depth technical presentations, virtually everything you need to cope with the ever-changing complexities of the hazardous materials management industry will be available to you at this event.

To: Tower Conference Management Co.
800 Roosevelt Rd. – Bldg. E408
Glen Ellyn, IL 60137-5835

□ I am interested in ATTENDING HazMat/International ’91. Please send full conference details and pre-registration form.

□ My company is interested in EXHIBITING. Please contact me with additional information.

Name ________________________________________________
Title ________________________________________________
Company ________________________________________________
Address ________________________________________________
City ___________________________ State _______ Zip ________
Phone ___________________________ FAX __________________

Co-Sponsored by:
National Environmental Training Association
New Jersey Institute of Technology
World Safety Organization
Chemical Equipment magazine
Hazardous Waste Treatment Council
Environmental Hazards Management Institute
National Environmental Health Association
Business & Legal Reports
Industrial Safety and Hygiene News
Printed Circuit News
Chemical Marketing Reporter
Environmental Protection magazine
World Wastes magazine
Environmental Liability Report
Environmental Software Report
Journal of Environmental Health
University of Findlay
University of Illinois, Institute of Labor and Industrial Relations
Hazardous Materials Intelligence Report
Asbestos Issues
Econ, Environmental Contractor
Water & Waste Water International
Environmental Careers
AHW Reporter
Association of American Railroads
EPI, Environmental Products Index

Write in 092 on inquiry card.
| Advertiser Index | AEHS ................................................. 31, 42 ................................ 089, 090 |
|------------------|-----------------------------------------------|-----------------------------|
| ABB Environmental Services, Inc. .................. 30 ................................ 037 |
| All-World Scientific .................................. 39 ................................ 088 |
| Allied Environmental Services .......................... 17 ................................ 082 |
| American Reclamation Corp. .......................... 18 ................................ 043 |
| Arte’s Manufacturing & Supply (AMS) .............. 19 ................................ 002 |
| Asphalt Drum Mixers, Inc. (ADM) .................. 32 ................................ 087 |
| Chama Corp. ............................................. 15 ................................ 044 |
| D’Ambra Construction Co., Inc. ..................... 42 ................................ 098 |
| EG & G Rotron ........................................... 43 ................................ 091 |
| Environmental Instruments ............................ 48 ................................ 030 |
| Environmental Solutions, Inc. ...................... 41 ................................ 034 |
| Enviroscan ................................................. 35 ................................ 086 |
| EnviroTech Mid-Atlantic .................................. 47 ................................ 093 |
| Friedman & Bruya, Inc. ................................ 44 ................................ 040 |
| Gabriel Laboratories, Ltd. .......................... 37 ................................ 001 |
| Gentec ..................................................... 39 ................................ 014 |
| Geraghty & Miller, Inc. ................................ 36 ................................ 059 |
| Javco, Inc. ............................................... 38 ................................ 005 |
| KVA Analytical Systems .................................. 29 ................................ 081 |
| Midland Machinery Co., Inc. ........................ 27 ................................ 097 |
| Modular Remediation Systems, Inc. ............. 317-784-7731 .................................. 096 |
| Noble Oil Services ....................................... 800-662-5364 .......................... 094 |
| O/C Tanks Corp. .................. 800-OC-TANKS ........................................ 24, 25 ................................ 053 |
| Petro Soil Systems ....................................... 609-354-8100 .......................... 060 |
| R.E. Wright Associates, Inc. ......................... 717-944-5501 .......................... 036 |
| Soil Purification, Inc. ............................... 404-861-0069 .......................... 021 |
| Soil Safe, Inc. ......................................... 301-327-6026 .......................... 033 |
| Tarmac Equipment Co., Inc. ......................... 816-228-3509 .......................... 095 |
| Thermotech Systems Corp. ...................... 407-290-6000 .......................... 083 |
| Tower Conference Mgmt. Co. ....................... 708-469-3373 .......................... 092 |
| United Retek Corp. ..................................... 508-429-6226 .......................... 056 |
| U.S. Environmental Services Corp. ............... 800-323-USES .......................... 046 |
| USTMAN Industries, Inc. ........................... 800-253-8054 .......................... 084 |
| Winn Engineering & Testing, Inc. ............... 800-256-WINN .......................... 041 |

Note: The Hotline and Index are provided as a service. The publisher does not assume liability for errors or omissions.

---

**Advertising in Soils magazine reaches over 10,000 of your best prospects at a fraction of the cost of general environmental magazines.**

**Soils 10,000+ circulation includes:**

- 8,000 major companies with hydrocarbon storage liabilities...
- 2,000 consultants specializing in hydrocarbon storage, cleanup, monitoring and equipment.
- 600 of the largest municipal, state and national regulatory agencies.
- **national conferences** on contaminated soil

Call: Soils 816-254-8735 for more information. Be a part of the excitement!
WE CAN LAB-TEST IT.  
WE CAN TASTE-TEST IT.  
WE CAN CLEAN IT.  
WE CAN PROVE IT!

Turning petroleum-contaminated soils into clean dirt. That's a challenge EnviroTech Mid-Atlantic always welcomes. Our integrated approach to cleaning up soils can take care of everything along the way. We begin with thorough on-site lab identification of the hydrocarbon waste contaminant. Our technical staff carries out microbial bench-testing to identify bacteria that can literally consume the contaminant. Our soil is stored in our covered building to prevent leaching of the waste into ground water supplies while awaiting treatment. Our rotary kiln thermal destruction units process up to 50 tons per hour. Environmental monitoring controls ensure complete elimination of soil contaminants while maintaining critical emissions control. And when we're through we'll even provide you with written verification of cleanup that's backed up by EnviroTech Mid-Atlantic's extensive liability coverage. Turning contaminated soil into clean dirt is what we do best and we can prove it!
Environmental Instruments has the technology, track record and expertise to deliver the best Vapor Phase Treatment systems for you. We can provide Blowers, Catalytic and Thermal Oxidizers, and Carbon Treatment for handling V.O.C.'s from your Soil Venting Systems and Air Strippers.

- Proven product line--our state-of-the-art equipment is high performance, "field friendly", reliable and agency permitted throughout the U.S.

- Individual system designs--with our wide range of products, we can tailor systems to meet your exact specifications.

- Complete Carbon regeneration service available.

- A knowledgeable staff of consulting engineers, geologists and scientists to expertly assist you.

- Complete line of environmental instrumentation including: monitoring treatment & recovery equipment.

At EI...We put it all together to serve you better.

CALL TOLL FREE 1-800-648-9355

HEADQUARTERS: CONCORD, CA • (415) 686-4474

LOS ANGELES DENVER NEW JERSEY HOUSTON SEATTLE TAMPA
(714) 668-9035 (303) 989-6150 (201) 221-1931 (713) 868-6040 (206) 328-1583 (813) 835-0190

Write in 030 on inquiry card