Superfund...a life sentence?
HOW LONG IS AN OWNER RESPONSIBLE FOR SITE CONTAMINATION?

LEAP before you look
WHEN IT'S BETTER TO BEGIN REMEDIA TION BEFORE ASSESSMENT

Soil scientist career survey

What's best ...ABOVE or BELOW?
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 land fill 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 chemicals, 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 landfilling 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 breathe 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.
Plan Now to Attend...

The program is designed specifically for people just getting involved in, or considering the apparent opportunities in thermal soil remediation. Learn from industry leaders, plant owners, and government officials. Gain valuable insight concerning industry market trends, business practices, technical awareness, and regulatory requirements.

If you missed the first Remediation America '91 Seminar last January, you will want to register early to attend this valuable and informative seminar.

Who Should Attend?

- Environmental Contractors
- Remediation Contractors
- Asphalt Plant Owners/Operators
- Soil Management Personnel
- Tank Removal Companies
- Excavators
- Landfill Owners
- Builders
- Consultants
- Developers

Register Today!

Attendees are responsible for their own transportation to and from Orlando, as well as lodging costs. For your convenience, a block of rooms has been reserved at the Sheraton Orlando North (407) 660-9000. The special discounted rate is $79.00 per night, single or double occupancy, with no charge for children sharing your room. You are encouraged to contact the hotel directly as soon as possible to make your reservations. The hotel cut-off date is April 1, 1991.

Call: Monica DISPETER
(407) 290-6000
for more information.
Write in 047 on inquiry card.

Learn More About...

Business Considerations: Present Industry Status
- Outlook - Market Interest (Portable/Stationary Plants)
- Economics (Operating Costs and Profit Margins) - Competitive Pressures - Legal Impacts.


Technical Operations: Experience of Operating Plants
- Plant and Equipment Performance - Material Handling
- Case Studies - Panel Discussions.


Testing: Requirements - Methods (Prior to and After Treatment) - Costs - Frequency - Precautions.

Asphalt Plant Conversions: Methods - Burners - Controls - Flighting - Baghouses - Oxidizers - Special Material Handling Equipment.

Plant Tour: Portable Soil Remediation Plant - Manufacturing Facility at Gencor Industries Inc.

Respond Before April 1, 1991!

Reservations and Fees: Space is limited and reservations are accepted in the order received. Fee for the seminar is $425 per attendee. Fee covers all session resource materials, continental breakfast and lunch each day of the seminar, morning and afternoon refreshment breaks, and a special evening hospitality buffet Monday, April 22nd, featuring the magic of an Orlando Tropical Night.

Soil Remediation Seminar April 22 - 23, 1991

Registrants (please type or print): ____________________________
Company/Organization: ____________________________
Type of Business: ____________________________
Address: ____________________________
City: ___________ State: ___________ Zip: ___________
Title: ___________ Phone: ___________ FAX: ___________

Total attending seminar: ________
Method of payment:
☐ Enclosed $425 fee
(check or money order)
Hotel information:
Sheraton Orlando North
I-4 and Maitland Blvd.
Orlando, Florida
(407) 660-9000

If more than one person is attending from your organization, make a copy of this form for each that will be attending. Each person is responsible for their own room expense. No additional charge for children. Plan to arrive the evening of April 21, 1991. Call Monica DISPETER (407) 290-6000 for more information.

Mail this completed form today and make checks payable to:

THERMOTEC SYSTEMS CORPORATION
A Gencor Industry
5201 N. Orange Blossom Trail · Orlando, FL 32810 · (407) 290-6000 · FAX (407) 578-0577
Soil contamination:
The human factor

"Reducing Risk: Setting Priorities and Strategies for Environmental Protection," a report recently issued by the Science Advisory Board (SAB) of the U.S. Environmental Protection Agency (EPA) focused on the more serious environmental problems facing the nation and how we can best control them.

The SAB report notes that EPA—and the nation—should attach as much importance to reducing ecological risks as is attached to reducing risks to human health. Natural ecosystems are extremely valuable and there is no doubt that over time, the quality of human life declines when the quality of natural ecosystems declines.

This concept is particularly relevant to soils. Our quality of life is dependent on the thin skin of soil on the surface of the earth. We depend upon the soil for food, fiber, shelter and assimilation of the residues of mankind. Human health and welfare rely on ecosystem life support systems, particularly healthy soil based life support systems. Local, regional and national efforts to evaluate and control relative environmental risks should recognize the vital role that soil ecosystems play in sustaining human health and a desirable quality of life. This role is not well understood by many engineers and scientists, commonly because few understand the nature and value of soils.

Most individuals receive little knowledge about soils—soil chemistry, soil physics, soil microbiology or the assimilative capability of soils—in their formal education. As a result, we have made much progress controlling many air and water pollution environmental problems, but relatively little attention has been paid to the impact of human activities on soil ecosystems and how such ecosystems can mitigate environmental problems. This reflects the fact that ecological problems are seen by the public as a less serious concern because the impact is often subtle, long-term and cumulative.

The SAB Reducing Risk report provides an important departure from this view and a compelling argument against the priorities of the status quo. Soil based ecosystems are extremely important to our standard of living and our health and welfare. Increased knowledge about the assimilative capacity of soil and its ability to mitigate environmental problems is a key component of understanding relative environmental and human health risks and approaches to control such risks.

By Raymond Loehr, Ph.D., H.M. Albarthy Centennial Chair, professor of Environmental & Water Resources Engineering Program, Univ. of Texas-Austin and Soils advisory board member.

Soils magazine is published bi-monthly by Group III Communications, Inc., 10229 E. Independence Ave., Independence, Missouri, 64053. (Phone: 816-254-8735; FAX: 816-254-2128.) Entire contents copyright 1991 by Group III Communications, Inc. All rights reserved. Opinions expressed by writers in Soils are not necessarily held by the publisher. SUBSCRIPTIONS: Soils magazine is mailed to companies with hydrocarbon storage liabilities, consultants and state and national regulatory people. U.S. subscriptions: $24 a year. Outside U.S.: $36 a year.
Features

6 East coast firm reclaims soil
AmRec puts contaminated soil in cold mix asphalt
By Susan Parker

8 Is your property covered? Insurance policies may or may not cover pollution damage
By Scott Forland

10 Leap before you look
Sometimes, it's better to begin remediation before assessment
By John M. Bruck, P.E.

13 Soil scientist career survey

14 Remediation of large sites
Big problems present cost saving opportunities
By Dennis Dineen, M.S., and Emmanuel Fakhoury, Ph.D.

18 Aboveground vs. underground storage tanks
By Susan Parker

24 Superfund: A lifetime sentence
How long must an owner be responsible for a site
By Richard S. Greeley, Ph.D.

28 Benzene degradation...a closer look
By Michael J. Sullivan, Paul A. McCaw and Christopher J. Miller

32 Ultraviolet rays expose soil contamination
By David G. Johnson and Donald W. Podsen

35 What's New

38 What, When & Where

39 Industry News

40 The state of State 'Superfunds' All 50 states have or are developing cleanup funds
By Michael J. Berg and Susan L. Mayer

44 Saddam's spill
Persian Gulf cleanup to take years; environment may never recover
Information provided by William D. Mahaffey, Ph.D.

Departments

35 What's New
38 What, When & Where
39 Industry News
46 Hotline and Index

Cover photo by
Terry L. Mundy

March-April 1991 Soils 5
East coast firm reclaims soil

AmRec is first in Massachusetts permitted to add contaminated soil to cold-mix asphalt

By Susan Parker

American Reclamation Corp. of Southborough, Mass., is one New England company attacking the problems of hazardous waste.

In the mid-1980s, John Glynn, president, of AmRec operated two companies, Ashland Industrial Fuel Corp. and Environmental Restoration Engineering. Wastes such as oil sludges and oily soil were managed in accordance with existing regulation and agency guidelines. However, Glynn found very few options which made sense as far as economics and liabilities were concerned. “Why should we transport oily soil to a landfill in Maine, pay high transportation and disposal costs, then face future liabilities for cleanup costs?” Glynn asked. His first step was to establish a 65-acre recycling site. In late 1988, AmRec received a Class A permit from the Massachusetts Department of Environmental Protection (DEP) allowing them to receive petroleum contaminated soil and to mix it into cold-mix asphalt paving.

“There were many details and hard work to meet the requirements for the various permits,” Glynn says. “Meetings with local agencies such as the board of health and conservation commission, liaison with DEP and public meetings were all included. Countless data, specification drawings and applications were prepared and submitted for review.”

During the past two years, AmRec has produced thousands of tons of asphalt: paving material for municipalities as well as the private sector in applications ranging from driveways to secondary roads. The paving product is a cold mix asphalt: which allows it to be stored or stockpiled over a long period of time. The product costs about 60 percent less than hot mix asphalt.

AmRec offers a wide range of services to contaminated site owners. One such client was Natick Paper Board Co. After a leak was discovered in its underground oil
storage tank, chief engineer James O'Connor explains, "We needed the tanks removed, and we had to deal with the petroleum contaminated soil. It was a serious issue for us and we were very concerned that we handle the situation properly and expeditiously in a cost-efficient manner."

Plant manager Jeff Comeau explains, "the option of putting the oily soil in a landfill in Maine wasn't real thrilling in that you still have liability if somewhere down the road they determine it's not safe."

Providing a turnkey solution, AmRec removed the soil, replaced the tanks, then sold the company the asphalt to cover a driveway leading to the site. Comeau estimated the cost was 40 percent less than expected.

Hundreds of clients in New England, including public agencies, utilities and industrial firms have brought thousands of tons of oily soil to AmRec for recycling.

To ensure the safety of their asphalt product, AmRec used various test procedures. In one, samples of asphalt were submerged in rainwater under standardized conditions over a period of one week. The rainwater was tested for total petroleum hydrocarbons (TPH) and volatile organic compounds (VOC). Neither was detected in the rainwater.

In a second test, AmRec asphalt was tested with the Environmental Protection Agency (EPA) extraction procedure toxicity method. No petroleum hydrocarbons were detected in the extraction liquid. The asphalt product also passed the extraction procedure toxicity test for heavy metals.

"It does not produce significant emissions of hazardous vapors into the air during the asphalt production," George Camougis, vice president and compliance officer for AmRec, says.

In addition to cost efficiency, "approval for recycling is no more complex than approval for disposal at a landfill or treatment by incineration," Camougis says.

AmRec has also signed an innovative agreement with the city of Charlton, Mass., to construct a 500-ton-per-day recycling transfer station. Faced with a state order to close their crowded local landfill, the city will earn $1.50 for every ton of refuse delivered to the new facility. AmRec hired a professional communications firm to set up an educational program for the community, starting with a program which will be taught initially to elementary and middle school children.

Turning to the future, AmRec now has a joint research and development program underway with the University of New Hampshire to investigate the recycling of crushed glass in the process. AmRec is also cooperating with Monsanto to investigate methods to recycle plastics and thus reduce the waste stream of that company. [Write in 345 on inquiry card for more information.]

SITE RECLAMATION SYSTEMS, INC.

KEY FEATURES

- Mobility and small size
- 3 hour set up or less
- On-site treatment
- Soils suitable as backfill
- Cost effective
- Minimizes liability
- Permanent solution

SITE RECLAMATION SYSTEMS, INC. (SRS) MANUFACTURES, SELLS, CUSTOMIZES AND OPERATES MOBILE SOIL VOLATILIZERS WHICH CLEAN SOILS CONTAMINET WITH PETROLEUM HYDROCARBONS.

FOR FURTHER INFORMATION PLEASE CALL OR WRITE: P.O. Box 11 • Howey-In-The-Hills, Florida 34737
(904) 324-3651

Write in 048 on inquiry card.
Is your property covered?
Insurance policies may or may not cover pollution damage Part II

By Scott Forland

In addition to comprehensive general liability policies, property insurance policies may also cover loss or damage caused by environmental contamination. The focus of property insurance policies is to cover loss or damage to the insured's own property. Therefore, these policies might apply to damage to the insured's property resulting from pollution caused by third parties off-site and also to pollution caused either by the insured or third parties on-site.

Two types of policies
An "all risk" policy extends to physical loss of or damage to property arising from any fortuitous cause, unless specifically excluded. In 1983, the phrase "all risk" was replaced with "risks of direct physical loss." The insured has the burden of proving that the covered property was physically lost or damaged due to a fortuitous and non-excluded event.

The other type, known as "named peril" coverage, applies only to certain risks named in the policy. The insured has the burden of proving that its loss arose from one of the named perils.

