Remediation Services Buyer's Guide

1992

Thermal desorption... now you're cookin'
Do it right the first time

Stretch your remediation dollar
METCO ENVIRONMENTAL, INC.

PROVIDING REMEDIATION OF CONTAMINATED SOIL AND DEVELOPING SAFE, ECONOMICAL ANSWERS TO TODAY'S ENVIRONMENTAL PROBLEMS

The METCO Group, building on twenty years of experience, can offer the professional services you need to deal with your environmental problems. METCO'S soil remediation equipment employs patented technology, using its radiant thermal process, to remove hydrocarbons and destroy many other organic pollutants from soil. We can remediate your soil on site with portable plants capable of production up to 150 tons per hour, or your soil can be treated at our stationary facilities in Maryland.

Specializing in remediation of petroleum contaminated soil, METCO can offer a reasonable alternative to accepting the financial liability which can continue to exist after landfilling your contaminated soils. We can safely accept your soil at our enclosed and permitted facilities for thermal remediation. Our price can compete with other less desirable methods of disposal and eliminate the associated risks. METCO'S performance can be bonded and certificates of destruction are available from our process. For information and pricing of our services contact us at (301) 729-6922 or FAX (301) 729-0118.

Write in 193
A PROBLEM SOIL? GRR! HAS THE SOLUTION.

Recycle Your Soil! as a raw material in the manufacture of GIANT CEMENT

Through our patented Tigrr! process, GIANT Resource Recovery has removed the contaminates from and recycled over 60,000 tons of soil. All of the solid siliceous residue from the process was then used as part of the raw material for GIANT’s cement production in a facility that meets RCRA standards.

- Improved waste management with NO LIABILITY
- Positive public perception of recycling
- No more dependence on landfills
- Protection of the environment

We turn a liability — waste — into an asset that replaces sand in our manufacturing process. Call us today at 1-800-786-0477 for an information packet.

Grr!

Giant Resource Recovery Company
Highway 453 / Post Office Box 352
Harleyville, South Carolina 29448
(803) 496-7676 / (800) 786-0477

Giant Cement Company
Highway 453 / Post Office Box 218
Harleyville, South Carolina 29448
(803) 496-7880 / (800) 845-1174

Keystone Cement Company
7311 Airport Road / Drawer A
Bath, Pennsylvania 18014-0058
(215) 837-1881 / (800) 255-5736

Write in 130
Staff
Publisher
William E. Neeley
Managing Editor
Susan Parker
Publications Director
Nina Furstenau
Advertising Director
Darcy V. Case
Graphic Artists
Keith Kavanaugh
Dave Eames
Technical Illustrator
John Weaver

Advisory Board Chair
Paul Kostecki, Ph.D.

Contents June-July 1992
1992 Remediation Services Buyer’s Guide
State by state listing
Turn to page 13.

Features

6 Do it right the first time
What are the options when a “remediated” site continues to show signs of contamination

30 Thermal desorption...
now you’re cookin’
Hot technology: how it works, what it costs, where’s it going?

58 Best strategies to survive real estate transactions
Know the best approaches to minimize liability and expense

Departments

56 What’s new
64 KVA flowmeter
70 Advertiser Index
66 Vitrification
and Hotline
68 Siteworks system

Here’s How It Works

Cover design by Keith Kavanaugh

Soils magazine is published nine times per year by Group III Communications, Inc., 10229 E.
Entire contents copyright 1992 by Group III Communications, Inc. All rights reserved. Opinions
expressed by writers in Soils magazine are not necessarily those held by the publisher.
SUBSCRIPTIONS: Soils magazine is mailed to companies with hydrocarbon storage liabilities and
to regulatory people. U.S. subscriptions: $36 per year. Outside U.S.: $60 per year, U.S. funds only.
“Whole sector’s contaminated. Need backhoes! Can we get ’em fast?”

Definitely — when you call Hertz Equipment Rental! You’ll get what you need, in any quantity, when you need it. Earth movers, air, electrical, aerial, material handling equipment and — you name it — all available at your call from the huge inventory on hand at every one of our branches, coast to coast. Late models. Brands you trust. All kept in top condition by our factory-trained service professionals who work to standards exceeding manufacturer specifications.

What’s more, Hertz knows the needs of the people who handle hazardous wastes. We’re fully experienced with the demands of Emergency Response Contracts, and we’re prepared to respond well within specified time frames. Moreover, our HazMat customers are assured continuous access to their Hertz representatives, because we supply every number needed for contact 24-hours a day, seven days a week: beepers, car phones, office phones, even home phones.

So, whether your contamination problem is severe or minor, consider your nearest Hertz Branch your equipment yard, ready to fill your needs fast! Want the location of your nearest Hertz Equipment Rental branch? Check your Yellow Pages, or call 1-800-223-0983.* Ask for your copy of our informative HazMat brochure, too.

*Within New Jersey, call 201-307-2722

Hertz Equipment Rental
Do it right the first time
What are the options when a “remediated” site continues to show signs of contamination?

By James Brown, Ph.D.

The soil cleanup process at leaking underground storage tank (LUST) sites is often incomplete, leaving some residual contamination behind. Even a small volume of moderately contaminated soil can contaminate large volumes of groundwater over long periods of time. Relatively small sites can accrue big cleanup expenses if all sources of contaminated soil are not removed. The result is excessive project costs from either extended groundwater monitoring or cleanup and delayed project closing. So what are some of the factors that weigh on the decision-making process of whether and how to proceed?

A typical LUST site contains one leaking tank on a parcel of one acre or less. Because these sites are usually small, the current preference is usually to excavate and dispose or recycle the contaminated soil off site. Soil within the tank cavity is usually excavated to a soil boundary at which there is no discernible evidence of residual free product or organic vapors and the tank cavity is backfilled. Unfortunately, relatively high soil concentrations of semi-volatile hydrocarbon compounds from fuel oils and degraded gasolines may still be present, but undetected by organic vapor monitoring.

Three case studies at relatively small sites demonstrate the decision process for remedial action. At all three sites, contaminated soil was excavated and disposed off site and tank cavities were backfilled. Following this initial cleanup, a relatively small zone of contaminated soil was discovered that was largely responsible for groundwater contamination at each site. The prediction is that if this residual contamination is not removed, it will release contaminants into groundwater at unacceptable levels for several years via mass flow, dissolution and desorption processes.

Site A was the most difficult in reaching cleanup goals. The source was a releases from a gasoline tank. The site was upgradient and within one half mile of potable water supply wells. As a result, groundwater treatment was required to attain drinking water standards for benzene, toluene, ethyl benzene and xylene (BTEX) compounds. The soil was fine textured clay and silty clay. Contaminant release rates from these low permeability materials was predicted to be quite low. The major source of contamination was a small area containing high levels of BTEX, ranging from 10 to 2,000 parts per million (ppm) which were undetected during the initial cleanup.

Site B involved tank removal plus excavation of soils exhibiting detectable organic vapors using a portable organic vapor analyzer. Unfortunately, residual soil BTEX volatiles from approximately 10 to 100 ppm—and petroleum hydrocarbon concentrations from 200 to 400 ppm remained on site after the cleanup. A series of soil borings and monitoring wells was installed following the cleanup. One of the well locations was found to be contaminated and was probably the main source of groundwater contamination. The regulatory requirement at this site is
for quarterly groundwater monitoring until BTEX volatiles exhibit a substantial decline. Groundwater in the area is not used for drinking. If this remaining source of contamination is not removed, unacceptable BTEX concentrations may persist for several years.

At Site C, the cleanup consisted of removing only the leaking tank and grossly contaminated soil. As a result, hydrocarbon levels ranging from 2,000 to 80,000 ppm remained after cleanup. Groundwater monitoring wells downgradient of the tank contained a visible sheen, evidence of free product. Wells with sheens must be pumped to the absence of all sheen. Pumping has continued for two years with no decline in sheen. The most obvious source of this material is soils containing residual free product. Release of thin free product films in soil by liquid-liquid partitioning could continue for several years before abating. Once sheening has stopped, quarterly groundwater monitoring will be required.

There are several factors that contribute to the persistence of residual hydrocarbon contamination at LUST sites. In soils contaminated with residual free product, immiscible hydrocarbon compounds remain trapped as pockets of free product in pore cavities. Major contaminant release mechanisms include liquid-liquid partitioning and dissolution. Residual free product remaining in soils is the most severe form of contamination, but it is also the most limited in extent.

Typically, following a subsurface release of free product, bulk hydrocarbons move by mass flow through soil, leaving behind a large quantity of residual free product. This soil will initially release contaminants to surrounding soil and groundwater as thin films of free product, followed by dissolution and desorption. Sorption and desorption occur on both organic and inorganic surfaces, such as aluminosilicate clays and oxides. A small zone of free product contaminated soil has the potential to adversely affect a much larger zone of previously uncontaminated soils. Dissolution and desorption of

Continues on page 8 ➔

Figure 1

Purgo Inc.
Soil Remediation Services

"We Guarantee More Than Service... We Promise Professional Commitment!"

- A full service company, specializing in on-site or off-site thermal remediation of soils contaminated with non-hazardous petroleum products.

- Fully bonded, with certified remediation services according to federal and state requirements.

- Handles large and small jobs, building a reputation for meeting clients' diverse and complex needs, delivering customized solutions and reliable service.

- A well documented paper trail traces material from the point it leaves client's site through remediation process.

Ask for our Services Brochure

Purgo Inc., Soil Remediation Services.

5020 Monument Avenue, Suite 1 • P.O. Box 6983 • Richmond, VA 23230
(804) 353-7400 • Outside VA (800) 446-2614 • Fax (804) 353-4317

Write in 136

June-July 1992 Soils 7
contaminants from soil can and do contribute contaminants to groundwater for very long periods of time.

Unfortunately, little information is available about sorption and desorption of hydrocarbon contaminants in saturated and unsaturated soils. The contaminant desorption process is therefore difficult to predict. One of the greatest difficulties in predicting desorption of soil contaminants is that soil water does not move uniformly through the entire body of soil, but along preferential flow paths, bypassing much of the sorbed contaminants held in the fine pore system. The net effect is that the actual contaminant desorption process is much slower than predicted from either desorption isotherms or distribution coefficients. As shown in figure 1, page 7, contaminant release may also be governed by diffusion.
within the fine pore system. Diffusion-limited release from low permeability to high permeability soil zones is a very slow process. Any site remediation plan which involves either excavation or groundwater treatment that does not consider the release of sorbed contaminants to groundwater is inadequate.