Scott Forland is an environmental attorney with Morrison, Hecker, Curtis, Kuder & Parrish, a law firm in Kansas City, Mo.

Theories of coverage
• All risk policies:
Seeking coverage for environmental contamination under all risk policies is a relatively new and untried area. Theories that might be asserted and held to entitle an insured to coverage are unknown.

One possible theory of coverage is to allege that the cause of loss is not the contamination itself, but the negligence of a third person that resulted in contamination. This is commonly referred to as "concurrent causation analysis." Under this analysis, several courts have found coverage if there are independent concurrent causes, one of which is covered. If the causes are found to be dependent concurring causes, there is coverage only if the "efficient proximate cause" is a covered risk. If the excluded cause is dependent upon the covered cause, coverage exists. However, if the covered cause is dependent upon the excluded cause, no coverage exists. The insured must determine what the causes are and whether each cause is covered or excluded.

Another possible theory of coverage under an all risk policy is to characterize the cause of loss as a peril other than contamination. Many all risk policies specifically exclude contamination, so if the insured can characterize the cause of loss as some peril other than contamination, coverage may exist. For example, in one case, a loss was defined as being caused by corrosion, a covered peril, rather than by contamination, an excluded peril.

• Named peril coverage:
Covered risks typically named in such policies include fire, smoke,
vandalism, malicious mischief and explosion. Each of these named perils has been cited by an insured and relied upon by a court to find coverage for certain types of contamination caused by these named perils. So if the cause of the contamination can be linked to a named peril, coverage may exist.

- Debris and pollution removal coverage:

Generally, the cost of cleaning up debris caused by an insured peril is covered under a property policy. The standard debris removal clause in commercial property insurance policies prior to 1986 revisions provides for payment of expenses incurred in removing debris from covered property if the debris is caused by or resulted from a covered cause of loss. The “Limits of Insurance” section of such policies provides that if the sum of the loss and debris removal expense exceeds the limits of insurance, the insurer will pay up to an additional $5,000 for each location in any one occurrence under the debris removal additional coverage provision.

Standard policy language does not define the term “debris.” One state appellate court held that escaped oil which contaminated the surrounding earth was debris and the cost of its removal compensable because the oil was insured under the policy when stored in underground storage tanks. The court noted that debris may mean waste material resulting from the destruction of some article. The insured was thus entitled to recover for both the lost quantity of oil and the cleanup expenses to remove the contaminated soil. In evaluating that case, one writer has even expressed that it might be read broadly to entitle insureds to recover for cleanup of pollution to adjacent non-covered land and water caused by a leak of insured property turned contaminant.

In addition to seeking recovery for damages to contaminated property, claims may also be asserted for damages to uncontaminated property necessary associated with removing pollutants from land or water or restoration of land after removal of pollution.

Second, a new, additional coverage provision entitled, “Pollutant Cleanup and Removal” was added. This additional coverage provides up to $10,000 for the cost of extracting pollutants from water or land if the release, discharge or dispersal is caused by or results from a covered cause of loss. There is a 180-day reporting requirement for this additional coverage.

An additional aggregate limit of insurance can also be purchased separately (for an additional premium) specifically to cover costs of cleanup and removal of pollutants from land and water.

**1986 exclusion provisions**

- **Land**

The standard form commercial property policy lists property that is not covered. Included since 1986 in the list of such property is “land (including land on which the..."

CONTINUES ON PAGE 34

---

**ANALYZER RENTALS**

- **FOR-**
  - WATER QUALITY
  - SITE ASSESSMENTS
  - HAZARDOUS SPILLS
  - FUGITIVE EMISSIONS
  - SOIL/WATER HEADSPACE
  - BENZENE ACTION LEVELS
  - INDUSTRIAL HYGIENE/SAFETY
  - UNDERGROUND STORAGE TANKS

- **Repairs**
- **Calibration**
- **Sales**
- **Training**
- **Consulting**

**INTEK CORP.**

10410 Rockley Rd. • Houston, Texas 77099

(713) 498-5855

**RENT-ALYZER**

1-800-323-6527

Write in 049 on inquiry card.

March-April 1991 Soils 9
Leap before you look
Sometimes, it’s better to begin remediation before assessment
By John M. Bruck, P.E.

While Webster doesn’t entirely agree, let’s define “paradigm” as a psychological filter that we use to mentally evaluate and react to a situation, a specific behavioral pattern in response to a given set of conditions. Environmental engineers, driven by regulations and agencies, have long followed the paradigm of completely and carefully assessing a contamination setting before selecting and employing a cleanup approach.

Leaking underground storage tank (UST) situations are no different. The release of product into the environment is reported to the agencies and containment measures are taken. Then, the site is investigated, assessed and further studied and plans are approved before remedial actions can really be implemented. The investigation, assessment and approval phases can take months and thus finding their way on to the critical path of a project and bringing owners, operators, contractors and others to a standstill. And, worse yet, the delays can easily worsen the environmental situation.

It is sometimes to the benefit of all concerned to consider and, if appropriate, employ long term remedial techniques immediately, before a detailed contaminant and site assessment is complete (or even initiated, in some cases) and before formal agency approval is received. Environmental issues can and do cause delays in projects, sometimes unavoidably. In some cases, it is possible to stay off the critical path of construction projects and still meet the regulatory requirements and other needs of an environmental remediation project. So let’s examine a new paradigm—remediation before assessment—and how it might be employed in an example situation: a leaking underground tank encountered during a construction project.

The key to keeping environmental contamination/cleanup off a construction project’s critical path is knowledge of potentially applicable cleanup technologies and how they may be employed. Technologies to be considered must generate chemical and physical information during their installation and operation, which can be useful in meeting the regulatory site assessment requirements later. Also, the initial sizing of the remedial system can be increased later if contamination beyond the primary site is found.

For UST leaks, three such soil cleanup technologies may be considered independently or in conjunction with one another. Although this is a partial list and is not intended to represent all available technologies:

- excavation,
- soil vapor extraction (SVE),
- bioremediation

Localized contamination, even at high (saturated) levels can easily be removed and contained by excavation. Excavated soil may be treated onsite or offsite and replaced into the cavity, or disposed (landfilled) without treatment.

John M. Bruck is president of Bruck, Hartman & Esposito, Inc., an environmental management, science and engineering firm in Cincinnati, Ohio.
Currently, excavation and landfilling is the most common remedial approach to leaking UST situations (see page 9, November-December 1990, Soils), particularly while petroleum contaminated soil is acceptable (in most midwestern states) for landfilling as a non-hazardous waste. That particular advantage may change as testing requirements and landfill permits become more stringent as they are in the Northeast.

SVE is a mechanical (usually vacuum) technique that removes volatile contaminants from the unsaturated zone, the volume of soil above groundwater (see p. 18, January-February 1991, Soils). When properly managed, the installation and operation of a SVE system can provide the technical data necessary to accomplish many investigation and assessment objectives. Analysis of soil samples and on-site organic vapor measurements can characterize contamination at specific points on the site. Vapor levels can be measured over time to develop an understanding of how well the system is removing contamination. Usually, the SVE approach can integrate very well with construction needs and regulatory requirements, while minimizing costs and project delays.

Bioremediation, the addition of oxygen and nutrients to promote breakdown of contaminants, is fast becoming an important tool for cleaning up soil and groundwater (see p. 20, November-December 1990, Soils). Care must be taken when introducing nutrient laden water to the subsurface so that none of the treated water escapes the capture zone of the system.

Most bioremediation systems must be permitted as a Class V underground injection well. A bioremediation system can be set up quickly and in close coordination with most construction projects, but it may take weeks to several months for the system to become acclimated and start significant degradation. Bioremediation systems need fine-tuning, varying levels of water treatment with oxygen and nutrients and pumping rates, but can be very effective in meeting cleanup objectives.

It is difficult to estimate the length of time it will take to clean up a particular site, or easily obtain accurate measurements to determine the degree to which contaminants are being removed. Experience has shown that the length of cleanup is generally six months to two years, although some sites may take more or less time. Additionally, and with other technologies, removal rates typically decrease over time as contaminant concentration decreases.

It should be accepted, then, that certain technologies exist that are compatible not only with the regulatory requirements of assessment and cleanup, but also with the sometimes even greater demands of completing construction related projects on time. While it takes careful communication with the appropriate agency in any contamination/cleanup situation, a number of projects employing the remediation before assessment paradigm have been successfully implemented using the technologies presented here, and the paradigm should be considered for use in the future.!
ACRONYM MANIA: Test your AIQ (acronym intelligence quotient)

The EI (environmental industry) has emerged as a VAPOR (viable acronym production organizational ramrod) to soundbite key groups, characteristics, devices and other catch phrases within the industry. Presumably, if these acronyms CROYT (casually roll off your tongue) you might be perceived as a FEAB (frequently erup-tant acronym bozo)! Answers on right.

<table>
<thead>
<tr>
<th>MCL</th>
<th>NAPL</th>
<th>SCS</th>
<th>DERA</th>
<th>TPH</th>
<th>RRF</th>
<th>API</th>
<th>RI</th>
<th>PPM</th>
<th>AEHS</th>
<th>PQL</th>
<th>RFID</th>
<th>BTEX</th>
<th>EPA</th>
<th>LCS</th>
<th>EIL</th>
<th>PAH</th>
<th>VOC</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATSDR</td>
<td>PID</td>
<td>STLC</td>
<td>PLIA</td>
<td>ISC</td>
<td>AAL</td>
<td>UST</td>
<td>ARAR</td>
<td>ASMS</td>
<td>GC/FID</td>
<td>TTC</td>
<td>GRO</td>
<td>RRF</td>
<td>SARAL</td>
<td>ROD</td>
<td>PRDF</td>
<td>RSC</td>
<td></td>
</tr>
</tbody>
</table>

---

NEED VAULTED STORAGE ABOVE 2,000 GALLONS?

THE EcoVAULT™
ABOVEGROUND STORAGE VAULT

THE ECONOMICAL AND ECOLOGICAL ABOVEGROUND STORAGE ALTERNATIVE
Sizes available in 550, 1,000, 2,000, 4,000, 6,000 and 10,000 gallon capacity.

- Modular vault design allows easier handling and internal tank inspection.
- Internal rib construction provides increased thermal protection.
- 6" concrete vault reduces fuel/vapor loss and provides ballistic protection.

For Engineering Drawings and Specifications Call: 1-800-ECO-VAULT or (703) 760-9330 · Fax: (703) 760-9335

The EcoVault Corporation
1420 Spring Hill Road, Suite 325 · McLean, Virginia 22102

Write in 079 on inquiry card.

12 March-April 1991 Soils

SEND BACK THAT CARD!
If you wish to continue receiving your Soils subscription, be sure to send in the card at the back of this issue.
Soil scientist career survey

Employees in environmental occupations may anticipate a salary increase in the 6.4 percent range in 1991, according to results of a survey conducted by William M. Mercer, Inc. of Denver, Colo., under the sponsorship of the Hazardous Waste Action Coalition (HWAC). Participants indicated anticipated salary hikes would be down some .04 percent from actual raises given in 1989.

"The survey's focus is on firms that are primarily engaged in environmental or hazardous waste activities," says Hoyt W. Doyel, principal of William M. Mercer, Inc. Respondents included 73 firms engaged in environmental consulting, remediation, chemical analysis, hazardous waste processing and storage and other related activities.

Starting environmental engineers can expect a salary of $28,000, ranging to $53,100 for those with over nine years' experience. Top engineering executives pull in some $108,500.

Doyel says questionnaires for the 1991 survey will be mailed by the first of May. Participation in the survey has grown dramatically since 1987 when 22 firms participated.

—Sample average compensation levels—

<table>
<thead>
<tr>
<th>Salary + Bonus</th>
<th>(000's)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permitting/Regulatory</td>
<td></td>
</tr>
<tr>
<td>Compliance Manager</td>
<td>$61.2</td>
</tr>
<tr>
<td>Remediation Technician</td>
<td>$23.0</td>
</tr>
<tr>
<td>(hourly position, 3-5 years)</td>
<td></td>
</tr>
<tr>
<td>Hydrogeologist III</td>
<td>$38.3</td>
</tr>
<tr>
<td>(4-6 years)</td>
<td></td>
</tr>
<tr>
<td>Environmental Scientist II</td>
<td></td>
</tr>
<tr>
<td>(4-6 years)</td>
<td>$37.7</td>
</tr>
</tbody>
</table>


Soils magazine introduces career opportunities...
Reach over 7,000 environmental specialists—engineers, geoscientists—with your ad in our job listing section.

Special ad rates for this section. Call Darcy Case at 816-254-8735 for complete information.

FREE CATALOG!

We specialize in Hand-operated Soil Sampling Equipment for the Pollution Control Industry!

Introducing The JMC Environmentalist's Sub-Soil Probe:
- Sliding Drop-Hammer for penetrating hard soils
- Foot-Operated Jack for retrieving samples
- Samples to depths beyond 15 feet
- Captures uncontaminated soil samples 36 inches long
- Uses removable plastic or stainless steel liners

Write or call us today!

Clements Associates Inc.,
R.R.1 Box 186 Newton Iowa 50208
Ph:1-800-247-6630 or 1-515-792-8285

Write in 051 on inquiry card.

ENVIROMENTAL CONSULTANTS AND ENGINEERS

- Site Assessments
- Liability Assessments
- Real Estate Transfers
- PCBs: Retro Fill, Retro Fit, Sampling & Disposals
- Emergency Response: Spills, Packaging & Disposals of Hazardous & Toxic Materials
- Third Party Quality Assurance Reviews

1-800-323-USES
CALV US TOLL FREE WITH YOUR ENVIRONMENTAL QUESTIONS!

LOCAL PHONE (215) 539-3233
FAX (215) 630-4836
16A W. Indian Lane
Norristown, PA 19403

Write in 046 on inquiry card.

March-April 1991 Soils 13
Remediation of large sites

Big problems present cost saving opportunities

By Dennis Dineen, M.S., and Emmanuel Fakboury, Ph.D.

Cleaning up sites that have large amounts of hydrocarbon contaminated soil is becoming more common.

In the past 10 years, characterization and remediation of sites with small volumes of contaminated soil have become well established. These sites are generally associated with leaking underground storage tanks (USTs) and most often involve volumes of diesel or gasoline contaminated soils ranging from several hundred to several thousand cubic yards.

More recently, characterization and remediation of sites with much larger volumes of contaminated soils are underway. These sites include refineries, bulk storage terminals and oil production fields. Volumes of contaminated soil at these sites often range up to hundreds of thousands of cubic yards. The methodologies to characterize the extent of contamination and the technologies to remediate small sites cannot simply be extrapolated to large sites. Doing so would result in investigation and remediation costing millions of dollars for a single site.

Large site characterization

Characterization of small sites to define the extent of contamination is usually the same regardless of the remedial technology to be used. Large sites need to be characterized in light of the most probable remedial technology to minimize site investigation costs.

On-site analytical laboratories and broad spectrum screening analyses on larger sites can substantially reduce individual analysis costs. Characterization of large sites typically contain gasoline or diesel whereas large sites are primarily crude oil, bunker fuel, lube oil and jet fuel as well as diesel and gasoline.

Sampling methodologies using broad-based screening techniques and random sample collection are usually better suited for large sites with numerous sources than for small sites with a single known source.

Small sites typically have one or two localized sources whereas large sites may have dozens or even hundreds of sources.

The biggest difference between characterization of large sites compared to small sites is a consequence of the fact that on-site treatment technologies are more likely to be used on large sites than on small. Since on-site technologies are far less dependent on unit volume costs than are off-site technologies, a less accurate (and therefore less costly) volume estimate is needed to provide an estimate of off-site remediation costs.

For example, if transportation and disposal costs were $150 per cubic yard and the estimated volume was 10,000 cubic yards, remediation costs (excluding excavation) would be $1,500,000. If the actual volumes were twice as large (20,000 cubic yards) then actual remediation costs would also double to $3,000,000. If the same soil were treated on-site using bioremediation, the estimated costs could be much less, $500,000, for example.

Because this cost consists largely of the relatively high fixed expense for permitting, sampling, treatment cell, irrigation equipment and project management, doubling the treatment from 10,000 to 20,000 cubic yards would only increase the much smaller unit costs for chemical fertilizer and expansion of the treatment area—both of which are likely to be less than 20 percent increase.

Given this situation, an error in the volume estimate where on-site treatment was used would result in a 20 percent underestimate of remediation costs, whereas an error in the volume estimate where off-site treatment was used would result in a 100 percent underestimate of remediation costs. Consequently, fewer resources can be expended on characterizing sites with on-site treatments without risking major errors in estimating remediation costs.

The second major opportunity for cost savings during investigation (and remediation) of large sites where hundreds of samples will be analyzed is to set up a laboratory

Dennis Dineen is principal scientist and Emmanuel Fakboury is a supervising soil scientist at McLaren/Hart, an environmental engineering firm in Irvine, Calif.
on-site to analyze for a broad spectrum of hydrocarbons using infrared spectrophotometry (EPA method 418.1) or gas chromatography (modified EPA method 8015). Using EPA method 418.1, costs for instrument and equipment purchase, certification and on-site operation are less than standard commercial laboratory rates when the number of samples analyzed exceeds 200 to 300.

A third difference between characterizing large and small sites is that large sites are more suitable for screening methodologies and random sampling than small sites. For example, only 24 samples were used to document that nearly 200,000 cubic yards of soil were contaminated at a bulk storage terminal in Southern California. This was possible because the facility had been in operation for nearly 80 years and all the individual sources had overlapped so that all the soil within the fire walls surrounding the tanks was contaminated. The extent of contamination was essentially defined by the depth to floating product and the walls around the facility which contained any spillage.

On large sites with multiple discrete sources, errors in volume estimation tend to balance themselves.

For instance, on one site with over 60 potential sources, individual volume estimates differed from actual contaminated volumes by over 100 percent. However, the actual total volume of all contaminated soil was less than ten percent of estimated volume.

**Technologies for remediating large sites**

Despite the availability of well documented alternative remediation technologies for hydrocarbon contaminated soils, the vast majority of sites with small volumes of contaminated soil are remediated by excavation and disposal. This alternative is often selected in spite of transportation costs, disposal costs, entry fees and taxes that can easily exceed $300 per cubic yard.

Excavation and disposal of small volumes continues to be a viable option due to the high fixed capital costs of alternative treatments, the lengthy time for permitting and treatment and the perceived uncertainty of alternative technologies.

On large sites, excavation and disposal is generally out of the question. And, because of the large volumes, fixed capital costs of alternative treatments are relatively low. Moreover, sites with large volumes of contaminated soil usually have sufficient space and time to utilize alternative treatments.

On site treatments which are widely used or have potential for widespread use for large volumes include:

- bioremediation
- thermal oxidation
- vapor extraction
- soil washing
- capping/containment

The on site technology with the widest applicability is bioremediation. Above ground

*Continues on page 16→*
bioremediation is suitable for all hydrocarbons except the lightest ends (gasoline) without major air emission controls. Above ground bioremediation has the lowest capital costs and a high level of technical confidence.

Major drawbacks are the time requirement (approximately six months for total petroleum hydrocarbon concentration under 10,000 parts per million for each layer treated) and the space requirement (a maximum of approximately 2,400 cubic yards per acre for “land farming”). Bioremediation can also be accomplished in situ, although with a lower level of confidence than above ground bioremediation and with more complications in design and verification.

Thermal oxidation is suitable for all hydrocarbons, including gasoline. The initial permitting design and capital costs are several times greater for thermal oxidation than for bioremediation, but operation costs are in the same range. Thermal oxidation units can be operated on smaller areas than bioremediation and can be scaled to accomplish the remediation in a shorter time, if required.

Thermal oxidation is best accomplished above ground with excavated soil although some pilot scale work is being done on in situ thermal oxidation.

Vapor extraction is effective for the volatile hydrocarbons such as gasoline, naphtha and other low molecular weight alkanes. Vapors are removed by applying a vacuum to a soil (either in situ or above ground) to remove the volatile hydrocarbons. Once removed, the volatile hydrocarbons are controlled by combustion, oxidation or carbon adsorption.

Soil washing, using non-toxic biodegradable surfactant, effectively and rapidly reduces contamination in sandy or gravelly soils. Soil washing can be done in situ or on excavated soil, but is most effective on soils with very high hydraulic permeability.

Soil washing has not been demonstrated on large volumes of contaminated soil or on soils with substantial clay content where mixing would be required to put the surfactant in contact with the hydrocarbons. Moreover, soil washing produces a large volume of oil and waste water that must be treated prior to disposal.

Finally, capping or containment is a technically acceptable method for remediating sites with large volumes of hydrocarbon contaminated soils. For all practical purposes, capping or containment is usually viewed as a temporary remediation for sites where existing operations are expected to continue into the foreseeable future, and other remediation technologies are not feasible because of existing operations. The major drawback of capping or containment is that hydrocarbons remain in place and must be monitored indefinitely.

**Approach to large sites**

For the most part, remediation of sites with large volumes of contaminated soil comes about due to strong economic pressure to develop the land or because of a cleanup order by a regulatory agency. Once the decision to remediate has been made, these guidelines should minimize costs of a major cleanup:

- Assemble all interested parties to review the situation and proposed action plan. Commit to regular meetings throughout the process. Interested parties would include the owner, developer, buyer, technical consultant, regulatory agencies and attorneys. The best results are those that emerge from cooperative rather than adversarial group effort.

- Minimize site investigations to essential information. Since the decision to remediate has already been made, the best is to devote resources to the cleanup.

- Identify the remedial technology as early as possible so investigations are focused and appropriate.

Write in 043 on inquiry card.

```
American
Reclamation
Corporation—
a fully permitted,
65-acre recycling,
facility located in
Charlton,
Massachusetts

Briefly, we take in:
- soil that has been contaminated with virgin oil
- mineral products (concrete, asphalt and tile)
- asphalt shingles, etc.

And, we recycle these materials to produce:
- cold-mix asphalt paving material
- various grades of aggregate material

Therefore, we provide our customers with the following benefits:
- in-state disposal convenience
- surprisingly low cost
- elimination of continued liability
- a waste reduction solution

To learn more about how AmRec conserves valuable resources, while providing a safe alternative for the management of a major national problem, call or write today:

AMERICAN RECLAMATION CORPORATION
225 TURNPIKE ROAD
SOUTHBORO, MA 01772
508 • 624 • 7006
```

Write in 348 on inquiry card for more information.
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, kerosine, diesel and jet fuel, as well as #6 fuel oil. SPI can process soil to less than 5 ppm total hyrdcarbons. 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.

SOIL PURIFICATION, INC.
P O BOX 72515 • CHATTANOOGA, TN 37407 • TELEPHONE 404-861-0069 • FAX 404-861-2051
Write in 043 on inquiry card.
Aboveground vs. underground storage

**Aboveground Storage (Pros):**
- Readily visible leak detection.
- No excavation costs.
- Relatively portable.
- Decreased risk of fire and/or explosion.
- Does not take surface land property.
- Less sensitive to extremes in climate.

**Aboveground Storage (Cons):**
- Strict EPA regulations.
- Uses available surface property.
- Surface modifications, dikes, landscaping, pads.
- Easier target for vandalism.
- Requires periodic exterior maintenance.

**Underground Storage (Pros):**
- Strict EPA regulations in place.
- Expensive excavation costs.
- Less portable
- Failure less visible.

**Underground Storage (Cons):**
- Decreased risk of fire and/or explosion.
- Does not take surface land property.
- Less sensitive to extremes in climate.

**Comparative Costs:**
Experts claim the relative cost of aboveground vs. underground tanks to be "comparable." A great deal depends on application, land costs, quantity and other factors. Overall, neither is reputed to be "the cheapest" or "the costliest."
aboveground storage may be a viable alternative for some owners and operators of underground tanks who are facing replacement. But, aboveground systems are far from being an unregulated free-for-all.

“The tank owner who chooses an aboveground system with the objective of avoiding underground tank regulation will be disappointed,” says A.D. Young, Jr., environmental consultant for Maclaren/Hart, New York, N.Y. Sweeping and detailed reforms are being drafted and implemented for aboveground systems. Florida, Illinois, Massachusetts, New York, Pennsylvania, South Carolina, Tennessee and Washington have enacted strict aboveground storage regulations. In California, Assembly Bill 1050 establishes a hazardous, aboveground tank inspection act.

“Congress is developing an aboveground storage tank program modeled after the underground program,” Captain John Hall of Los Angeles, Calif., says. “At the federal level, regulations are changing very rapidly and becoming more proactive. We expect this in 1991.” However, aboveground regulation remains more flexible than underground, and installation practices are less rigid, Hall says.

Yet any buyer of an aboveground system must make sure the new system meets compliance when the regulations take effect.