For example, implementation of a pump and treat system for groundwater remediation at any site with some residual soil contamination is likely to be both costly and unpredictable in terms of time to attain cleanup objectives. This is particularly important when zones or layers of fine textured soil material are contaminated. Because a small volume of soil has the potential to release contaminants to groundwater for several years, it is very important that all residual contamination be identified and removed to the greatest extent possible.

The regulatory goal at all three case history sites is a soil action limit of 100 ppm of petroleum hydrocarbons. Strict adherence to this limit would nearly eliminate all contaminated source materials thereby preventing further groundwater contamination. In practice, however, few sites are remediated to this limit. Before regulations were in place, many sites were remediated only to the extent that soils containing residual free product (30,000 ppm petroleum hydrocarbon concentrations or greater) were removed. At other sites, field screening with portable organic vapor monitoring equipment delineated a clean soil boundary. Unfortunately, this equipment is not capable of detecting organic vapors from soils containing as little as 100 ppm petroleum hydrocarbon concentrations. In fact, organic vapors are often undetectable at 2,000 to 3,000 ppm petroleum hydrocarbon concentration unless the source is a highly volatile product such as gasoline or a very recent spill of No. 2 fuel oil, kerosene or jet fuel.

At many LUST sites, high levels of residual soil contamination cannot be removed if they extend beyond a reasonable excavation limit. This can occur when contamination extends beneath buildings or other permanent structures or when contamination is deep. However, at many sites, contaminated source material could be removed, but is not. In some states, removal of contaminated soil is only required to a depth where saturation is encountered. Unfortunately, the zone of saturation at most sites fluctuates by several feet per year. If free product is present, it becomes distributed throughout the entire groundwater fluctuation zone. If excavation proceeds only to the limit of saturation during a seasonal high water table condition, most of the contamination may remain on site. Although excavation within a saturated zone is difficult and may require simultaneous pumping and collection of contaminated water, it is imperative that all contaminated soil materials in the groundwater fluctuation zone be removed, eliminating a source of prolonged groundwater contamination.

There is a need for a field screening process during soil excavation capable of identifying hydrocarbon contaminated soils at or below a regulatory action limit. Without an effective screening process, a series of separate excavations is required to identify a clean soil boundary, with collection of confirmatory soil samples after each excavation. This process is both costly and time consuming.

TRC Environmental Consultants of Somerset, N.J., recently tested a portable field screening instrument, the Horiba OCMA-220 oil analyzer. The unit uses infrared spectroscopy to detect petroleum hydrocarbons at levels well below 100 ppm. Preliminary testing confirmed the capability of the instrument to detect low petroleum hydrocarbon concentration levels in soil. Use of this or a similar screening apparatus permits generation of real time field data which can help direct excavation to a clean soil boundary without the additional costs and delays associated with incremental excavation and confirmatory sampling.

It is important to be able to determine whether it is more cost-effective to proceed with either long term groundwater monitoring or

Continues on page 10 **
groundwater treatment, or both—or to re-excavate the remaining contaminated soil. If re-excavation is the most economical option, it is critical that it be preceded by a thorough soil boring investigation or soil gas survey to define the approximate boundaries of contamination, and accompanied by a field screening process capable of identifying low hydrocarbon levels. None of the three case study sites has been re-excavated, but that option is being considered. A comparison of the costs to re-excavate versus costs of no further remedial action is shown in Figure 2, page 8.

The estimated costs for the re-excavation option ranged from $24,000 to $33,000 for the three sites. The cost difference is based on a greater number of monitoring wells at Site A and fewer at Site C. The estimated cost to attain site closure without re-excavation is considerably greater than the cost to re-excavate at all three sites. At Site C, which requires pumping and disposal of sheened groundwater plus intermediate-term monitoring, the cost to attain closure was 3.8 times that for re-excavation and short-term monitoring. The relative difference in costs was similar at Site B, which is also deemed to require intermediate-term monitoring.

The greatest relative difference in estimated cost to attain closure is at Site A, in which a portable activated carbon treatment unit plus a part-time operator is required for removal of volatile gasoline components. This pump and treat system, plus quarterly monitoring is expected to be required for some 15 years. The estimated cost of this option, $428,000, is over 13 times greater than the cost of the re-excavation and short-term monitoring option.

It is obvious that there is a substantial cost in leaving even small volumes of contaminated soil on site following an initial cleanup. The cost estimates presented here assume a short-term monitoring period of one year following successful removal of all sources of contamination—and that contaminant concentrations in monitoring wells will decline within the year. At Site A, where drinking water standards apply, the monitoring period may extend beyond one year. But even if monitoring were required for four years, the costs would still be less than one quarter of the cost for a groundwater pump and treat system.

For the no-excavation option at Sites B and C, a six-year monitoring period was assumed. This is a reasonable estimate, given that both sites contain moderate to high levels of residual soil contaminants which will probably be released slowly by both dissolution and desorption.

In the absence of complete source removal typical in most small site LUST cleanups, release of soil-borne contaminants to groundwater can be expected, resulting in costly long-term groundwater monitoring and cleanup. In most cases, re-excavation is more cost-effective than a no action alternative. Once the decision is made to achieve complete source removal, the course of action to accomplish it is similar for most sites, regardless of
whether an initial cleanup effort has occurred. The first step to achieve total source removal is to define the boundaries of contamination. The two most common approaches are a soil gas survey or soil boring investigation. The soil gas survey is most appropriate to detect gasoline and light fuel constituents at sites with relatively homogeneous, coarse-textured soils. Soil gas surveys are not appropriate at sites with fine-textured, low-permeability soils—or at sites containing heterogeneous fill materials or clay lenses or layers. A soil boring investigation is the most typical approach, but it is often used after removal of the leaking tank rather than before. As a result, outlying areas of contaminated soil are identified, but not removed. In addition, some of these borings are converted to groundwater monitoring wells. This approach practically guarantees the existence of a future groundwater quality problem.

A more effective approach is to start by installing soil borings on a systematic grid to determine the vertical and horizontal extent of contamination. Once the contaminant distribution has been identified, all sources of contamination can be removed and groundwater monitoring wells sited outside soil contamination boundaries to determine the nature and extent of groundwater contamination. This approach is based on the assumption that all contaminated soil can be excavated. For those sites where hydrocarbon contamination has penetrated to depths greater than the practical limit of excavation—or beneath buildings, total source removal is not an option.

Frequently, soil excavation at LUST sites proceeds to a zone of saturation and no further, in accordance with regulatory requirements. If a contaminated groundwater fluctuation zone is within a depth of feasible excavation, all soil within this zone should be removed. The zone of groundwater fluctuation is nearly always severely contaminated if there has been bulk flow of petroleum product through overlying soil. It is also important to use some means of rapid screening for low soil hydrocarbon levels as part of a total source removal process. If the required soil cleanup limit is 50 to 100 ppm, some means must be available to screen soil materials to these low concentrations. Many analytical laboratories offer 24-hour turnaround results at reasonable cost. A more effective method, however, is to use a portable infrared spectrophotometer that can detect low soil contamination levels using accepted analytical methodology.

A great deal of uncertainty still exists about the desorption of petroleum hydrocarbon compounds in soil. Future research needs include adsorption and desorption investigations in both batch and column studies to more accurately predict the release of BTEX volatiles from soils containing low levels of these compounds. Column investigations should be designed to study these processes under both saturated and unsaturated conditions with a wide variety of naturally occurring soil materials.

Write in 563 for more information

---

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

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

Often, in the mad rush to satisfy state or federal regulators, characterization and identification analyses are overlooked. After the regulators are gone, questions come up like: “Was it all ours?” or “Just how old was it?” It is usually too late to ask these questions because all of the evidence needed (oil sheens, contaminated soils) has been removed.

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

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

**FRIEDMAN & BRUYA, INC.**

Environmental Chemists

Petroleum Product Identifications
Expert Witnesses ● Soil and Water Testing

Write in 055

June-July 1992 Soils 11
This is not what we do. This is what we save.

Through soil recycling, the beauty and value of a virgin forest will not be destroyed by clearing for a new landfill. Soil Safe's unique stabilization process recycles 100% of incoming material, thereby not contributing to landfill growth.

We offer turnkey services for petroleum contaminated soil removal needs. Professionally managed from start to finish, we perform site audits, collect soil samples, complete required analytical tests, schedule trucking and loading, supervise soil removal, and finally, accept material at our facility where it's recycled into high quality construction materials and paving products.

Our comprehensive Materials Management Program provides a complete audit trail for every truckload and/or drum of material that enters the facility. All incoming soil and outgoing recycled products are closely managed to monitor our constantly changing inventory of material.

Another advantage we offer our clients is the volume of material we are capable of recycling relative to other disposal alternatives. The plants at our Baltimore facility are capable of producing 650 tons of paving products each hour. Because of these significant production capabilities, we have recycled in excess of 375,000 tons of soil in the two year period we have been in business.

The market for our recycled products is ever expanding. We have completed over 50 construction projects to date, and our Construction Sales Division consistently has an inventory of 50 potential projects under evaluation. Many of our clients who bring soil to our facility enjoy significant savings by utilizing our recycled products in their paving projects.

Having the capability to manage both incoming and outgoing material in a cost effective and efficient manner is the key competitive advantage we offer our valued clients. For more information on our services and how we can help you solve your soil problems, call DAN NIESER, Marketing Director.

This is what we do.

Shopping Center / Vienna, Virginia
Warehouse / Rockville, Maryland
Service Station / Alexandria, Va

Visit us at HazMat International, Booth 1812
Remediation Services
Buyer’s Guide

We made every effort to contact firms across the U.S. who provide remediation services. We know there are more out there. We hope to continue to collect information about remediation firms throughout the year. And we expect next year’s guide to be even better.

The guide is simply organized—state by state—and includes company addresses, telephone and fax numbers, as well as a contact person for more information. At the end of each listing is a three letter code to indicate the particular remediation services each company offers.