“In most cases, the state legislation being proposed contains no guidance whatsoever about safe tank installation, additional safety controls that may be needed, siting guidelines and fire protection features,” says Arthur E. Cote, assistant vice-president and chief engineer of the National Fire Protection Association (NFPA). As a result, NFPA is proposing amended codes to address aboveground storage fire safety.

Hall adds that Underwriters Laboratory and American Petroleum Institute are among the groups who issue standards for aboveground tank storage.

Wayne B. Geyer, executive vice president of the Steel Tank Institute (STI) of Lake Zurich, Ill., acknowledges that the market for aboveground tanks is on the rise in the product mix of manufacturers. STI has also adopted several recent standards and practices regarding aboveground tanks, addressing external corrosion protection, installation, diking and double wall standards.

“We orchestrate all those standards so we can manage aboveground storage and underground storage facilities and make sure they are properly constructed and installed and tested,” Hall says.

Continues on page 22
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
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.
Of the many lessons learned from the unregulated, buried steel tank past, one is that the storage of combustible, toxic liquids must be regulated—whether above the ground or below.

Tank customers buy much more than storage space. Protection from all manner of potential hazards, ranging from spills to explosions, is inherent in tank technological systems today. The time for easy assumptions is past. It can no longer be assumed that underground storage is safer, nor that aboveground is cheaper, Young says.

Underground tanks have been considered superior in terms of fire safety. Historically, petroleum products were stored in bare steel underground tanks with fire and explosion prevention being a primary concern.

Aboveground has the edge in terms of easiest leak detection. But, high technology leak detection systems for underground units, and aboveground concrete vaults with two-hour firewall ratings have made the distinctions less clear cut.

Many users must cope with such congested available surface land that underground tank upgrade is their only choice. This is particularly true of urban locations.

“Building expansion, parking space or ease of access may be severely inhibited by tankage obstruction,” Young observes. So for the estimated 700,000 tanks that serve retail motor fuel facilities, aboveground tankage may not be a realistic option. Although in some areas, code amendments permit retail dispensing of gasoline from aboveground tanks in special enclosures.

According to figures published in the Federal Register, Vol. 52, No. 74, over 650,000 tanks are classified as non-retail motor fuel facilities, logical candidates to consider aboveground tankage. Utility companies, construction compounds, remote industrial sites, local governments, mining and transportation sites are typically included in this category.

Another site-related point of comparison is the trade-off between the excavation required to install underground versus the surface modifications required for an aboveground tank. Surrounding an aboveground installation may require spill containment dikes, grading to facilitate surface water run-off or construction of concrete pads. On the other hand, excavation cost for an underground unit may run as much as the tank itself.

Testing and monitoring systems for both types of tanks is growing in sophistication daily. Research and standards for such considerations as cathodic protection systems, hold-down materials, secondary containment, leak detection, spill and overfill prevention and installation standards are constantly being upgraded.

The trend in aboveground technology is toward concrete vaulting. According to Philip Cruver, director of EcoVault Corp. of Vienna, Va., use of aboveground vaulted tanks is growing in federal government, municipal and commercial sectors. Steel-reinforced concrete, six inches thick, functions as a two-hour firewall, ballistic-proof leak containment for an aboveground tank.

Secondary containment (double wall tankage) is increasingly chosen for both above and underground storage. In either application, double walls provide near fool-proof protection against leakage.

In the case of aboveground storage, if a single wall tank is used, it must be fitted with some type of secondary containment—either a vault, a 110 percent spill recovery containment area, or impervious liner. Secondary containment can take many forms and no doubt the EPA will mandate some of these obvious, “tried and true” methods.

Experts assert the impact of climatic extremes on aboveground storage is a virtually a “non-issue.” Temperature extremes have little effect on common types of petroleum storage, so the decision to bury a tank in order to protect the contents from extreme heat or cold is not a “make-or-break” factor. But Young says certain highly volatile materials stored aboveground in extremely hot climates could evaporate “without special and costly conservation vents.” He also points out that extreme cold may cause aboveground piping and valves to freeze. Underground storage provides sufficient insulation to mitigate both potential problems.

Aboveground tank owners do have to attend to periodic maintenance of the tank exterior. Brian Digrado, marketing manager of Brown-Minneapolis Tank of Eagan, Minn., says a typical aboveground tank requires a protective coat of fresh paint or coating about once every five years or so.

Comparative portability of the tanks may be an issue of some importance to some decision-makers. Aboveground owners enjoy more ease of portability than do underground owners. Certainly both can be moved, but in the case of an underground tank, the process of moving it would require
it to be sent back to the manufacturer for recertification before
reinstallation. This, with excavation costs, would make consideration of
moving an underground unit more prohibitive than an aboveground
tank. Underground tanks are rarely moved.

The easier portability of aboveground tanks is also serving
to encourage manufacturers to offer aboveground units for lease. As
Cruver points out, “as contrasted to a UST, vaulted aboveground tanks
can be repossessed if the lessee fails to make the monthly payment.
Operators of fuel storage systems are discovering that leasing gives
them the convenient use of valuable equipment without the head-
aches associated with ownership.”

For anyone in the position of deciding which way to go with
hazardous liquid storage, the first stop must be the local fire marshall.
The local authority has jurisdiction over the EPA to mandate more
stringent requirements than federal regulation dictates. The local
authority is the best source to begin to sort out the local, state and
federal requirements for a particular application. For example, local
governments have full authority to require a certain thickness of
concrete pad, or to state how far aboveground tanks must be located
from roads or buildings. The EPA rules serve as minimum standards.

Regulations vary at the state level as well. For example, each state
administers its own environmental cleanup fund. Generally funded by
tank registration fees, these funds function to protect owners from
huge cleanup costs in the event of a catastrophic tank failure. In many
cases, an aboveground tank may fall under the umbrella protection
of the site’s buildings and structures.

Ultimately, Digrado says, “every tank installation has to be approved
by the local fire marshall to assure it meets all state, county and city
requirements and codes.”

Finally, a decision-maker must ask the big question: if there were to
be a catastrophic tank failure,

where would I prefer the tank to be located—aboveground or
below? Many feel that an
aboveground failure would be
easier to handle, simply because
the failure would be instantly
visible and more accessible. Others
feel the tank is safer, less suscep-
tible to failure, if it is tucked away
underground.

As with any complex business
decision, numerous tankage
characteristics must be weighed
and applied to the specific site and
need. Best sources for guidance are
the local fire marshall and the
various tank manufacturers.

Write in 349 on inquiry card for more
information.

Be a part of the
excitement! Advertise in
Soils magazine.
Call Darcy Case at 816-
254-8735 for details
or fax media kit requests
to 816-254-2128.

AMERICA'S MOST WANTED

crack resistant, high strength steel

America’s #1 choice. The
sti-P₃® underground
storage tank. Available
in single or double wall
configurations to 50,000
gallons complete with a
30 year limited warranty.

BMT Multi-Product
Storage Tank System.
This compartment tank
design is built to UL-58
and sti-P₃® codes in
single or double wall
styles to 50,000 gallons.

Underwriters
Laboratories Inc.

BROWN-MINNEAPOLIS TANK
a national leader in steel storage tank technology

ST. PAUL
2875 Highway 55
Eagan, MN 55121
(612) 454-6750

BIRMINGHAM
3017 N. 35th Street
Birmingham, AL 35207
(205) 841-0403

PROVO
520 W. 2000 South
Orem, UT 84058
(801) 373-8520

Write in 054 on inquiry card.

March-April 1991 Soils 23
RISK ASSESSMENT PROCESS
(Figure 1)

Phase 1 and 11

Site Assessment
Measure soil contaminants.

Exposure Assessment
Determine who is exposed to the contaminants and the amount of exposure suffered.

Toxicity Assessment
Obtain toxicity data for each contaminant from EPA's IRIS.

Risk Assessment
Calculate cancer and noncancer health risks. Evaluate uncertainties.
Superfund: A lifetime sentence?
How long must an owner be responsible for a site?

By Richard S. Greeley, Ph.D.

If you own or operate a facility where the soil has become contaminated, can you ever hope to be free from worry about your environmental liability? Can you ever achieve disengagement from environmental liability?

Suppose you have had a Phase I environmental site assessment conducted for your site and contamination was found. You have then paid for a Phase II site characterization (drilling and sampling) and a Phase III site remediation (cleanup). Your remediation contractor has now stated that all the identified contamination has been removed and properly disposed of in accordance with all Federal and state regulations. Are your environmental concerns over? For that matter, can you be sure your facility is clean even if you have had a Phase I environmental site assessment by a reputable firm and no contamination has been detected?

The short answer is, No! The original Superfund statute, the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the Superfund Amendments and Reauthorization Act (SARA), together with many similar state statutes, have led to the situation that owners and operators of facilities are liable for a release of contamination retroactively.

Since the EPA can add chemicals to the Toxic Compound List (TCL) and can lower the limits considered to be safe, a site which was qualified as clean can suddenly become contaminated...

Richard Greeley is general manager for R.E. Wright Associates, Inc., an environmental consulting firm in Middleton, Pa.

which is described statistically by the standard deviation about the mean.

In some regions, EPA will consider a site soil concentration of an element to be within the natural variability of background soils if the concentration is less than two standard deviations greater than the mean for background soils. In this case, the element in your soil would not be considered a contaminant.

For instance, Table 1 indicates the geometric mean of the concentrations of so-called heavy metal elements in samples of surface soils in New Jersey. Also indicated is the standard deviation about the mean and the value of the mean plus two times the standard deviation. These latter values represent the maximum value which would be considered to be within the normal variation in the background of New Jersey soils.

For instance, the table indicates that a lead (Pb) concentration of 138 parts per million (ppm) would be considered a background level within the normal variability of ordinary New Jersey soils.

Of course, there may be considerable argument over what is meant by "background." Measurements of background concentrations of elements and chemicals in soil have been reported for the U.S. as a whole and for various states and

Continues on page 26→
regions of the country. However, to be realistic, the background approach generally involves taking a set of samples in the area of the site which can be considered to have been unaffected by any spills or releases. Be prudent. Reach a prior agreement with state and/or federal officials that the area selected as representing background is valid.

The Risk Assessment Approach

Common sense would suggest that if there were no risk to public health and the environment from a site, even if the site soils contained elements or chemicals at concentrations greater than background the public health and environment are threatened by the concentrations of toxic or hazardous chemicals on the site. The risk assessment process involves estimating how much of the soil might be contacted, inhaled or ingested by workers or trespassers on the site, and by persons living, working or playing near the site.

For instance, children may trespass on the site and play in the dirt, receiving contaminants through dermal absorption through the skin, ingestion by licking their

<table>
<thead>
<tr>
<th>Geometric Mean***</th>
<th>Cd</th>
<th>Cr</th>
<th>Cu</th>
<th>Fe</th>
<th>Mn</th>
<th>Ni</th>
<th>Pb</th>
<th>Zn</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.1</td>
<td>12.8</td>
<td>9.7</td>
<td>19,480</td>
<td>235</td>
<td>31.3</td>
<td>15</td>
<td>41</td>
</tr>
</tbody>
</table>

| Standard Deviation | 1.4| 1.6| 2.5| 1.9| 2.7| 1.5| 3.0| 2.0 |

| Mean and Twice Standard Deviation | 3.9| 32| 60| 69,536| 1,700| 69| 138| 171 |

[* Source: Data from Professor Toth, Rutgers University.]
[** ppm = parts per million or milligrams per kilogram of soil.]
[***Geometric mean of 19 soil samples taken from the "A" Horizon.]

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 throughout the United States

From 26 March-April 1991 Soils

Career opportunities in Soils magazine
Reach over 7,000 environmental specialists—engineers, geoscientists—with your ad in the new job listing section.

Soils reaches many prospective employees in industry, consulting firms, state and national regulatory agencies, universities and many soil and groundwater associations.

Call Darcy Case at 816-254-8735 or fax media kit requests to 816-254-2128.

Write in 037 on inquiry card.
fingers or inhalation of contaminated dust. Contaminated soil may be blown off site by the wind and be inhaled or ingested by persons nearby.

The EPA has published a set of assumptions for guidance in making these estimates. Given the amount of contaminated soil to which a child or adult may be exposed, the health risk is calculated by multiplying the exposure by health risk factors available from the EPA Integrated Risk Information System (IRIS). The results are quantitative estimates of (a) the increased risk of getting cancer from carcinogenic chemicals in the soil and (b) the risk of getting sick from non-carcinogenic chemicals in the soil. The risk assessment process is outlined in Figure 1 on page 24.

Obviously, there are numerous and significant uncertainties in the results. The EPA guidance involves worst case assumptions so as to be sure to protect the public. However, a site owner or operator could have a risk assessment conducted using more appropriate site-specific assumptions and data with the intent of showing that both carcinogenic and non-carcinogenic risks are insignificant.

Federal and state environmental officials will rarely, if ever, sign off a site and declare it free from contamination. The site is ever brought into question during a Phase I or II environmental site assessment. These approaches can be used to guide the design for a Phase III remedial action of a contaminated site by indicating the levels to which the contamination must be cleaned. Finally, after remedial action is finished, these approaches can be considered a Phase IV "Disengagement" to declare that the site is clean and presents no significant risks to public health and the environment.

Write in 350 on inquiry card for more information

**AVOID ENVIRONMENTAL AND FINANCIAL DISASTER!**

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

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.

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

**Soil gas and Water Sampling Kits are also available**

*US Patent # 4,804,050. Other US & Foreign patents pending

**Call KVA - the leader in soil gas sampling equipment**

KVA
ANALYTICAL SYSTEMS
281 MAIN STREET • FALMOUTH, MA 02540
TEL: (508) 540-8841 • FAX: (508) 497-953

Write in 005 on inquiry card.
Factors that affect benzene degradation

**Temperature**
Highest rates of degradation occur at temperatures above 20°C, while freezing conditions tend to slow microbial activity.

**Moisture**
Twenty percent capillary saturation is sufficient for oil biodegradation. Ten percent saturation is associated with marginal activity.

**Oxygen**
Degradation rates decrease as the oxygen supply is depleted. If 100% of available capillary space is saturated, too little oxygen will be present for metabolic activity.

**Fungi**
Pre-existing populations that metabolize benzene tend to increase after a period of acclimation. Role of fungi; increases with decreasing pH.

**Bacteria**
Like fungi, population that metabolizes benzene tends to increase. Unlike fungi, the role of bacteria decreases with decreasing pH.

---

Benzene degradation...a closer look
Incorporating biodegradation rates into risk assessment

By Michael J. Sullivan, Paul A McCaw, Christopher J. Miller
The half-life of benzene in gasoline contaminated soils may be less than one year. But, risk assessors often assume the exposure point concentration of benzene remains constant.

However, data from several studies indicate that biodegradation is a significant fate mechanism for benzene and other hydrocarbons. The incorporation of half-lives facilitates the estimation of long-term exposure to decreasing concentrations of benzene over time.

Biodegradation, a significant loss mechanism for benzene in soil, has been studied under aerobic and anaerobic conditions. Biodegradation is important because decreases of benzene in soil over time will significantly decrease levels to which individuals may be exposed. Given the high vapor pressure for benzene, it is expected that volatilization is also a significant loss mechanism for benzene in surface soils.

These decreases can be significant when modelling long term exposures for the estimation of carcinogenic risk. Due to the abundance of information confirming the degradation of benzene in soils, it is appropriate to develop a method of estimating risks and developing remedial criteria which incorporates half-life estimates.

Selection of a degradation rate

Many site- and chemical-specific factors affect the rate of degradation. In circumstances involving a lack of data, it may be appropriate to use the most conservative half-life estimate or to incorporate an uncertainty factor.

When gasoline or another petroleum product is released into the soil, the makeup of the microbial community is often altered. There is a tendency for species diversity to decrease as organisms which can’t metabolize petroleum constituents are eliminated by the inherent toxicity of the product. At the same time, populations of bacterial and fungal species which can utilize these constituents tend to increase. Increases of petroleum levels in soil up to five percent (50,000 ppm) have been observed to stimulate microbial activity in petroleum utilizing species. This implies that a period of acclimation may be required before significant rates of degradation will occur. Failure to account for an acclimation period may result in an overestimation of biodegradation rates.

The actual rate of degradation in soils is affected by temperature, oxygen and moisture content, pH and the presence of mineral nutrients. While freezing conditions slow microbial activity (and therefore degradation) biodegradation will continue at temperatures as low as -1.1°C as long as the soil solution remains liquid. The highest rate of degradation apparently occurs at soil temperatures above 20°C.

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.
Oxygen and moisture content are often limiting factors in biodegradation. It has been shown that degradation rates decrease as the oxygen supply is depleted. The aeration of soils is dependent on the amount or air vs. water filled pore space, or capillaries, and the size of the pores. While "water logging" of soils will reduce the oxygen content, some moisture content is necessary. If 100 percent of the available capillary space is saturated, then too little oxygen will be present for metabolic activity. A ten percent capillary saturation is associated with marginal metabolic activity due to the reduction of available water as a result of osmotic and metric forces. Twenty percent capillary saturation is sufficient for oil biodegradation.

Several studies have shown that the rate of biodegradation is higher in alkaline than acidic soils. The role of fungi increases and the role of bacteria decreases with decreasing pH. Optimum soil pH conditions for biodegradation activity for both fungal and bacterial degraders is probably neutral to slightly alkaline.

**Application of degradation rates**

Despite the variability of site conditions which impact the rate of degradation, the basic method for incorporation of half-life estimates remains the same. The initial safe concentration (ISC) is based on the risk-specific concentration (RSC), a degradation rate coefficient and a specified exposure duration. The equation (ISC = RSC/(1-ekt/kt)) assumes: (1) first-order degradation throughout the period of exposure; (2) degradation is initiated at t=0 years; and (3) the RSC is the average allowable concentration over the exposure period.

This methodology may be adapted to address a variety of issues at sites depending on the information requirements. At sites requiring risk estimates, degradation rates can be used to evaluate changes in concentrations over time, thereby facilitating the estimation of potential current and future exposures to benzene. In cases where a remedial goal is the endpoint of the assessment, ISCs can be used to set remedial criteria under a number of situations. An ISC can be determined for the impacted matrix based on direct exposures (dermal contact, incidental ingestion). ISCs can be estimated to protect against indirect exposures (inhalation of fugitive dust and vapors). ISCs can be set to protect an uncontaminated aquifer against potential future impacts. In all cases, the ISC is based on the RSC.

In some situations involving a compound with a short half-life and extended exposure durations, the resulting ISC may be set at a level which exceeds the reference dose (RFD), the daily allowable exposure for the compound. The RFD protects against non-carcinogenic effects and is frequently larger than the dose which is protective of carcinogenic effects, the risk-specific dose (RSD). In some cases, the RSD may be exceeded during the initial exposure period if remediation was terminated when the ISC was reached. Therefore, it may be necessary to compare the RFD or other toxicological endpoints to the maximum daily dose associated with the ISC to ensure adequate protection against more acute, non-carcinogenic effects.

**Accurate risk estimations**

Although risk assessment is frequently used to determine site-specific risks and remedial goals for petroleum contaminated soils, decreases in contaminant concentrations over the exposure period are rarely considered. The assumption that concentrations will not decrease with time is inappropriate in light of available information. Incorporating estimated half-lives of petroleum constituents into the risk assessment process is an important step in providing more accurate estimates of exposure to changing concentrations over time.

\[ ISC = \frac{RSC}{1-ekt/kt} \]

where:

- \( ISC \) = initial safe concentration (mg/L)
- \( RSC \) = risk specific concentration (mg/L)
- \( k \) = degradation rate coefficient (1/year)
- \( t \) = exposure duration (years)

Write in 351 on inquiry card for more information.
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

New technology makes your plant cleaner at lower operating cost

- OXIDIZER RECOVERS 98% OF PRIMARY HEAT
  System stores heat, then uses this energy to help oxidize hydrocarbons.
  Result: low temperature stack!

- OXIDIZER OPERATING TEMPERATURE CAN BE SELF-SUSTAINING
  “Fuel free point” occurs at 200 PPM hydrocarbon concentration.
  You pay less for fuel!

- REDUCED NOx PRODUCTION
  Unlike direct-flame oxidizers and their by-products of combustion, the TARMAC low-temperature system is easier to permit!

Over 100 units permitted and running (including California and New Jersey).

- Let us design a fuel-saving oxidizer for your plant.

FAX to 816-228-0888

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 057 on inquiry card.
Hold it up to the light

**Ultraviolet rays expose low level soil contamination**

*By David G. Johnson and Donald W. Podsen*

A field screening method using ultraviolet light to detect low level soil contamination may offer a quick technique to compliment existing approaches.

While the methodology is not new to soils cleanup, it is actually based on a process used for decades in the petroleum exploration industry to identify oil shows in drill cuttings.

Initial testing indicates that oils with little or no volatility can be detected at low concentrations in soil when cut with a solvent and observed under long-wave ultraviolet light.

Thirty soil samples that had been analyzed for either total petroleum hydrocarbons (TPH), using EPA method 418.1 or for oil and grease using EPA method 413.1 were examined under ultraviolet light to determine if a correlation exists between fluorescence and the degree of contamination.

The samples were collected at ten sites and contained various fuel oils, gasoline and lubricating oil. Known dates of product releases ranged from as recently as within the last two years to one case in which the release occurred more than 50 years ago.

Soil colors ranged from light tan to brown and from gray to black. While some samples had a strong oily odor, others had no detectable odor. Recent photoionization detection tests indicated that only two of the 30 samples contained volatile organic compounds. TPH and oil and grease concentrations ranged from less than five parts per million (ppm) to greater than 150,000 ppm.

The samples were collected from depths ranging from five to 30 feet in both the saturated and unsaturated zone.

To test the samples, a small quantity of each was placed in a 40 milliliter (ml) vial and examined under natural light to determine if any oily stain or sheen could be observed.

Then, the samples were placed in a viewing chamber lit by long-wave ultraviolet light to determine the intensity of fluorescence in the samples.

Finally, less than ten ml of each sample was placed in a second 40 ml vial and was cut by adding approximately ten mL of a solvent.

David G. Johnson is senior hydrologist, and Donald W. Podsen is senior geologist for the Webran Engineering Corp. of Andover, Mass.
ml of acetone. The cut sample was
then placed under the ultraviolet
light to determine the intensity of
fluorescence. The intensity of
fluorescence was described as
either faint, pale, dull or bright.
Cutting the samples with acetone
distinguished petroleum fluores-
cence from mineral and flushed the
oil from the soil particles into a
solution where it was more readily
observed.
A 40 ml vial of acetone and vials
of uncontaminated soil (both
natural and cut) were also ob-
served under ultraviolet light
to serve as comparative
controls.
The observations were
compared against petroleum
type, soil type and oil concen-
trations detected by laboratory
analysis of each sample. The
results of this comparison
indicate that some soil samples
which have petroleum concen-
trations greater than 1,500
ppm fluoresced when placed
under ultraviolet light. How-
ever, an equal number with
high petroleum concentrations
did not fluoresce.
When cut with acetone, soils
with petroleum concentrations
ranging from less than five
ppm to greater than 150,000
fluoresced under ultraviolet
light. The intensity of fluo-
rescence ranged from very faint
to bright, with white and
yellow colors observed. The
majority of samples that
contained low TPH concentra-
tions (less than 100 ppm) had
a faint response to ultraviolet
light, but at this early point in
the initial testing, no other
apparent correlation could be
made between the intensity of
fluorescent response and the
petroleum concentrations.
This initial testing indicates
that field screening of petro-
leum contaminated soil can
potentially be enhanced by the
use of ultraviolet light particu-
larly if a cutting agent is
applied.
Furthermore, soil type, color,
petroleum type or age does not
appear to affect the effectiveness
of this method. Ultraviolet field
screening appears to have potential
for sites involving excavation
associated with underground
storage tank removal and replace-
ment.
These results indicate that by
preparing standard reference
samples at a given site with at least
one known clean sample and one
contaminated, comparisons can
possibly be made in the field to-
separate soils. Use of this method
would help reduce the guesswork
when separating contaminated from
clean soils.
Further investigation is underway
to determine if TPH concentrations
can be determined using ultraviolet
methods. And, researchers need to
determine if correlations exist
between intensity of fluorescent
response and concentration of
petroleum in the soil. In addition,
different concentrations and types
of cutting agents are being tested to
determine the optimal fluorescent
response.

Write in 354 on inquiry card for more
information.