Keep the guide as a reference throughout the year. If you have questions or suggestions to improve the guide, or, if you wish to be included in next year’s guide, please mail or fax:

Soils Magazine, Editor
10229 E. Independence Ave.
Independence, MO 64053
Fax: 816-254-2128

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

FAST ON THE JOB...

Making both large jobs and small jobs more profitable!

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

"The most portable pugmill available anywhere."

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

Write in 081

June-July 1992 Soils 13
ALASKA
B.C. Excavating Inc.
2251 Cinnabar Loop
Anchorage AK 99507
907-344-4490 Robert Haines
FAX: 907-344-4492
BIO EXC REC SVE
SVT SFL STB TTR
LFM
Geochem/Agri Enviro Svcs.
500 W. Potter Dr.
Anchorage AK 99518
907-272-2121 Joe Neubauer
FAX: 907-272-2121
BIO SWA LFM

ALABAMA
ETC
2252 Rocky Ridge Rd. #106
Birmingham AL 35216
205-823-6381 Margaret Naugle
FAX: 205-823-6381 CON
Sunbelt Resources
715 Skyland Blvd. E.
Tuscaloosa AL 35405
205-758-3657 FAX: 205-349-4288
TTR

ARKANSAS
Arkansas Research & Inst Co. Inc.
10310 W. Markham Ste. 165
Little Rock AR 72205
501-224-2793 Joe Henry
FAX: 501-224-2793
BIO EXC REC SVT
SFL SWA LFM
Relco Inc.
Hwy 82 East Box 1628
Texarkana AR 75502
501-772-3867 Rhonda Maxwell
FAX: 501-772-4157
SVT SWA
Smith Fiberglass Products Inc.
2700 W. 65th St.
Little Rock AR 72209
501-568-4010 Janice Brummett
FAX: 501-568-4465
MFG: TANKS PRD
York Env. Svcs.
Box 343
Malvern AR 72104
501-844-4470 Sherman Wright
FAX: 501-844-4472
EXC STB LFM

ARIZONA
Arizona Instrument
1100 E. University Dr.
Tempe AZ 85281
800-528-7411 Allen Porter
FAX: 602-731-3434 SVE MFG

Desert Earth Engineering
1001 S. Euclid
Tucson AZ 85719
602-792-4767 John Purcell
FAX: 602-792-2539
SGT
Diversified Contractors
1701 W. Linden
Phoenix AZ 85007
602-274-0787 Russ Woody
FAX: 602-257-0773
BIO EXC REC STB TTR
EMCON Southwest
3922 E. University Dr.
Phoenix AZ 85034
602-470-0444 Gene Cetwinski
FAX: 602-470-0567
BIO EXC REC SVE
SVT LFM
Patrick Welch Inc.
10505 N. 59th St. Ste. 600
Scottsdale AZ 85253
602-941-1400 Patrick Welch
FAX: 602-998-1046
BIO SVE SWA STB ENG
Tracer Research Corp.
3855 N. Business Center Dr.
Tucson AZ 85705
602-388-9400 Betty Dykstra
FAX: 602-293-1306
SVE SGT
US Tank Management Inc.
703 S. Main St. Ste. 15
Cottonwood AZ 86326
800-786-8786 Rick McNerney
BIO EXC SVE SVT
LFM
W.E. Duke, P.E.
10625 E. Cinnabar Ave.
Scottsdale AZ 85258
602-391-3067 Earl Duke
SVE SVT
Western Tech.
4625 S. Ash St. Ste. J12
Tempe AZ 85282
602-830-6733 Glen Turney
FAX: 602-470-7045
BIO EXC SVE SVT
SFL STB

CALIFORNIA
A & S Env. Recovery Inc.
2261 E. 15th St.
Los Angeles CA 90021
213-623-9443 Douglas Kunnel
FAX: 213-488-9854
SVE STB

KEY:
BIO=BIOREMEDIATION
CON=CONSULTING
CSW=COMPUTER
ENG=ENGINEERING
EXC=EXCAVATION
FIN=FINANCE
LAB=LABORATORY
LFM=LANDFARMING
MFR=MANUFACTURER
MON=MONITORING
MFG=MANUFACTURING
PRD=PRODUCTS
REC=RECYCLING
SVE=SUSTAINABLE
SOIL=SUSTAINABLE
STB=STABILIZATION
SVA=SUSTAINABLE
SOIL WASHING
TTR=TERMS
TP=TESTING
TANK=TANK SERVICES
TRANSPORTATION
VIT=VITRIFICATION
<table>
<thead>
<tr>
<th>Company</th>
<th>Address</th>
<th>Phone</th>
<th>Contact Person</th>
<th>Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adwest Technologies Inc.</td>
<td>803 W. Angus Ave.</td>
<td>714-997-8722</td>
<td>Joe Terry</td>
<td>SVE TTR MFG</td>
</tr>
<tr>
<td>Airex Corp.</td>
<td>803 W. Angus Ave.</td>
<td>714-997-2349</td>
<td>Joe Terry</td>
<td>SVE TTR MFG</td>
</tr>
<tr>
<td>Ally Capital Corp.</td>
<td>803 W. Angus Ave.</td>
<td>714-997-8722</td>
<td>Joe Terry</td>
<td>SVE TTR MFG</td>
</tr>
<tr>
<td>American Env. Mgt. Corp.</td>
<td>10960 Boatman Way</td>
<td>714-826-6320</td>
<td>Anneline Osterberg</td>
<td>FAX: 714-826-0604</td>
</tr>
<tr>
<td>Applied Env. Svs.</td>
<td>23223 Plaza Pointe Dr. Ste. 100</td>
<td>714-826-6320</td>
<td>Stephen Testa</td>
<td>REC SVE SVT SFL SWA STB TTR TDR VIT LFM</td>
</tr>
<tr>
<td>Biotek Env. Svs. Inc.</td>
<td>5353</td>
<td>714-822-0562</td>
<td>Steve Harrow</td>
<td>BIO TTR</td>
</tr>
<tr>
<td>Byron Instruments/General Analysis</td>
<td>26776 Simpatica Circle</td>
<td>714-826-8722</td>
<td>Elsie Ventura</td>
<td>FAX: 714-822-0562</td>
</tr>
<tr>
<td>California Env. Eng. &amp; Contractors</td>
<td>429</td>
<td>714-852-6517</td>
<td>Michael Hodges</td>
<td>BIO SVE</td>
</tr>
<tr>
<td>Clean Earth Inc.</td>
<td>26631 Cabot Rd. Ste. B</td>
<td>714-852-6517</td>
<td>Richard Vogel</td>
<td>BIO EXC SVE TTR</td>
</tr>
<tr>
<td>Clean-Up Technology Inc.</td>
<td>3228 Nebraska Ave.</td>
<td>714-852-6517</td>
<td>Anthony Ulrick</td>
<td>BIO EXC SVT SWA</td>
</tr>
<tr>
<td>Eagle Monitoring Systems Inc.</td>
<td>23 Mauchly Ste 109A</td>
<td>714-852-6517</td>
<td>Nina Behnia</td>
<td>BIO EXC SVT SWA</td>
</tr>
<tr>
<td>Environdyne Inc.</td>
<td>2840 A Howe Rd.</td>
<td>714-852-6517</td>
<td>Rob Eisele</td>
<td>BIO EXC REC SVE SVT TTR TDR VIT LFM</td>
</tr>
<tr>
<td>Environmental Instruments</td>
<td>2170 Commerce Ave. Unit 2</td>
<td>714-852-6517</td>
<td>Barry Zvibeleman</td>
<td>MFG SVT</td>
</tr>
<tr>
<td>Evax Technologies Inc.</td>
<td>269 Mt. Hermon Rd. Ste. 101</td>
<td>714-852-6517</td>
<td>Tom Armstrong</td>
<td>BIO EXC SVE SVT TTR</td>
</tr>
<tr>
<td>Excel Env. and General Eng.</td>
<td>15725 Texaco Ave.</td>
<td>714-852-6517</td>
<td>Walter Wojak</td>
<td>BIO EXC SVT</td>
</tr>
<tr>
<td>Fostar Wheeler Environsponse</td>
<td>11936 Altamar Pl.</td>
<td>714-852-6517</td>
<td>Joseph Mathewson</td>
<td>STB TTR LFM</td>
</tr>
<tr>
<td>Gibson Oil &amp; Refining Co. Inc.</td>
<td>3300 Truxton Ave. Ste. 200</td>
<td>714-852-6517</td>
<td>Dick Dahn</td>
<td>BIO EXC SVE SVT STB TTR LFM</td>
</tr>
<tr>
<td>Hert Combustion Engineers</td>
<td>931 S. Maple Ave.</td>
<td>714-852-6517</td>
<td>Gilbert Castro</td>
<td>BIO EXC SVE SVT STB TTR LFM</td>
</tr>
<tr>
<td>Jacobs Engineering Group Inc.</td>
<td>251 S. Lake Ave.</td>
<td>714-852-6517</td>
<td>Harold Diot</td>
<td>BIO EXC SVE SVT STB TTR LFM</td>
</tr>
<tr>
<td>Jacobs Env. Management Inc.</td>
<td>3892 Del Amo Blvd. Ste. 707</td>
<td>714-852-6517</td>
<td>Stefanie Spikell</td>
<td>BIO EXC SVE SVT STB TTR LFM</td>
</tr>
<tr>
<td>Microenvironment Inc.</td>
<td>3892 Del Amo Blvd. Ste. 707</td>
<td>714-852-6517</td>
<td>Stefanie Spikell</td>
<td>BIO EXC SVE SVT STB TTR LFM</td>
</tr>
<tr>
<td>Net Pacific Inc.</td>
<td>435 Tesconi Circle</td>
<td>714-852-6517</td>
<td>Jeran Stumbaugh</td>
<td>BIO EXC SVE SVT STB TTR LFM</td>
</tr>
<tr>
<td>P Environmental</td>
<td>230 Dove Ct.</td>
<td>714-852-6517</td>
<td>Dick Botke</td>
<td>BIO EXC SVE SVT STB TTR LFM</td>
</tr>
<tr>
<td>Peregrin Env.</td>
<td>859 Cowan Rd.</td>
<td>714-852-6517</td>
<td>Allen Mason</td>
<td>BIO EXC SVE SVT STB TTR LFM</td>
</tr>
<tr>
<td>PETROCHEMICALS &amp; ACCESSORIES FOR THE PETROLEUM, ENVIRONMENTAL &amp; WATER WELL INDUSTRIES</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Accessories for monitoring of underground storage tanks
Steel protective enclosures
Threaded flush joint screen and casing
Sampling devices
Well screens/observation wells
Points-plugs couplings-adapter
Custom fabrications

Continues on page 16→

Write in 181
"Today's Solution to Yesterday's Pollution"

DISPOSAL TECHNOLOGIES, INC.