---

**Why Wait For The Lab?**

With Dexsil's L2000 PCB/Chloride
Analyzer, you can have an answer in
less than 10 minutes.
The L2000 was designed for use by
non-technical personnel to determine
PCB levels in both soil and oil over a
range of 5 to 2000 ppm. Compact
and portable, the L2000 allows you to
quantitatively determine PCB levels
in a non-laboratory environment.
The L2000 substantially reduces
the costs of PCB detection and
quantification; an average oil analysis
costs $5.00 and a soil analysis $10.00.
The sample is prepared with a
sodium reagent which transforms the
PCB into chloride. The L2000
chloride ion-specific electrode
measures the level of chloride present.
It converts the amount to a PCB
equivalent and displays the result in
parts per million. Since different types
of PCB contain different percentages
of chlorine, the L2000 can be user set
for Aroclor 1242, Aroclor 1260 or
Askarel A (60% 1260 and 40%
trichlorobenzene). If the Aroclor is
unknown, the Analysis Range is set at
1242 for the most conservative
reading.
For more information on L2000 and
free product literature contact Dexsil.

DEXSIL®
One Hamden Park Drive • Hamden, CT 06517
203-288-3509 • Fax: 203-248-6523
L2000 is a trademark of the Dexsil Corporation.

Write in 058 on inquiry card.

March-April 1991 Soils 33
Is your property covered?, from page 9

property is located), water, growing crops or lawns." However, prior to the new endorsement clarifying coverage for pollutants adopted in 1986, none of the standard property forms contained an express exclusion of land from covered property.

- Water
  The 1986 "Changes—Pollutants" list is amended to include water as property not covered. Prior to 1986, no such provision existed in the standard form property insurance policy.

- Pollution
  The standard "Building and Personal Property Coverage Form" provides that the insurer will not pay for loss or damage caused by or resulting from release, discharge or dispersal of contaminants or pollutants. The 1986 endorsement amends that language to provide as follows:

  We will not pay for loss or damage caused by or resulting from the release, discharge or dispersal of "pollutants" unless the release, discharge or dispersal is itself caused by any of the "specified causes of loss." But if loss or damage by the "specified causes of loss" results, we will pay for the resulting damage caused by the "specified cause of loss."

  The phrase "specified cause of loss" is defined as fire, lightning, explosion, windstorm or hail, smoke, aircraft or vehicles, riot or civil commotion, vandalism, leakage from fire extinguishing equipment, sinkhole collapse, volcanic action, falling objects, weight of snow, ice or sleet, water damage. So, unless the pollution results from a specified cause of loss and damage results specifically from the specified cause of loss, coverage is excluded.

  This standard endorsement was released in 1986 and has since become part of the standard commercial property insurance policy. Under this exclusion, if a fire ensues as a result of the release of a pollutant, there would be no coverage for contamination of covered property. There would, however, be coverage for damage caused by the fire itself.

  Whenever insured property is contaminated, a review of all policies should be made to determine the nature and extent of coverage provided for environmental contamination. While these policies often have a number of exclusions that might apply, recent endorsements regarding debris removal and pollutant cleanup and removal might provide reimbursement for costs associated with the cleanup of insured property.

Write in 346 on inquiry card for more information.

---

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.

GenTec®
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.
Enviro-Clean double-wall composite UST

Clawson introduces steel, fiberglass tank

The new Enviro-Clean double-wall composite UST is comprised of 100 mil thick fiberglass laminate permanently bonded to a UL 58 dual-wall steel tank. The Clawson Tank Co., Clarkston, Mich., tank is made with UL 58 steel for strength and broad product compatibility and fiberglass laminate for corrosion resistance.

A 5-8 mil thick resin base coat is applied to the steel first, then an 85-102 mil thick mixture of fiberglass roving and chemical-resistant isophthalic resin is sprayed on, followed by a 10-15 mil thick final resin coat. The laminate cures to form an inseparable, reinforced composite structure, says the company.

The tanks include a monitoring column which allows for the use of various monitoring devices. They are delivered, according to Clawson, with a vacuum on the interstice to eliminate the need for preinstallation tightness testing and come in sizes up to 50,000 gallons. The strength of the tank allows for normal installation handling without backfill procedures for supporting the tank, says the manufacturer.

For more information, write 064 on inquiry card.

All set up and ready to move

EasyPurge skid-mounted environmental remediation systems save time and money with each installation and are reusable with a minimum of relocation expense, says Nepcco Equipment, Ocala, Fla.

The Nepcco systems are mounted on steel skids with each pre-wired, pre-ducted, pre-piped, factory tested and documented, and fully assembled when they arrive on site.

The EasyPurge systems are available in standard sizes from 4x4 feet to 8x20 feet and include groundwater and product recovery systems, air strippers, liquid and vapor phase carbon units, transfer pumps, oil/water separators, holding tanks, pre-treatment units, instrumentation and remote monitoring telemetry units.

For more information, write 065 on inquiry card.

For advertising information, call 816-254-8735.

JAVCO INC.

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.
Filter out the problems

The new Norwell Bailer Screen, a slotted cylinder with a closed base that acts as a sieve to filter out mud, grit and debris in groundwater samples, is available from Norton Performance Plastics, Wayne, N.J.

The slot size of the accessory is .010. The unit attaches to the bottom of the bailer and allows water to run into the cylinder itself. The bailer can then fill to collect a usable test sample, without problems associated with the valve seating improperly, says Norton.

The screen is attached by screwing the slotted cylinder into the base of the bailer assembly. It is made of 100 percent Teflon® material. For more information, write 067 on inquiry card.

OCR’s Filter Scavenger

No more drifting around

A separator system that recovers hydrocarbons floating on water in a virtually water-free state? That’s what OCR Environmental Equipment of Greenville, N.H., says you get with their new Filter Scavenger system.

The Filter Scavenger system is an oil/water separator system for use in shallow well recovery where flammable vapors are present. It retrieves floating hydrocarbons from surface water using a floating intake buoy with a separator screen. The recovered product is automatically pumped into a recovery tank. The portable system features chemical-resistant membrane and corrosion-resistant, quick-disconnect hoses. There are optional fine mesh cartridges for light hydrocarbons and heavy mesh cartridges for heavy hydrocarbons. For more information, write 068 on inquiry card.

MSI-301 organic vapor monitor

You can take it with you

A portable organic vapor monitor is available from Microsensor Systems, Inc., Springfield, Va. The MSI-301 detects and measures benzene, toluene and xylene in a vapor mixture and has sensitivities in the parts per billion to parts per million concentration range.

The MSI-301 combines a isothermal (65°C) gas chromatograph with a solid-state detector and microcomputer. The 12 pound unit uses ambient air as its carrier gas, electric power and an activated charcoal scrubber that is refilled after 1,000 hours of operation. The unit may also be operated with an optional 12 VDC eight-hour rechargeable battery pack. For more information, write 069 on inquiry card.

AMS Deluxe Gas Vapor Probe

Gas vapor probe for USTs available from AMS

Available from Art’s Manufacturing & Supply, Inc. (AMS), American Falls, Idaho, is the AMS Deluxe Gas Vapor Probe system for monitoring underground storage tanks. The system’s stainless steel points are driven in the soil at various locations and depths around the tanks. Included in the system are an electric rotary hammer, 12 feet of gvp extensions, manual hammer attachment, 10 dedicated points, an extendable tile probe, teflon tubing, retrieval jack and carrying case. Also available are continuous flighted augers in three foot sections and the AMS retract-a-tip. For more information, write 070 on inquiry card.
What's New

HydroGuard System

O/C Tanks introduces new store-and-check system

The HydroGuard™ System is a new integrated underground fuel storage and environmental security system from O/C Tanks Corp., a subsidiary of Owens-Corning Fiberglas located in Toledo, Ohio.

The tank comes in 600 to 20,000 gallon capacities with 360 degree, Type II, double-wall construction. It also features a secondary containment collar for fittings and a turbine enclosure for the submersible pump housing.

"Each system is shipped complete with an activated hydrostatic leak monitoring system. By activating the system before we ship the tank we are able to detect any transit and jobsite damage immediately," says Andy Mance, product manager.

For more information, write 071 on inquiry card.

Vapor VOCs are food for this cat

A new system for destroying VOCs discharged from soil vapor extraction systems and air strippers used in remediation projects is now available from Anguil Environmental Systems, Inc., Milwaukee, Wis. The Remedi-Cat is a catalytic fume oxidizer system designed for destroying both chlorinated and non-chlorinated vapor phase VOCs.

The system, which can destroy up to 99 percent of incoming fumes, uses noble metal catalyst technology to convert the vented contaminants to harmless carbon dioxide and water vapor, says Anguil. The Remedi-Cat can be configured to process from 100 to 500 cubic feet per minute, with optional larger systems available with air volumes up to 50,000 standard cubic feet per minute.

It is a self-contained system that is compact for ease of transportation and simple for ease of operation, says Environmental Instruments, Concord, Calif., a supplier of the Remedi-Cat and other environmental instruments.

For more information, write 072 on inquiry card.

Interstitial monitor for UST's available

A new interstitial-area monitor for leakage in double-walled USTs is available from Corespan, Inc., Geneva, Ohio. The Corespan Mark II holds constant vacuum, has a gauge for visual monitoring and an UL-listed switch to give an alarm if a leak should occur.

The vacuum draws from the bottom of the tank and can collect any fluid in an accumulator for visual inspection at ground level. There is no danger of contamination of the tank contents or the environment from using this monitor, the company says.

For more information, write 073 on inquiry card.

Fabrico brochure answers tank line questions

Fabrico, Chicago, Ill., has published an easy-to-use guide to tank liners and secondary containment.

The 16-page brochure answers basic questions concerning tank liners for tanks made of FRP resin fiberglass, concrete, wood/plywood, or steel. The guide also provides information on liners used for many secondary containment applications.

The Fabrico guide also features a “problem/solution” section. For a copy call or write: Fabrico Liner Division, 4222 S. Pulaski Rd., Chicago, Ill. 60632; 1-800-621-8546 (nationwide); 312-890-5550 (in Illinois), or Fax: 312-890-4669.
“Loss Prevention in Field Operations” is being offered by the Association of Engineering Firms Practicing in the Geosciences (ASPE), Silver Spring, Md. This seminar is for consulting engineering firms, hazardous materials remediation firms, architects, contractors, owners, public agencies and others. The seminar concentrates on communications between field personnel and contractors, owners’ representatives and others who may be on the site. Loss Prevention in Field Operations is co-sponsored by the DPIC Companies, a national insurer of engineering and architectural firms.

For more information, contact ASPE, 8811 Colesville Rd., Ste. G106, Silver Spring, Md., 20910, 301-565-2733.

• March 15-16: Houston, Texas
• April 12-13: San Jose, Calif.
• April 26-27: Detroit, Mich.


For more information, contact Richard Miller at American Ecology Services, Inc., 127 E. 59th St., New York, NY, 10022, or call 212-371-1620.

“Fundamentals of Groundwater Contamination” will include presentations on UST management, groundwater aspects of tanks and spills, geologic aspects of groundwater flow, aquifer and well hydraulics, and regulatory developments.


“Remedial Strategies and Decision Making” will include presentations on: remedial requirements of RCRA, SARA and revised NCP, hydrogeological aspects of remedial actions, site-specific risk assessment for remedial planning, and source control strategies.

• May 16-17: Arlington, Va.

“Health and Safety Training for Hazardous Waste Activities” is a 40-hour OSHA certification training course that includes hands-on instruction to satisfy OSHA regulations covering personnel involved in investigation and remediation of hazardous waste sites.

• April 8-12: Conshohocken, Pa.
• May 6-10: Conshohocken, Pa.
• June 10-14: Conshohocken, Pa.

Three seminars dealing with regulatory compliance are being given by the Environmental Resource Center this year. For more information on any of the three, contact Daralyn Carroll at 919-822-1172 or 800-537-2372, or Fax 919-822-0449.

“OSHA’s Hazard Communication Standard: Training for Trainers” is designed for managers, foremen or supervisors who have the responsibility of training employees on the physical and health hazards associated with exposure to chemicals manufactured, produced or used in the workplace.

• April 12: Tampa, Fla.
• May 7: Lexington, Ky.
• May 22: Las Vegas, Nev.
• June 3: Newark, N.J.
• June 17: New Orleans, La.
• August 6: Chicago, Ill.
• September 5: Atlantic City, N.J.
• September 24: Pittsburgh, Pa.
• October 15: Tampa, Fla.
• October 21: Houston, Texas
• November 21: Dallas, Texas
• November 22: Nashville, Tenn.
• December 5: Los Angeles, Calif.
• December 13: Raleigh, N.C.

“SARA Title III & OSHA Right-to-Know” is a one-day seminar that details the requirements and concisely explains how to comply with the OSHA Hazard Communication Standard and the Emergency Planning and Community Right-to-Know Act (SARA Title III).