In today's times, it has become increasingly essential that contaminated soil generators and contractors protect themselves from liability regarding the disposal of their waste materials. At Disposal Technologies, Inc. we pride ourselves in our ability to assure our customers the utmost in protection by eliminating liability through the implementation of our innovative qualification program, waste tracking and security system.

WHY NOT TRY THE BEST!

DISPOSAL TECHNOLOGIES

FEATUREING

- petroleum contaminated soil
- non-hazardous wastes
- hazardous wastes
- municipal solid waste
- demolition debris

CALL 1-800-428-SOIL(7645)

Thermal Treatment • Recycling • Landfiling
605 Townsend Rd.  
Cocoa  FL  32926  
800-282-4584  Robert Pierce  
FAX: 407-639-4017  
EXC  SVE  SVT  SFL  
SWA  STB

GEO Trace Inc.  
Box 1243  
Mt. Vernon  FL  62864  
618-244-7900  Jane Williams  
FAX: 618-244-7999  
BIO

Global Energy  
2888 N.E. 35th Ct.  
Ft. Lauderdale  FL  33308  
305-563-1600  Charles Sechan  
FAX: 305-563-7398  
EXC  REC

Groundwater Control Inc.  
754 Harrison St.  
Jacksonville  FL  32220  
904-783-0477  Gary Wilkins  
FAX: 904-695-0881  
BIO  EXC  SVE  STB

International Recovery Corp.  
700 S. Royal Poinciana Blvd. Ste. 800  
Miami Springs  FL  33166  
305-884-2001  
REC  TTR  CON

Jones Edmunds & Assoc.  
730 N. Waldo Rd.  
Gainesville  FL  32601  
904-377-5821  Terri Reeves  
FAX: 904-377-3166

SVE  TTR  VIT  
Metalf & Eddy Pieco  
3162 Clemson Rd.  
Orlando  FL  32808  
407-295-7101  Dan Oyler  
FAX: 407-292-2062  
BIO  EXC  SVE  STB

Mobile Reclaim Inc.  
4131 NW 13th St. Ste. 105  
Gainesville  FL  32609  
904-373-4614  Jeff Bornean  
FAX: 904-373-4628  
TTR

NEECO  
Box 1046  
Gonzalez  FL  32560  
BIO  SVE  SVT  SFL  
SWA  LFM

OMNI Env. Inc.  
5788 Aia South  
St. Augustine  FL  32084  
904-471-8628  Tony Tripi  
FAX: 904-471-4635  
TTR  TDR

ProEco Inc.  
7439 E. Hillsborough Ave.  
Tampa  FL  33610  
800-788-5103  Robert Cabianca  
FAX: 813-620-0731  
TKT

Resource Recovery of America Inc.  
2300 Hwy 60 West  
Mulberry  FL  33860  
813-425-1234  Ray Alkhatib  
TTR

Sonas  
Box 7387  
Tallahasee  FL  32314  
904-576-7645  B.J. Cowart  
FAX: 904-575-5636  
TDR

Thermotech Systems Corp.  
5201 N. Orange Blossom Trail  
Orlando  FL  32810

KEY: BIO=BIOREMEDIATION  
CON=CONSULTING  
CSW=COMPUTER SOFTWARE  
ENG=ENGINEERING  
EXC=EXCAVATION  
FINANCE  
LAB=LABORATORY  
LFM=LANDFARMING  
MFR=MANUFACTURER  
MCN=MONITORING  
PRO=PRODUCTS  
REC=RECYCLING  
SVE=SOIL VAPOR EXTRATION  
SVI=SOIL VENTING  
SFL=SOIL FLUSHING  
SGT=SOIL GAS TESTING  
STB=STABILIZATION  
SWA=SOIL WASHING  
TTR=THERMAL TREATMENT  
TDS= THERMAL DESORPTION  
TKS=TANK SERVICES  
TKT=TANK TESTING  
TRA=TRANSPORTATION  
VIT=VITRIFICATION

FOR TOTAL DESTRUCTION OF HYDROCARBON BASE MATERIALS.  
MANUFACTURED & DESIGNED FOR HIGH TONNAGE PRODUCTION $$.  
CALL KEN OLSON, SIOUX FALLS, S.D., U.S.A.  
1-800-685-8265  605-336-1131  Fax: 605-336-6270

18 June-July 1992 Soils
RUSH BTEX/TPH
1-(800)-845-9529
Contact STATLab Coordinator for details and scheduling information

A Full Service Environmental Testing Laboratory
Dedicated Equipment and Personnel
EPA-Approved Quality Control

METHODS
BTEX By Method 8020 or 8240
TPH By GC/PPUREABLE--Method 8020
TPH BY GC/EXTRACTABLE--Method 8100
(72-Hr. Turnaround ONLY)

MACK LABORATORIES, INC.
2199 Dartmore Avenue
Fargo, ND 58103
(701) 282-7777
(701) 282-7777
FAX: (701) 282-7777

Write in 151

Continues on page 20

Paving the Way to Soil Remediation

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

THE SOLUTION

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

Write in 148
INFORMATION FOR THE FOLLOWING COMPANIES

**INDIANA**

A.C.I. Inc.

1329 CR 68

Garrett IN 46738

219-637-3546 Gary Kruger

BIO CON

Asphalt Drum Mixers

1 ADM Parkway

Huntertown IN 46748

219-637-5729 Steve Crabill

MFG TTR

Chama Corp.

352 N. Main St. Box 489

Roanoke IN 46783

800-232-4262 Charlotte Geeting

FAX: 219-672-8412 PRD

Cannon Env. Svs. Corp.

800 Cannon Dr.

Porter IN 46304

219-465-6952 James Armour

FAX: 219-465-7169 BIO EXC SVE SFL

SWA STB TTR TDR

LFM

Environment Technology

6633 E. State St.

Ft. Wayne IN 46815

219-386-4429 Jerry McDaniel

FAX: 219-485-2658 BIO EXC SVE SVT

STB LFM

Farlow Env. Engineers Inc.

9202 N. Meridian St. Ste. 203

Indianapolis IN 46260

317-846-9700 Raymond Kent

FAX: 317-846-4511 BIO SVE SVT

Griffin Remediation Svs.

3450 Calumet Ave.

Hammond IN 46320

219-931-1662 John Flak

FAX: 219-931-7877 BIO EXC SVE SVT

STB LFM CON

Soil Exploration Svs.

2415 Shoaff Rd.

Hurtetown IN 46748

219-637-6164 David Nystuen

FAX: 210-637-6232 BIO SVE LFM

TMS Analytical Services Inc.

7725 Moler Rd.

Indianapolis IN 46268

317-875-5884 Jody Walker

FAX: 317-872-6189 LAB

**IOWA**

Advanced Env. Svs. Inc.

Corporate Centre 200 P.O. Box 160

Marion IA 52302

319-377-6357 Dave Constant

FAX: 319-377-0075 EXC SVE SVT

Continues on page 22→

---

Choose the 99.99% Efficient Option

LOW TEMPERATURE VOLATILIZATION OF PETRO-SOILS

- Fully Mobile Unit
- Contaminated Soil Specialists
- Permits Nationwide
- Stack Test Results Available
- Up to 60 Tons/Hours
- No Project Too Big or Small
- Mechanical and Chemical Engineers
- Competitive Costs
- Staff Health and Safety Trained

ConTeck

ENVIRONMENTAL SERVICES, INC.

22460 HWY. 169 NW, Elk River, MN 55330

612-441-4965

FAX 612-441-2025

Call today for our Statement of Qualifications, or to discuss your Remedial Needs.

1-800-669-0699

Grand Rapids, Brighton, Kalamazoo, Marshall and Marquette, Michigan. Bowling Green, Ohio and Atlanta, Georgia.

---

"Providing Innovative Solutions for Today's Complex Environmental Problems"

Superior

ENVIRONMENTAL CORP

EXPERIENCED REMEDIAL SERVICES

- Biological Treatment
- Thermal Treatment
- Soil Venting
- Soil Flushing
- Air Stripping
- Internal Combustion Engine for Ground Water & Soil Treatment

Call today for our Statement of Qualifications, or to discuss your Remedial Needs.

1-800-669-0699

Grand Rapids, Brighton, Kalamazoo, Marshall and Marquette, Michigan. Bowling Green, Ohio and Atlanta, Georgia.