• March 22: Cleveland, Ohio
• March 26: Houston, Texas
• March 26: Detroit, Mich.
• April 4: Williamsburg, Va.
• April 8: Tampa, Fla.
• April 19: Des Moines, Iowa
• April 24: Pittsburgh, Pa.
• May 1: Los Angeles, Calif.

The 1991 North American Waste Exchange Conference on Industrial Recycling will feature Congressman Al Swift, of the Subcommittee on Transportation and Hazardous Materials, as its keynote speaker. A waste exchange is an information clearinghouse that allows generators to advertise their waste to potential users. The conference has been organized by the Spokane-based Pacific Materials Exchange in conjunction with the North American Waste Exchanges.

For more information, contact Robert Smee at the Pacific Materials Exchange, S. 3707 Godfrey Blvd., Spokane, WA, 99204-5753, or call 509-623-4244.

• May 5-8: Spokane, Wash.
CET buys Thorne and Baker Pacific

Thorne Environmental, Inc., and Baker Pacific Corp., both Long Beach, Calif., based environmental clean-up firms, have been acquired by Consolidated Environmental Technologies (CET), Inc., Vancouver, British Columbia, an international environmental firm. The acquisition marks CET’s entrance into the Western United States’ environmental marketplace.

CET is a division of Consolidated Press U.S., Inc., which is owned by Consolidated Press Holdings Ltd., a privately held Australian company.

Calendered offered to industrial firms

Environmental Protection Systems, Inc., Rochelle Park, N.J., is offering a regulatory calendar to industrial firms who must comply with many OSHA and EPA regulatory requirements and to their attorneys. It is updated periodically to reflect new compliance deadlines. Environmental Protection Systems offers analytical, industrial hygiene and environmental engineering services.

For more information, write 075 on inquiry card.

Short notices

• **Recon Systems, Inc.**, Raritan, N.J., has been awarded an environmental consulting contract by the Port Authority of New York and New Jersey to be administered by the Port Authority on behalf of Essex County, the city of Newark and the Port Authority.

• **GeoResearch**, Long Beach, Calif., has purchased an Airex Corp. Retox regenerative thermal oxidizer for its fleet of mobile soil and ground-water remediation treatment systems. The system uses an electrically heated gravel bed to oxidize volatile organic compounds.

For more information, write 076 on inquiry card.

**Ariel Industries**, Chattanooga, Tenn., delivered its first portable, 30-60 tph Low Temperature Thermal Desorber unit to the Soil Recycling Co. of Toronto, Ontario. The plant, designed to thermally process petroleum contaminated soil, was the first of its type permitted by the Ministry of Environment in Ontario, says Ariel.

For more information, write 077 on inquiry card.

• **Geraghty & Miller, Inc.**, Plainview, N.Y., and Heidemij, Amstelhoek, The Netherlands, have announced a joint venture to introduce Heidemij’s soil washing technologies to the U.S. The soil washing system, a physio-chemical method, addresses both organic and inorganic contamination.

For more information, write 078 on inquiry card.

**Geraghty & Miller** also announced the consolidation of its pollution prevention and remediation engineering services with its groundwater and hydrocarbon services in Andover, Mass.
The state of state LUST funds
All 50 states have or are developing cleanup funds

By Michael J. Berg and Susan L. Mayer

Congress has required owners and operators of underground storage tanks (USTs) containing petroleum to demonstrate financial ability to pay for corrective action and third-party liability costs. But, most owners and operators have been unable to obtain this often expensive insurance.

And, because of the high probability that USTs have costly existing releases, commercial insurers are generally willing to insure only upgraded tanks with release detection.

In response, most states have established UST insurance funds to assist owners and operators to comply with financial responsibility requirements.

The cost of cleaning up a release from an UST containing petroleum often exceeds $100,000. Every release represents a financial burden that could force owners out of business.

In 1984, in response to growing concern over leaking USTs, Congress amended the Resource Conservation and Recovery Act (RCRA) through the Hazardous and Solid Waste Amendments (HSWA). Subtitle I, added to RCRA by HSWA mandated that EPA develop a comprehensive regulatory program for USTs containing petroleum and hazardous substances. Later the Superfund Amendment and Reauthorization Act of 1986 (SARA) created a Leaking Underground Storage Tank (LUST) Trust Fund to finance cleanups of releases from tanks containing petroleum when responsible parties are unable or unwilling to pay for a cleanup.

The federal financial responsibility regulations require owners and operators to demonstrate annual aggregate coverage of $1 million for owners or operators of one to 100 tanks, $2 million for owners of more than 100 tanks.

In April 1991, marketers with 13 to 99 tanks at more than one facility are required to comply. And, by October 1991, marketers with one to 12 tanks and non-marketers with net worth less than $20 million are required to comply.

Deadlines for larger volume owners and operators have already passed.

Thirty-eight states have established state funds as crucial components of their petroleum underground storage tank financial responsibility programs. All remaining states are in various stages of considering state funds. Some are likely to offer coverage before the end of 1992. New York and New Jersey, who account for about 16 percent of all tanks nationwide, however, are apparently not likely to develop funds in the next two years.

Participation in most state funds is mandatory. Only five states give owners and operators the option of declining to pay required fees or taxes and thereby decline coverage. In addition, some state funds have imposed regulatory compliance or various risk-based standards as eligibility requirements.

In mandatory programs, participants represent a mix of “low risk” and “high risk” tanks, which reduces the uncertainty of the overall risk underwritten by the fund. More low risk tanks will participate in a mandatory than in a voluntary program if private insurance is available and less expensive than fund coverage, which will reduce average costs per tank.

Mandatory participation facilitates the subsidization of small or financially marginal firms. Large firms who can pass a financial test or obtain less expensive insurance elsewhere must remain in the fund.

In addition, mandatory participation increases the feasibility of funding options that are not paid by owners and operators (such as gas taxes).

Mandatory participation reduces administrative expense involved in processing risk-based applications and provides a large base of insureds among whom to spread fixed administrative costs.

However, mandatory participation may be unpopular with tank owners and operators who are able to pass a financial test of self-insurance or buy available commercial insurance at a lower cost than fund coverage. Those who have already upgraded and/or cleaned up existing releases may oppose mandatory coverage as well.

Mandatory programs may also limit private insurers’ participation in the state’s UST insurance market and reduce the incentive for increased insurance availability.

A voluntary program allows tank owners and operators to decline to pay for fund coverage if they can demonstrate financial responsibility through other means, such as a financial test of self-insurance, commercial insurance or other guarantee.

Continues on page 42→
- States with State Funds (submitted to or approved by EPA).
- States with legislation pending (no fund submitted to EPA).
- States with no State Fund program.
A voluntary fund may encourage private insurers to cover USTs. Insurance companies may enter the market insuring a few, relatively low-risk USTs and then expand their coverage as they gain UST claims experience and as USTs comply with increasingly stringent regulations that reduce the likelihood of future claims. And, as existing releases are detected and cleaned up, private insurers are likely to expand coverage.

A voluntary fund will be smaller than a mandatory fund. The smaller size and more limited enrollment will decrease government involvement in the private sector.

But, a voluntary program could encourage private insurers to sell less expensive insurance to low risk owners and operators, leaving the fund with high risk tanks.

A voluntary fund must be financed by fees on covered USTs, otherwise virtually all owners and operators will participate at no cost, thus limiting potential financing methods.

With high risk tanks and financing based on enrollment, the fund might impose extremely high fees or deductibles which many participants might not be able to afford.

A voluntary program will be more difficult to administer. A state must collect fees and adjust revenues with changing participation and closely monitor claims experience and adjust reserves to reflect changing needs.

Types of coverage

- Cover both corrective action and third party liability costs.
- Most state funds provide this type of coverage. This option makes it easier for owners and operators to comply with federal financial responsibility regulations and easier for the state to ensure that owners and operators are in compliance.

This program requires experts in claims management who have the experience and skills to defend against claims, negotiate with injured parties, determine extent of damage, evaluate and implement corrective action options and monitor and adjust claims payments.

- Cover corrective action costs only.

A few states have decided to cover cleanup costs and leave the substantially less frequent third-party damage claims to commercial insurers. Under this option, where corrective action and third-party claims are covered by separate mechanisms, EPA financial responsibility rules require that they each be covered for $1,000,000 (or $500,000 for marketers with low throughput) per occurrence.

One advantage of this option is that both a state and the insurance industry cover the activity with which it is most familiar. Insurers are in the business of adjusting third-party claims, while states focus on environmental cleanup.

The state corrective action staff is generally in place and has experience in cleanup oversight and administration. This option has the advantage of encouraging private insurers to cover liability costs. Because third-party claims occur much less frequently than corrective action claims, third-party coverage is more attractive to insurers.

Existing releases

A state fund must address the question of whether it will cover existing releases that occurred before the date a tank was first covered by an assurance program. Many of these releases are a result of tank spills or overfills and therefore may not be detected by tank tightness tests or inventory monitoring. Covering existing releases significantly increases fund costs. However, screening out all existing releases would be difficult. Moreover, many owners and operators would be unable to pay for the cleanup of existing releases without fund coverage or other state assistance.

While the cleanup of existing sites is a great environmental need, it is an expensive undertaking. For example, in conducting analysis for the Wyoming Department of Environmental Quality, ICF Inc. estimated that the costs over five years of a fund with a $10,000 deductible would be $38,000 per UST for coverage of all releases and $3,000 per UST for coverage of new releases only.

Amounts of coverage

Most states have designed their funds to require owners and operators to pay a specific deductible before the fund begins coverage. Making the owner or operator responsible for a portion of the costs defrays state costs, ensures that an owner or operator takes some responsibility for a release and promotes good tank management.

Deductible amounts range from small sums ($500 or $5,000) to a significant portion of the total coverage limits (perhaps $300,000). In a few states, the deductibles are higher for third-party liability costs than for corrective action costs. Several states have adopted more complex deductibles. For example, a few states impose higher...
deductibles for firms that are marketers or have large numbers of covered tanks or facilities. If the deductible for firms with many tanks is set too high, these firms may view the fund as inequitable, particularly if they tend to have few releases because their tanks have already been upgraded.

First dollar coverage

In order to comply with the UST financial responsibility regulations, an owner or operator must demonstrate coverage from the “first dollar” spent under a state fund or another financial responsibility mechanism. First dollar coverage, combined with active fund participation in overseeing corrective action would help ensure that fund resources are spent wisely. Requiring deductibles creates a risk that the owner or operator will spend the deductible amount unwisely, increasing cleanup costs to the fund. Accordingly, a state may wish to assume responsibility for the cleanup from the first dollar in order to ensure the money is well spent.

Maximum coverage limits

All state funds have limits. Most have ceilings of $1 million per occurrence for corrective action and third-party liability amounts. For marketers and non-marketers with a throughput exceeding 10,000 gallons per month, $1 million is the minimum coverage required under federal rules. Some funds provide additional aggregate coverage limits up to $2 million, or provide unlimited aggregate coverage.

Write in 353 on inquiry card for more information.

PETRO SOIL SYSTEMS

609-354-8100

TURN-KEY SERVICES INCLUDE:

- CREDIT ARRANGEMENTS
- TRANSPORTATION
- MANIFESTING
- SITE MANAGEMENT
- SITE EQUIPMENT OPTION
- DOCUMENTS
- LIABILITY RELEASE

RESULT ORIENTED PROCEDURES

- THERMAL
- LANDFILLS
- ASPHALT MIXES
- PORTABLE RECYCLING
- BIOREMEDIATION
- VITRIFICATION
- IN SITU TECHNOLOGIES

FOR INFORMATION, REFERENCES AND SERVICE, CALL 609-354-8100 OR WRITE PETRO SOIL SYSTEMS OF AMERICA, 417 HADDON AVENUE, HADDONFIELD, NJ 08033.

Member: AEHS Association for the Environmental Health of Soils.

Write in 060 on inquiry card.

March-April 1991 Soils 43
Saddam Hussein’s environmental attack threatens the ecosystem throughout the Persian Gulf. Fish, birds and other sealife are gravely affected. Man, too, is threatened with oil migrating near essential desalination systems. American science and technology will undoubtedly play a major role in remediating this and other war-related contamination. In an active war zone, however, mitigation of the environmental casualty to minimize further risk is difficult. The priority, therefore, is to solve the problem using technologies that are proven, safe and effective.

The immediate mobilization of booms, skimmers, pumps, barges and other ancillary mechanical recovery systems is well underway in the Gulf to minimize damage from the 460 million gallon release. Orders for miles of vinyl booms are currently being filled by American companies.