Write in 266

Write in 203

---

June-July 1992 Soils 21
American Soil Processing Inc.
Corporate Centre 200 P.O. Box 160
Marion IA 52303
319-377-6357 Tad Cooper
FAX: 319-377-0075 TDR

Clements Associates Inc.
RR#1 Box 186
Newton IA 50208
800-247-6630 Charles Clements
FAX: 515-792-1361
MFG SGT

Enviro-Tec Inc.
Box 318/Hwy 9 West
Cresco IA 52136
800-728-6187 Ron Moen
FAX: 319-547-2548 BIO

HW2 Remediation Svcs. Inc.
438 Southgate
Iowa City IA 52240
319-339-0702 Kirk Sadleik
FAX: 319-339-1610 BIO REC SVE SWT TTR LFM

Iowa Environmental Testing Inc.
15 So. 1st St.
Council Bluffs IA 51501
712-323-4766 Jeff Hopkins
FAX: 712-328-1016 LAB SGT

Land Renu Inc.
15 South 14th St.
Council Bluffs IA 51501
712-323-5022 Randy Golden
FAX: 712-328-1016 BIO EXC LFM

Microbial Env. Svcs. Inc.
1120 Aurora Ave.
Des Moines IA 50322
515-276-3434 Jonathan Lamprey
FAX: 515-276-0246 BIO SWT

KANSAS
Filter Media Service Corp.
918 N. Santa Fe
Wichita KS 67214
800-227-2460 Ruth Wooden
FAX: 316-264-3618 MFG

Progressive Env. & Safety
Box 177
Bonner Springs KS 66012
913-441-0468 David Redlin
FAX: 913-441-8776 BIO EXC REC SVE STB TTR LFM

TerraTech Environmental Service Inc.
212 S. Hydraulic
Wichita KS 67211
316-262-0735 Bruce Reed
SGT TKS

Trinity Env. Tech. Inc.
62 E. 1st
Mound Valley KS 67330
316-328-3222 Linda Neal
FAX: 316-328-2033 LAB

KENTUCKY
Cartec Technical
618 Buttermilk Pike
Covington KY 41017
606-341-6006 E.J. Foltz
FAX: 606-341-5081
EXC SVE SWT SFL SWA LFM

Gentec Environmental
12611 Townepark Way
Louisville KY 40243
800-826-0233 Lennie Loesch
FAX: 502-245-2005 MFG TTR

Modern Welding Co.
2880 New Hartsord Rd.
Owensboro KY 42303
502-685-4400 Ron Ecleberry
FAX: 502-684-6972 MFG

State Wide Env. Inc.
Box 128
Campbellsville KY 42719
502-465-6599 Curtiss Shewmaker
FAX: 502-465-2069 EXC SVE SWT TDR CON

LOUISIANA
Analysis Laboratories Inc.
Box 8666
Metairie LA 70011
504-889-0710 Harley Albert
FAX: 504-889-2613
SGT

Anti Pollution Inc.
Box 885
Morgan City LA 70381
504-384-9517 Chuck Cloutier
FAX: 504-385-3566 BIO SFL LFM

SPL Laboratories Inc.
Box 31780
Lafayette LA 70593
318-984-2374 Wayne Boling
FAX: 318-988-1578 LAB

MASSACHUSETTS
ABB Env. Svcs. Inc.
107 Audubon Rd., Bldg 3, Ste. 25
Wakefield MA 01880
617-245-6606 Corinne Schultz
FAX: 617-246-5060 BIO SVE

American Reclamation Corp.
225 Turnpike Rd.
Southboro MA 01772
508-624-7006
FAX: 508-481-5393 REC

Applied Env. Recycling Systems
30 Federal St.
Saalem MA 01970
508-741-351
FAX: 508-741-0334 REC

Bardon Trimount
70 Blanchard Rd. Box 39
Burlington MA 01803
617-221-8400 David Peter
FAX: 617-221-8452 REC

Brox Industries Inc.
1471 Methuen St.
Dracut MA 01826
508-454-9105 Erik Stevenson
FAX: 508-454-9471 REC TTR

Brox Industries Inc.
181 Mill St.
Marlborough MA 01752
508-454-9105 Erik Stevenson
FAX: 508-454-9105 REC

Consolve
70 Westview St.
Lexington MA 02173
617-674-2197 Lisa Boulais
FAX: 617-674-2217 CON

EE&G Inc.
149 Cross St.
Winchester MA 01890
617-721-1013 John Crowther
FAX: 617-721-1001 BIO EXC SVE SWT SWA LFM

The Foxboro Co.
33 Commercial St.
Foxboro MA 02035
800-521-0451 Brenda Tynan
FAX: 508-549-6750 SGT

Groundwater Technology Inc.
100 River Ridge Dr.
Norwood MA 02062
800-635-0053 Josh Jackson
FAX: 617-769-7992 BIO EXC SVE SWT SWA STB TTR TDR

HMM Associates Inc.
196 Baxter Ave.
Concord MA 01742
508-371-4000 Peter Swinick
FAX: 508-371-2468
KVA Analytical Systems
281 Main St.
Falmouth MA 02540
508-540-0561 FAX: 508-457-4810
SGT MFG

Pelican Env. Corp.
2 Kuniholm Dr. New Eng. Ind. Pk.
Holliston MA 01746
617-235-5997 Donald Crawshaw
FAX: 508-429-7242 SVE

Technatest
3 Singletary Ave.
Sutton MA 01590
508-865-3666 Brit Woodason
FAX: 508-865-5750 TKT

United Retek Corp.
Box 6057
Holliston MA 01746
508-429-6220 Betty Cappucci
FAX: 508-429-6828 REC STB

Vapex Env. Tech. Inc.
480 Neponset St.
Canton MA 02021
617-821-5560 FAX: 617-821-7967
BIO SVE SVT TTR

MARYLAND
American Env. Svs. Corp.
1305 Ritchie Rd.
Capitol Heights MD 20743
301-350-7280 Anthony Allegretto
FAX: 301-499-2849 BIO EXC REC SVE
SVT LF M

AWD Tech. Inc.
15204 Omega Dr.
Rockville MD 20850
301-948-0040 Rob Kleinsteuber
FAX: 301-948-6094 BIO EXC SVE TTR
TKS

Contaminated Soil Consultants Inc.
14412 Old Mill Rd. Ste. 101
Upper Marlboro MD 20772
301-627-9180 Barbara Fortna
FAX: 301-627-9185
SVT LF M

11019 McCormick Rd.
Hunt Valley MD 21031
410-584-7000 Carol Novalis
FAX: 410-771-1625
BIO EXC REC SVE
SVT STB TTR TDR

Lube Cube
8258 Veterans Hwy Ste 7
Millersville MD 2108
800-777-2823 Darlene Bauer
FAX: 301-987-3890 MFG: TANKS PRD

METCO Environmental Inc.
Box 368
Cumberland MD 21502
301-729-6922 J.T Mattingly
FAX: 301-729-0118 EXC REC TTR

Recycling Alternatives Inc.
737 E. Main St. Box 1896
Salisbury MD 21802
410-860-0268 Mike Howell
FAX: 410-860-0269 BIO REC TTR TDR

Soil Recycling Tech. Inc.
10948 Beaver Dam Rd. Ste. F
Hunt Valley MD 21030
800-522-7645 Joseph Connor
FAX: 410-857-8087 REC TDR

Soil Safe Inc.
4600 E. Fayette St.
Baltimore MD 21224
800-562-4365 Daniel Nieser
FAX: 410-327-6960 REC STB

Target Env. Svcs. Inc.
9180 Rumsey Rd.
Columbia MD 21045
410-992-6622 Kevin Dawson
FAX: 301-992-0347 BIO SVE SVT

University Micro Reference Lab Inc.
611 P Hammonds Ferry Rd.
Linthicum MD 21090
410-789-3636 Carolyn Watt
FAX: 410-789-3638 BIO

MICHIGAN
Applied Science & Tech. Inc.
Box 1328
Ann Arbor MI 48106
313-663-3200 Tom Wackerman
FAX: 313-663-0079 BIO EXC SVE SVT
SPL
B.E.S.T. Inc.
28138 Northline
Romulus MI 48174
313-941-4447 Larry Bergun
FAX: 313-941-4252

Continues on page 24→

KVA SOIL GAS MONITORING AND CONTROL SYSTEMS

AVAILABLE FROM KVA: MINI PIEZOMETERS / SAMPLERS
SOIL GAS FLOWMETERS • INJECTABLE SPARGE POINTS
SOIL GAS SAMPLERS • THERMAL PROBES • SOIL SAMPLERS
GROUNDWATER FLOWMETERS

CALL KVA - THE LEADER IN SOIL GAS SAMPLING & MONITORING EQUIPMENT

KVA ANALYTICAL SYSTEMS
281 MAIN STREET • PALMOUTH, MA 02540

TELEPHONE: (508) 540-0561 FAX for info: (508) 457-9053
FAX for sales: (508) 457-4810

Write in 215

June-July 1992 Soils 23
BIO  REC  SVT  SWA
STB  LFM

Carlo Env. Tech. Inc.
44907 Trinity Dr. Box 744
Mt. Clemens MI 48046
313-468-9580 Ellin Glynn
FAX: 313-468-9589
BIO  EXC  SVE  SVT
SFL  SWA  STB  VIT
LFM

Clayton Env. Consultants
41650 Gardenbrook Rd. Ste. 155
Novi MI 48375
313-344-8550 Alice Farrar
FAX: 313-344-0229
BIO  EXC  SVT  SVE
SWA

The Dragan Corp.
30445 Northwestern Hwy. Ste. 260
Farmington Hills MI 48334
313-932-0228 Jim Dragan
FAX: 313-932-0618
BIO  SVE  SVT  SFL
LFM

Enviro Products
1431 Rensen St. Ste A
Lansing MI 48910
800-Enviro 4 FAX: 517-887-8374
MFG

Gast Mfg. Corp.
PO Box 97
Benton Harbor MI 49022
800-952-4278
FAX: 800-331-3289
MFG

Hadley Ind.
5900 W. 4th Street
Ludington MI 49431
800-345-4227 Rod Prodonovich
FAX: 616-843-3882
SVE

Kalkaska Construction Services Inc.
418 S. Maple
Kalkaska MI 49646
616-258-9134 Dennis Hogerheide
FAX: 616-258-6113
MPC Env.
8631 W. Jefferson
Detroit MI 48209
313-849-2333 Charles Usher
FAX: 313-849-1620
EXC  SVE  SVT

MPC Env.
8631 W. Jefferson
Detroit MI 48209
313-849-2333 Charles Usher
FAX: 313-849-1620

Soil and Materials Eng. Inc.
43980 Plymouth Oaks Blvd.
Plymouth MI 48170
313-454-9900 Sharon Derry
FAX: 313-454-0629

Spill Management Inc.

207 W. Grandview Pkwy. Ste. 202
Traverse City MI 49684
800-800-6084 Keith Izatt
FAX: 616-929-3391 MFG

Superior Env. Corp.
14641 16th Ave. Box 118
Marine MI 49435
616-677-5255 Jim Pratt
FAX: 616-677-5258
BIO  EXC  REC  SVT
SFL SWA TTR TDR

Traverse Group Inc.
3772 Plaza Dr. Ste. 5
Ann Arbor MI 48108
313-747-9300 Laura Armstrong
FAX: 313-747-9229
BIO  EXC  SVE  SVT
SFL SWA

Underground Tank Env. Group
1669 S. Isabella Box 484
Mt. Pleasant MI 48804
517-772-2441 Steve Nielsen
FAX: 517-772-2146 EXC

UST Tech
3220 Robert Longway Blvd.
Flint MI 48506
313-232-4425 FAX: 313-232-4425
BIO  EXC  LFM SVE
TKS  TTR

MINNESOTA

Barr Engineering
8300 Norman Center Drive Ste. 300
Minneapolis MN 55437-1026
612-832-2600 Sue Swenson
CON  ENG

Biotrol Inc.
11 Peavy Rd.
Chaska MN 55318
609-951-0314 Pamela Sheehan
FAX: 609-951-0316
BIO  SWA  LFM

Clark Engineering Corp.
2815 Wayzata Blvd.
Minneapolis MN 55405
312-374-4740 Dan Johnson
FAX: 612-374-4749
CON

ConTeck Env. Svcs.
22460 Hwy 169 NW
Elk River MN 55440
612-441-4964 Larry Hicks
FAX: 612-441-2025

Delta Env. Consultants
900 Long Lake Rd.
St. Paul MN 55112
612-636-0220 Colleen Rannei
FAX: 612-636-6514
BIO

E & A/EMCON Minnesota
Box 154
Lake Elmo MN 55042
612-770-0080 George Johnson
FAX: 612-770-2121
BIO  EXC  REC  SVE
SVT  TTR  LFM

GME Consultants Inc.
14000 21st Ave. N.
Minneapolis MN 55447
612-559-1859 William Kwasny
FAX: 612-559-0720
BIO  EXC  SVE  SVT
SFL  STB  LFM

Land Farms Inc.
16521 Weston Bay Rd.
Eden Prairie MN 55347
612-937-5526 John Knoblauch
LFM

Thein Well Co. Inc.
13555 Hwy 71 NE Box 778
Spicer MN 56288
612-796-2111 Peter Thein
FAX: 612-796-2114
BIO  EXC  SVE  SVT

Twin City Testing Corp.
731 Pelham Blvd.
St. Paul MN 55114
612-645-3601 Jack Matlock
FAX: 612-659-7515
BIO  SVE  SVT  SWA
STB  TTR  LFM

Xerxes Corp.
7901 Xerxes Ave. S.
Minneapolis MN 55431
612-887-1890 Terry Jensen
FAX: 612-887-1882
MFG  TANKS

MISSOURI

Alpha Env. Biosystems
160 S.W. Market St.
Lee’s Summit MO 64081
816-524-8811 Bill Worley
FAX: 816-525-5027
BIO

The Angervine Co.
3380 Tree Court Ind. Blvd.
St Louis MO 63122
800-392-9015 Kirk Angervine
FAX: 314-225-8745
BIO

BioVac Env. Svcs. Inc.
566 First Capitol Dr. Box 938
St. Charles MO 63302
314-947-9917 Mark Lynch
FAX: 314-947-9917
BIO  SVE  SVT  SFL
SWA  LFM

Carter Equipment Co.

KEY: BIO=BIOREMEDICATION
CON=CONSULTING
CSW=COMPUTER SOFTWARE
ENG=ENGINEERING
EXC=EXCAVATION
FIN=FINANCE

LAB=LABORATORY
LFM=LANDFARMING
MFR=MANUFACTURER
MON=MONITORING
PRD=PRODUCTS
REC=RECYCLING

SVE=SOIL VAPOR EXTRACTION
SVT=SOIL VENTING
SFL=SOIL FLUSHING
SGT=SOIL GAS TESTING
STB=STABILIZATION
SWA=SOIL WASHING

TTR=THERMAL TREATMENT
TDS=THERMAL DESORPTION
TKS=TANK SERVICES
TGT=TANK TESTING
TRA=TRANSPORTATION
VIT=VITRIFICATION

24 June-July 1992 Soils
Environmental Audits & Consultants, Inc.
provides the best in alternative technology.

Services include:
- Insitu Bioremediation Testing
- Pilot Studies
- Designing, Installation, Maintenance and Reporting.

Continuing services include:
- Landfarming
- Phase 1 thru Phase 3 Audits
- Legal Assistance for Land Transfers
- Tank Removal Services
- Soil Sampling
- Laboratory and Field Analysis.

For Assistance call, fax or write:
800-472-8119
618-283-3637 Fax: 618-283-3662
1111 N. 5th St. Vandalia, IL 62471
When buried troubles surface

Ground water contamination is just one way your underground storage tanks can spell "trouble". Let the environmental remedial specialists at USTTech put their Underground Storage Tank (UST) experience to work for you. We'll assist you in achieving total compliance with updated federal & state regulations. In addition, USTTech will provide financial support assistance for your project.

Put USTTech's comprehensive Underground Storage Tank experience to work for you and rest assured you'll never have buried troubles!

USTTech is certified in Ohio, Indiana and is a Michigan MUSTFA approved contractor.

3220 Robert T. Longway Blvd.  
Flint, MI 48506  
313-232-4555  
FAX: 313-232-4425

Environmental Remedial Specialists

Write in 250

June-July 1992 Soils 27
Disposal Technologies
395 Nugent Drive
Calverton NY 11933
516-727-7045 Jim DeGregorio
FAX: 516-727-4622
REC TTR

Dunn Corp.
12 Metro Park Rd.
Albany NY 12205
518-458-1370 Bill Butler
FAX: 518-458-2472
EXC SVE SVT

EG&G Rotron-Industrial Div.
North St.
Saugerties NY 12477
914-246-3401 Peter Rosse
FAX: 914-246-3802
MFG

General Testing Corp.
710 Exchange St.
Rochester NY 14608
716-454-3760
FAX: 716-454-1245
LAB

Geraghty & Miller
125 Bethpage Rd.
Plainview NY 11803
516-249-7600 Maureen McPartland
FAX: 516-249-7610
CON ENG SGT SWA

Inter Coastal Water Inc.
40 Burt Drive Ste. 10
Deer Park NY 11729
516-242-2121 George Kryissing
FAX: 516-242-2140
TTR

Lamson Corp.
#1 Lamson St.
Syracuse NY 13206
315-433-5500 Gary Adams
FAX: 315-433-5451
SVE SVT

Lopat Enterprises
1750 Bloomsbury Ave.
New York NY 07712
908-922-6600 H. Belisle
STB

Midland Machinery Co. Inc.
101 Cranbrook Ext. Box 326
Tomawanda NY 14151
716-692-1200 Beth McNally
FAX: 716-692-1206
REC STB

National Soils Inc.
#8 Towpath Rd
Fort Edward Village NY 12828
518-747-4104 Sid Gordon

FOX: 518-747-2596
TTR TDR
O’Brien & Gere Eng. Inc.
Box 4873 5000 Brittonfield Pkwy.
Syracuse NY 13221
315-437-6100 Gary Kirsch
FAX: 315-463-7554
BIO EXC REC SVE
SVT SFL SWA STB
TTR TDR VIT LFM

OGB Tech. Svcs. Inc.
5000 Brittonfield Pkwy. Box 5240
Syracuse NY 13220
315-437-6400 Terry Brown
FAX: 315-437-9800
BIO EXC SVE SVT
SFL SWA SBT TTR
VIT LFM

OP-Tech Env. Svcs. Inc.
Old River Rd. Box 5102
Massena NY 13662
315-764-1917 John Condino
FAX: 315-764-9453
EXC

Photovac International Inc.
25-B Jefryn Blvd. West
Deer Park NY 11729
516-254-4199
FAX: 516-254-4284
MFG

Royce Environmental
5550 Merrick Rd.
Massapequa NY 11758
516-254-2197 Joe Dee
FAX: 516-264-3355
TTR

Roux Assoc. Inc.
775 Park Ave.
Huntington NY 11743
516-673-7200 Al Lewis
FAX: 516-673-7216
BIO EXC SVE SVT
TDR LFM

Sevenson Env. Svcs. Inc.
2749 Lockport Rd.
Niagara Falls NY 14302
716-284-0431 Philip Deluca
FAX: 716-284-1796
EXC STB

SLC Consultants/Constructors Inc.
6362 Robinson Rd.
Lockport NY 14094
716-433-0776 Don Kuhn
FAX: 716-422-0802
BIO EXC STB

Specialized Process Equipment Inc.
5000 Brittonfield Pkwy. Box 3283
Syracuse NY 13220
315-437-2400 David Tagg
FAX: 315-437-9800
SVE SVT SFL SWA
TTR VIT

Superior Refuse Intermediaries Inc.
120 Mineola Blvd.
Mineola NY 11501
516-746-1111 Michael Feire
FAX: 516-742-5813
EXC REC SVT TTR
TDR

U.S. Hydrogeologic Inc.
328 Main Mall
Poughkeepsie NY 12601
914-473-0074 John Conrak
FAX: 914-485-5106
CON

Waste Stream Tech. Inc.
302 Grote St.
Buffalo NY 14207
716-876-5290 Edward Oddo
FAX: 716-876-2412
BIO LFM

OHIO

Bruck Hartman Env. Inc.
4055 Executive Park Dr.
Cincinnati OH 45241
513-483-3000 Ria Davidson
BIO REC SVE SVT SFL SWA STB
TTR TDR VIT LFM

Columbus Instruments
950 North Hague Ave.
Columbus OH 43204
614-276-0861 Jan Czekajewski
FAX: 614-276-0529
BIO MFG

Encore Env.
344 W. Henderson Rd.
Columbus OH 43214
614-263-9287 Brad Schneider
BIO REC SVE
SVT SFL SWA STB
TDR LFM

Environment One
7777 Wall St.
Cleveland OH 44125
216-524-0888 Bill Sanders
FAX: 216-524-2090
BIO REC SVE
SVT SFL SWA STB
TDR LFM

Environmental Well Products
1639 Stanley Ave.
Dayton OH 45404
800-777-0977 Toni Cuvo
FAX: 513-461-3257
SVE SVT

Continues on page 48→
TARMAC offers
customized plants and plant components

- Highly portable...Hercules plane transportable.
- 33 Ton/hr. Two-load portable plants...light oil remediation.
- 33 Ton/hr. Three-load portable plants...heavy oil remediation.
- 50-70 Ton/hr. Three-load portable plants...light oil remediation.
- 50-70 Ton/hr. Four-load portable plants...heavy oil remediation.
- 100-120 Ton/hr. Stationary plants...light oil remediation.
- 100-120 Ton/hr. Stationary plants...heavy oil remediation.