However, because the release is located in a war zone, organization of the long range remediation effort is in a state of uncertainty. Government representatives are quick to point out it is not the responsibility of the United States government to clean up the Persian Gulf. Cleanup is the spiller’s responsibility.

In early February, the United States sent a team of experts headed by the Coast Guard from such groups as the Army Corps of Engineers, Environmental Protection Agency and the Department of Energy to begin assessment.

As scientists begin to assess the release, there is little doubt they will look to lessons learned in the cleanup of the Exxon Valdez spill of 1989.

THANK YOU

The Conference Organizers of the Second Annual West Coast Conference on HYDROCARBON CONTAMINATED SOILS & GROUNDWATER, Newport Beach, CA, March 4-7, 1991, would like to thank the following groups for their generosity and assistance in making the conference a tremendous success:

Applied Geosciences
Anaheim Public Utilities Department
ARCO Products Company
California Department of Health Services
Chevron Oil Field Research Company
EMCON Associates
EPA/Office of Underground Storage Tanks
Groundwater Technology, Inc.
Hydro-Fluent, Inc.
ICF Technology Incorporated
IT Corporation
James M. Montgomery, Consulting Engineers, Inc.
Lawrence Livermore National Laboratory
Lockheed Aeronautics System Division
McLaren/Hart

Orange County Chamber of Commerce
Orange County Health Care Agency
Port of Los Angeles
Radian Corporation
RETec
Shell Oil Company
Southern California Edison Company
Southern California Gas Company
State Water Resources Control Board
The Earth Technology Corporation
Toxic Treatments (USA), Inc.
TPS Technologies, Inc.
US EPA/Region 9
Western States Petroleum Association

Write in 061 on inquiry card.
The EPA response to that release illustrated that the application of organisms has yet to be scientifically proven effective, except in fully contained bioreactor systems used to process contaminated soil and water in tanks.

In Prince William Sound, site of the Exxon Valdez spill, as in many environments, there are organisms already present in the soil and water which will naturally degrade the contaminant material. Bioremediation activities on the beaches may involve the application of nutrients to microbial populations to achieve rapid degradation of the contaminant compound.

The National Environmental Technology Applications Corporation, (NETAC), with the support of the EPA tested 11 commercial formulations for beach application in Prince William Sound. Two were chosen and applied, but the results from field studies are still being compiled. Still, Prince William Sound recovered more quickly than expected from the Exxon Valdez spill.

The story of the Persian Gulf release remains to be told over years to come as specialists cope with the massive damage.

Write in 352 on inquiry card for more information.

---

**CALL FOR PAPERS**

**Third Annual West Coast Conference on ...**

**HYDROCARBON CONTAMINATED SOILS AND GROUNDWATER**

Analysis, Fate, Environmental & Public Health Effects, and Remediation

Orange County, California

March, 1992

**CONTRIBUTED PAPERS AND POSTERS** are invited for presentation in the following areas:

- chemical analyses
- hydrocarbon identification
- site assessment/field sampling
- regulatory programs and policies
- environmental fate
- environmental modeling
- soil chemistry
- hazard, exposure, and risk assessment
- standard remedial technologies/corrective actions
- innovative remedial technologies
- case studies on the above

**SPECIAL SESSIONS** directed to the railroad, shipping, and transportation industries as well as the military are planned. Presentations related to the following areas are encouraged:

- diesel fuel contamination
- contamination at military installations
- contamination at shipping ports
- estuarine contamination
- international developments

**DEADLINE FOR SUBMISSION IS JULY 1, 1991.**

For either a paper or poster to be considered please submit an ABSTRACT containing: presentation title; 300 word narrative; and for each author, name, degree, title, affiliation and complete address and phone number. PLEASE INDICATE YOUR CHOICE OF EITHER ORAL PRESENTATION OR POSTER.

**PROCEEDINGS** will be published after the conference and will include manuscripts from both oral and poster presentations. Presenters will be required to submit a manuscript by January 1, 1992.

**EXHIBITION SPACE** is available.

**FOR FURTHER INFORMATION** and abstract submission please contact:

Martha Barrett
EPACH Corporation
150 Fearing Street, Suite 17
Amherst, MA 01002
TEL: 413-549-5561
FAX: 413-549-0579

Write in 062 on inquiry card.
### Fast Response Hotline

<table>
<thead>
<tr>
<th>Company</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABB Environmental</td>
<td>617-245-6606</td>
</tr>
<tr>
<td>American Reclamation Corp.</td>
<td>508-624-7006</td>
</tr>
<tr>
<td>Atlantic Thermal Soil Remediation</td>
<td>302-652-5976</td>
</tr>
<tr>
<td>Brown-Minneapolis Tank</td>
<td>612-454-6750</td>
</tr>
<tr>
<td>Chama Corporation</td>
<td>800-232-4262</td>
</tr>
<tr>
<td>Clements Associates, Inc.</td>
<td>800-247-6630</td>
</tr>
<tr>
<td>Dexit Corporation</td>
<td>203-288-3509</td>
</tr>
<tr>
<td>Dunn Geoscience Corporation</td>
<td>518-458-1313</td>
</tr>
<tr>
<td>Ecova Corporation</td>
<td>800-548-3668</td>
</tr>
<tr>
<td>EcoVault</td>
<td>800-ECOVault</td>
</tr>
<tr>
<td>Environmental Instruments</td>
<td>415-686-4474</td>
</tr>
<tr>
<td>EPACH Corporation</td>
<td>413-549-5561</td>
</tr>
<tr>
<td>Friedman &amp; Bruya, Inc.</td>
<td>800-487-8231</td>
</tr>
<tr>
<td>Gencor Industries, Inc.</td>
<td>407-290-6000</td>
</tr>
<tr>
<td>Gentec</td>
<td>800-826-0223</td>
</tr>
<tr>
<td>Geraghty &amp; Miller, Inc.</td>
<td>800-225-8419</td>
</tr>
<tr>
<td>Intek Corporation</td>
<td>800-332-6527</td>
</tr>
<tr>
<td>Javco, Inc.</td>
<td>414-337-4990</td>
</tr>
<tr>
<td>KVA Analytical Systems</td>
<td>508-540-0561</td>
</tr>
<tr>
<td>Micro Systems, Inc.</td>
<td>703-642-6919</td>
</tr>
<tr>
<td>O/C Tanks Corporation</td>
<td>800-OC-TANKS</td>
</tr>
<tr>
<td>Petro Soil Systems</td>
<td>609-354-8100</td>
</tr>
<tr>
<td>RE Wright Associates</td>
<td>717-944-5501</td>
</tr>
<tr>
<td>Site Reclamation Systems, Inc.</td>
<td>904-324-3651</td>
</tr>
<tr>
<td>Soil Purification, Inc.</td>
<td>404-861-0069</td>
</tr>
<tr>
<td>Soil Safe, Inc.</td>
<td>901-327-6026</td>
</tr>
<tr>
<td>Tarmac Equipment Co., Inc.</td>
<td>816-228-0882</td>
</tr>
<tr>
<td>United Retek Corporation</td>
<td>508-429-6220</td>
</tr>
<tr>
<td>U.S. Environmental Services</td>
<td>800-323-USES</td>
</tr>
<tr>
<td>Winn Engineering &amp; Testing Inc.</td>
<td>800-256-WINN</td>
</tr>
</tbody>
</table>

### Advertiser Index

<table>
<thead>
<tr>
<th>Company</th>
<th>Page</th>
<th>Inquiry</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABB Environmental</td>
<td>26</td>
<td>037</td>
</tr>
<tr>
<td>American Reclamation Corp.</td>
<td>16</td>
<td>043</td>
</tr>
<tr>
<td>Atlantic Thermal Soil Remediation</td>
<td>45</td>
<td>080</td>
</tr>
<tr>
<td>Brown-Minneapolis Tank</td>
<td>23</td>
<td>054</td>
</tr>
<tr>
<td>Chama Corporation</td>
<td>32</td>
<td>044</td>
</tr>
<tr>
<td>Clements Associates, Inc.</td>
<td>13</td>
<td>051</td>
</tr>
<tr>
<td>Dexit Corporation</td>
<td>33</td>
<td>058</td>
</tr>
<tr>
<td>Dunn Geoscience Corporation</td>
<td>11</td>
<td>050</td>
</tr>
<tr>
<td>Ecova Corporation</td>
<td>47</td>
<td>023</td>
</tr>
<tr>
<td>EcoVault</td>
<td>12</td>
<td>079</td>
</tr>
<tr>
<td>Environmental Instruments</td>
<td>48</td>
<td>030</td>
</tr>
<tr>
<td>Epach Corporation</td>
<td>44</td>
<td>061</td>
</tr>
<tr>
<td>EpachCorporation</td>
<td>45</td>
<td>062</td>
</tr>
<tr>
<td>Friedman &amp; Bruya, Inc.</td>
<td>29</td>
<td>055</td>
</tr>
<tr>
<td>Gencor Industries, Inc.</td>
<td>3</td>
<td>047</td>
</tr>
<tr>
<td>Gentec</td>
<td>34</td>
<td>001</td>
</tr>
<tr>
<td>Geraghty &amp; Miller, Inc.</td>
<td>39</td>
<td>014</td>
</tr>
<tr>
<td>Intek Corporation</td>
<td>9</td>
<td>049</td>
</tr>
<tr>
<td>Javco, Inc.</td>
<td>35</td>
<td>059</td>
</tr>
<tr>
<td>KVA Analytical Systems</td>
<td>27</td>
<td>005</td>
</tr>
<tr>
<td>Micro Systems, Inc.</td>
<td>15</td>
<td>052</td>
</tr>
<tr>
<td>O/C Tanks Corporation</td>
<td>20,21</td>
<td>053</td>
</tr>
<tr>
<td>Petro Soil Systems</td>
<td>43</td>
<td>060</td>
</tr>
<tr>
<td>RE Wright Associates</td>
<td>11</td>
<td>036</td>
</tr>
<tr>
<td>Site Reclamation Systems, Inc.</td>
<td>7</td>
<td>048</td>
</tr>
<tr>
<td>Soil Purification, Inc.</td>
<td>17</td>
<td>063</td>
</tr>
<tr>
<td>Soil Safe, Inc.</td>
<td>2</td>
<td>033</td>
</tr>
<tr>
<td>Tarmac Equipment Co., Inc.</td>
<td>31</td>
<td>057</td>
</tr>
<tr>
<td>United Retek Corporation</td>
<td>30</td>
<td>056</td>
</tr>
<tr>
<td>U.S. Environmental Services</td>
<td>13</td>
<td>046</td>
</tr>
<tr>
<td>Winn Engineering &amp; Testing Inc.</td>
<td>39</td>
<td>041</td>
</tr>
</tbody>
</table>

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 goes directly and only to major companies affected by hydrocarbon contaminated soil...companies that face the task of meeting contaminated soil edicts, and companies who specialize in soil cleanup, hydrocarbon storage and monitoring.

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

8,000 major companies with hydrocarbon storage liabilities...companies in the market for improved underground storage tanks, monitoring and cleanup services and equipment.

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. Don't miss the summer '91 issues!!!
BIOREMEDIATION

When it's experience you're looking for, no one beats ECOVA. In the past four years we've processed over 800,000 cubic yards of contaminated soil and millions of gallons of water using innovative, cost-effective biological remediation techniques. ECOVA's experience is not just in the lab—it's in the field.

It's that field experience that separates us from other companies claiming bioremediation expertise.

ECOVA's treatment technologies also include:

- Soil Washing
- Physical/Chemical Processes
- Incineration

These technologies are combined to develop the most effective treatment process for each individual site.

If you need to solve a hazardous waste problem, call ECOVA today. . . We've got the experience.

ECOVA

ECOVA Corporation
3820 159th Avenue NE • Redmond, WA 98052
(206) 883-1900
1-800-548-3668

Solid-Phase Bioremediation

ECOVA has processed over 800,000 cubic yards of soil using onsite bioremediation processes—a level of onsite experience unsurpassed in the industry.

In Situ Bioremediation

In situ bioremediation of hydrocarbons, pesticides, and chlorinated solvents such as TCE have achieved significant results for both soils and groundwater.

Slurry-Phase Bioremediation

Batch and continuous flow slurry-phase bioreactors are used to treat chlorinated hydrocarbons, soluble organics, pesticides and pentachlorophenol.
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 Stripper.

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

WRITE IN 030 ON INQUIRY CARD