FAX to 816-228-0888

COMPONENTS & SERVICES
Check your requirements:
- Screening/Shredding/Crushing
- Material Feed
- Dryers/Kilns
- Oxidizers
- Baghouses
- Burners
- Heat Exchangers
- Controls
- Soil Conditioners
- Permit Compliance

NAME ________________________________
TITLE ______________________________
COMPANY __________________________
ADDRESS ___________________________
CITY ___________ STATE _____ ZIP ____
PHONE ___________ FAX _____________

Original Equipment Manufacturer
TARMAC EQUIPMENT CO., INC. Soils Division
219 N. 7 Highway • Blue Springs, MO 64014
800-833-4383
Write in 158
Thermal desorption... now you’re cookin’

Hot technology: how it works, what it costs, where’s it going?

By William Troxler, James Cudahy, James Yezzi, Richard Zink and Seymour Rosenthal

Thermal desorption has gained rapid acceptance as a soil remediation technology. There are four general types of equipment used in thermal desorption: rotary dryer, asphalt plant aggregate dryer, thermal screw and conveyor furnace. How does each work and what factors influence performance?

First, an overview

Thermal desorption includes a number of ex situ processes that use either direct or indirect heat exchange to heat a waste material to volatilize organic materials. Thermal desorption systems typically operate at soil treatment temperatures in the range of 400 to 600°F to treat petroleum contamination. However, systems constructed of special alloys are available that will operate at soil

Continues on page 32 ➔

Figure 1

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Rotary Dryer</th>
<th>Asphalt Plant</th>
<th>Thermal Screw</th>
<th>Conveyor Furnace</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated number of systems</td>
<td>40-60</td>
<td>100-150</td>
<td>18-22</td>
<td>1</td>
</tr>
<tr>
<td>Estimated number of contractors</td>
<td>20-30</td>
<td>No estimate</td>
<td>9</td>
<td>Fixed</td>
</tr>
<tr>
<td>Mobility</td>
<td>Fixed and mobile</td>
<td>Mobile</td>
<td>Mobile</td>
<td>Mobile</td>
</tr>
<tr>
<td>Typical site size (tons)</td>
<td>500-25,000</td>
<td>0-10,000</td>
<td>500-5,000</td>
<td>500-5,000</td>
</tr>
<tr>
<td>Soil throughput (tons/hour)</td>
<td>10-50</td>
<td>25-100</td>
<td>3-15</td>
<td>5-10</td>
</tr>
<tr>
<td>Maximum soil feed size (inches)</td>
<td>2-3</td>
<td>2-3</td>
<td>1-2</td>
<td>1-2</td>
</tr>
<tr>
<td>Heat transfer method</td>
<td>Direct</td>
<td>Direct</td>
<td>Indirect</td>
<td>Direct</td>
</tr>
<tr>
<td>Soil mixing method</td>
<td>Shell rotation and lifters</td>
<td>Shell rotation and lifters</td>
<td>Auger</td>
<td>Soil agitators</td>
</tr>
<tr>
<td>Discharge soil temperature (°F)</td>
<td>300-600 (a)</td>
<td>600-1,200 (b)</td>
<td>300-800</td>
<td>300-500 (c)</td>
</tr>
<tr>
<td>Soil residence time (minutes)</td>
<td>3-7</td>
<td>3-7</td>
<td>30-70</td>
<td>3-10</td>
</tr>
<tr>
<td>Thermal desorber exhaust gas temperature (°F)</td>
<td>500-850 (a)</td>
<td>800-1,000 (b)</td>
<td>3000</td>
<td>1,000-1,200</td>
</tr>
<tr>
<td>Gas/solids flow</td>
<td>Co-current or counter-current</td>
<td>Co-current or counter-current</td>
<td>Not Applicable</td>
<td>Counter-current</td>
</tr>
<tr>
<td>Atmosphere</td>
<td>OXidative</td>
<td>Oxidative</td>
<td>Inert</td>
<td>Oxidative</td>
</tr>
<tr>
<td>Afterburner temperature (°F)</td>
<td>1,200-1,800</td>
<td>1,400-1,800 (f)</td>
<td>Generally not used</td>
<td>1,400-1,800</td>
</tr>
<tr>
<td>Maximum thermal duty (MM Bltu/hr) (g)</td>
<td>10-100</td>
<td>50-100</td>
<td>7-10</td>
<td>10</td>
</tr>
<tr>
<td>Heatup time from cold condition (hours)</td>
<td>0.5-1.0</td>
<td>0.5-1.0</td>
<td>Not reported</td>
<td>0.5-1.0</td>
</tr>
<tr>
<td>Cool down time from hot condition (hours)</td>
<td>1.0-2.0</td>
<td>1.0-2.0</td>
<td>Not reported</td>
<td>Not reported</td>
</tr>
<tr>
<td>Total Petroleum Hydrocarbons</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial concentration (mg/kg)</td>
<td>80-35,000</td>
<td>Not reported</td>
<td>60-50,000</td>
<td>5,000</td>
</tr>
<tr>
<td>Final concentration (mg/kg)</td>
<td>&lt;10-300</td>
<td>Not reported</td>
<td>ND-5,500</td>
<td>&lt;10.0</td>
</tr>
<tr>
<td>Removal efficiency (%)</td>
<td>95.0-99.9</td>
<td>Not reported</td>
<td>64-88</td>
<td>&gt;89</td>
</tr>
<tr>
<td>BTEX</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial concentration (mg/kg)</td>
<td>NR</td>
<td>Not reported</td>
<td>155</td>
<td>Not reported</td>
</tr>
<tr>
<td>Final concentration (mg/kg)</td>
<td>&lt;1.0</td>
<td>Not reported</td>
<td>&lt;0.01</td>
<td>Not reported</td>
</tr>
<tr>
<td>Removal efficiency (%)</td>
<td>NR</td>
<td>Not reported</td>
<td>&gt;89</td>
<td>Not reported</td>
</tr>
</tbody>
</table>

(a) Carbon steel materials of construction
(b) Alloy materials of construction
(c) Hot oil heat transfer system
(d) Molten salt heat transfer system
(e) Electrically heated system
(f) Not used on all systems
(g) Total duty of thermal desorber plus afterburner

William Troxler, James Cudahy and Richard Zink are with Focus Environmental, Inc. of Knoxville, Tenn. James Yezzi is with the U.S. Environmental Protection Agency, Edison, N.J. Seymour Rosenthal is with Foster Wheeler Envireponse, Inc. of Edison, N.J.
Low-Temperature Thermal Desorption
Efficient and Cost Effective On-site Remediation of Hazardous and Non-Hazardous Materials

Williams is a leading full service remediation contracting firm specializing in technology-based on-site treatment of contaminated materials. Williams Environmental Services' Mobile Thermal Desorption Units provide the most reliable, efficient and cost effective remediation of hazardous and non-hazardous materials in full compliance with all regulatory requirements. Let us demonstrate how Williams' experience, expertise, and advanced technology can solve your remediation needs.

For more information call today 1-800-247-4030.
discharge temperatures as high as 1,200°F.

Volatile organic compounds are separated from the solids by a purge gas which may be air, nitrogen, a combustion gas or other inert gas. After the purge gas exits the thermal desorber, it is treated by an offgas treatment system—destroyed in an afterburner or collected by a physical/chemical treatment, typically a condenser followed by activated carbon adsorption. Particulates may be collected by a cyclone, baghouse or wet scrubber.

Different devices transfer heat to a waste material by either direct or indirect heat transfer. Direct heat transfer fires a fuel oil, natural gas or propane burner so waste is heated by the radiant heat from the flame and convective transfer from the combustion gas. Combustion gas from the burner is in direct contact with the waste material. Indirect heat transfer can be accomplished different ways for different systems. Thermal screws, for example, use hot oil that circulates through the shell and screw auger to transfer heat primarily by conduction.

The surfaces of thermal desorption devices that are in contact with waste materials are not lined with refractory or insulating materials. Therefore, the maximum temperature of the soil or sludge that can be achieved in a thermal desorption device is generally limited by the materials of construction of the device.

**Rotary dryer**

There are approximately 40-60 rotary dryer systems in use to treat petroleum contaminated soils. Rotary dryer systems range in size from complete systems that fit on one trailer—to large systems that may require up to 10 trailers to transport. Rotary dryers typically have treatment capacities of 10 to 50 tons per hour.

The rotary dryer is a cylindrical metal drum inclined slightly to the horizontal. A propane or fuel oil burner is located either at the feed or discharge end of the dryer to provide heat to desorb organic materials from the soil feed. Depending on dryer design, combustion gas from the burner flows co-currently with or counter-currently to the flow of solids. Figure 2, page 32, illustrates a counter-current rotary dryer system. A co-current system is shown in Figure 3, page 34.

Soils are fed into the upper end of the dryer and transferred by rotation of the inclined shell. Solids are helped to move along the length of the drum with internal longitudinal lifers that pick up the soil, carry it to near the top of the cylinder, then drop it through the hot combustion gases from the burner. The intense mixing that occurs in the rotary dryer enhances heat transfer by convection to allow rapid heating of the soils. The residence time of solids in the kiln is controlled by the rotational speed of the cylinder, the angle of inclination of the drum and the arrangement of the internal lifers.

Offgas treatment systems typically include a cyclone, a baghouse and an afterburner. Afterburners are typically

*Continues on page 34 ➔*
THE LYSIMETER CHOICE

TIMCO™ Manufacturing, a leader in groundwater monitoring equipment, is also your choice for pore liquid sampling. That's because TIMCO™ offers a choice of Lysimeters for every monitoring need from waste management to groundwater protection.

Porous Teflon Lysimeters
Designed by TIMCO™ to meet the most stringent monitoring requirements. Teflon's chemically inert properties ensure long life and accurate samples. No adhesives. Preserves sample integrity.

Porous Ceramic Lysimeters
Special threaded ceramic filters ensure a leak-free seal without adhesives. TIMCO™ cup and tube type Lysimeters are available in both shallow (up to 20 ft.) and deep (up to 300 ft.) sampling configurations.

In addition, TIMCO™ offers a complete range of Lysimeter accessories including head assemblies, vacuum pressure hand pumps, gauge assemblies and silica flour.

NOW YOU HAVE A CHOICE.

TIMCO™

P.O. Box 8
851 Fifteenth Street
Prairie du Sac, WI 53578
800-236-8334
608-643-8334
FAX 608-643-4275

Figure 3

Now you're cookin', from page 33

used downstream of a rotary dryer to oxidize vaporized organic contaminants. Rotary dryer afterburners are direct-fired units which operate at temperatures of 1,400 to 1,600°F with gas residence time of one-half to two seconds.

The soil and dust particulates entrained in the offgas from the rotary dryer are removed in a cyclone and a baghouse. Fines collected by the cyclone or baghouse may be recycled to the dryer or mixed with the treated solids exiting the dryer.

Asphalt plant aggregate dryers
Estimates of the number of U.S. asphalt plants currently processing petroleum contaminated soils range from as low as 50 to as high as 150 plants.

In this case, soil treatment may be performed as a recycling process in which the clean, treated soil is used as a portion of the aggregate for asphalt paving. The aggregate dryer is typically a counter-current rotary dryer with a cyclone and baghouse, but no afterburner. Because of regulatory concerns about potential hydrocarbon emissions, some states are requiring such units to be retrofitted with afterburners. Soil discharge operating temperature range for an asphalt plant rotary dryer is about 300 to 600°F. Soil treatment capacities can range from 25 to over 100 tons per hour.

Thermal screw
Nine contractors have been identified that use thermal screw systems to process petroleum contaminated soils and sludges. All use trailer-mounted mobile systems. A thermal screw system may include from one to four screw augers which can be configured either in series or in parallel.

Indirectly heated screw augers convey, mix and heat contaminated soils to desorb moisture and volatile organic compounds into a purge gas stream. Most systems circulate a hot heat transfer oil through the hollow flights of the screw auger and return the fluid through the center of each shaft to the process heater. The heated oil is also circulated through the jacketed trough in which each screw auger rotates. One system has been identified that uses molten salt as a heat transfer fluid and one that uses electric heat. A typical thermal screw treatment system is illustrated in Figure 4, page 38.

The heat transfer fluid heater system
is fired with propane, natural gas or fuel oil to heat the fluid. Heat transfer oils can be heated to approximately 650°F and molten salt to 1,100°F. A fraction of the flue gas from the heat transfer fluid heater is diverted to the thermal screw to provide an inert purge gas and to maintain an exit vapor temperature above 280°F to avoid condensation of volatilized organics.

Soil discharge temperatures may be limited by the materials of construction of the device and the maximum working temperature of the heat transfer fluid. Systems that use hot oil as the heat transfer medium can achieve soil temperatures up to 500°F under normal operating conditions while systems that use molten salt can heat soil to 900°F. Electrically heated systems may reach temperatures as high as 1,600°F.

Thermal screw systems are available with capacities ranging from three to 10 tons per hour of contaminated soil.

The organics contained in the offgas from a thermal screw system are typically treated by physical/chemical unit processes. Most thermal screws use a condenser system combined with other unit operations such as water quench systems, baghouses and activated carbon adsorbers.

**Conveyor furnace**

One conveyor furnace is being used in California to remediate petroleum contaminated soils. A diagram of this system is in Figure 5, page 40. The conveyor furnace is a directly heated unit which uses a set of propane burners that fire into a primary furnace. A layer of contaminated soil is continuously moved through the primary furnace by a flexible metal conveyor belt. Soil agitators lift the conveyor belt and turn the soil over to enhance heat transfer.

The gases that leave the primary furnace, including volatilized contaminants, are treated in an afterburner to destroy the organic constituents in the gas stream. Gases from the afterburner are ducted through the offgas treatment system, which consists of a quench chamber, a dual-venturi collision scrubber, a mist eliminator, an induced draft fan, an exhaust stack and a flue gas analysis system. The scrubber blowdown is added to the dry processed soil in the discharge screw conveyor to cool and moisten the soil to minimize dust formation.

Soil discharge temperature from the conveyor furnace ranges from 300 to 800°F. Capacity to treat contaminated soil ranges from three to 10 tons per hour.

**Performance factors**

Three key factors affect performance of a thermal desorber—equipment operating parameters, contaminant characteristics and soil characteristics.

The primary equipment related factors affecting thermal desorption performance are the maximum soil temperature achieved, soil residence time, oxygen content of the purge gas, type of heating method and mode of operation.

Treatment temperature is a function of the moisture content, heat capacity and particle size of the soil—as well as the heat transfer and mixing.

*Continues on page 38 ➤*

---

**Rotron blowers provide soil solutions.**

EG&G Rotron regenerative blowers have proven themselves in years of environmental service to be quiet, compact, and reliable. These direct-drive low-maintenance blowers require no lubrication.

They have explosion-proof motors, spark-resistant construction, and adaptable vacuum performance curves. Environmental applications include:

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

Rotron also has accessories such as moisture separators available.

Call or fax a request for a copy of

There’s a lot of important information buried in this ad.

These days, the environment is no longer a hidden issue. Which is why O/C TANKS make more sense than ever.

And in environmentally sensitive areas why our double-walled Fiberglas® tanks are the best choice yet.

Fiberglas® tanks: rust-proof and rust-proof proven

When steel tanks rust — inside or out — they can leak. Fiberglas® tanks never rust. So they never leak from corrosion. And O/C TANKS have proven that in use. In fact, we’re now the world’s most experienced manufacturer of underground tanks with over 185,000 installed nationwide.

Protecting our precious underground water supplies

No one wants polluted drinking water. Or polluted well water. Or farms with tainted irrigation systems. That’s why the American Petroleum Institute guidelines recommend secondary containment for underground tanks when potable water wells or sole-source aquifers are within 300 feet of the tank. In environmentally sensitive areas, our double-walled HydroGuard™ System is the perfect solution.

The system is activated at our factory and goes right to work. HydroGuard™ checks the tank’s condition during transportation
and through installation. After that, the system operates continuously underground. And that's not all.

**The Leak Detection System that's unique to HydroGuard™**

HydroGuard™ provides 360 degree secondary containment 24 hours a day for the life of the tank. Its built-in leak monitor is actually sensitive enough to detect leaks as tiny as 0.10 gallons per hour, not coincidentally the EPA standard for precision-testing. And if that's not enough reassurance, HydroGuard™ comes with a 30-year structural and corrosion warranty.

If you're looking for a new tank that will protect the environment from pollution and your business from liability risks, choose the HydroGuard™ System. Don't bury a mistake.

---

**A SUBSIDIARY OF OWENS/CORNING FIBERGLAS**

{ } Send me your HydroGuard™ System Brochure

{ } Have a salesman call me (or call 1-800-OC-TANKS)

Name: ____________________________________________

Company: _________________________________________

Address: _________________________________________

City: _____________________________________________ State: ________

Zip: ________ Phone: ____________________________

Send to C.M.X. Meeks, O/C TANKS Corp., P.O. Box 10025, Toledo, OH 43699-0025

Write in 195
characteristics of the thermal device. The temperature required to volatilize an organic contaminant can be estimated from the vapor pressure of the compound. Technical and economic data indicate that soil must generally be heated to the temperature at which the contaminant would achieve a vapor pressure of between one-half and two atmospheres in a closed system. The boiling point of a compound is the temperature at which the vapor pressure would achieve one atmosphere.

Temperature required to treat a specific petroleum product can be estimated from the distillation temperature range of the virgin product.

Treatment time is related to treatment temperature in that the same residual organic concentrations can be achieved at different combinations of these parameters. For example, a thermal desorption system operating at a soil discharge temperature of 400°F and 60 minutes residence time may achieve the same treatment criteria as one operating at a discharge temperature of 600°F and five minutes residence time.

Treatment time in directly heated devices is generally less than 10 minutes. Treatment time is more difficult to monitor than treatment temperature and so is not normally used as a monitoring and control parameter for these types of devices. Thermal screws typically have solids residence times ranging from 30 to 70 minutes.

Residence time of a solid in a thermal desorption device depends on the physical configuration of the device, speed of the conveying mechanism (kiln or auger rotation, belt speed) and the angle of inclination of the system.

In purge gas type devices, the purge gas may be oxidative or inert. For direct fired systems, the combustion

Continues on page 40
DON'T DESTROY YOUR CONTAMINATED SOIL REMEDIATE, RECLAIM, RECYCLE

Soil Remediation Plant

Site Assessments
Analysis
Testing
Excavation
Transportation

Asphalt Plants
Asphalt Recycling
Material Production

Stone Processing
Screening
Crushing
Aggregate Plants

YOUR FULL SERVICE COMPANIES
All companies owned and operated by
GENNARO GROUP OF CORPORATIONS

CALL NOW FOR IMMEDIATE INFORMATION AND QUOTATIONS
Phone (216) 536-6825 • FAX (216) 536-6838

Write in 259
gas from the burner serves as a purge gas. This stream always contains significant amounts of excess oxygen. The organic content of the feed material must generally be limited to less than two to three percent to stay below the lower explosive limit if an Continues on page 42

---

# The Association for the Environmental Health of Soils Invites Your Membership.

AEHS welcomes membership from everyone interested in soil contamination. The Association will actively recruit members from the scientific, regulatory, industrial and public sectors. Membership provides a linkage for all concerned with soil contamination through a number of vehicles:

- The Association's semiannual newsletter.
- The Association's membership directory.
- Reduction in registration costs for selected technical conferences.
- Savings on selected publications.
- A Professional, peer-reviewed journal in the near future.

For more information please complete and forward to:
AEHS
P.O. Box 312
Amherst, MA 01004
Tel: (413) 549-5170.

Name: ______________________________
Company: __________________________
Address: __________________________

Telephone: _________________________

---

40 June-July 1992 Soils
Western Thermal Soils Company

...a New, Thermal Option for Soils Contaminated with Petroleum Hydrocarbons.

- Completely portable,
- 25-35 tons per hour,
- Quiet, clean operation,
- Large or small projects,
- Permitted in So. Calif.,
- Serving the Western U.S.,
- Totally self-contained.

Western Thermal Soils Co.

3200 San Fernando Road, Los Angeles, CA 90065
Tel: 213-258-2777
Ask for George Cosby or Frank Sheets

The unit comes equipped with process fuel instrumentation and control room for safe, efficient and dependable operation.
oxidative purge gas is used.
Some systems operate under an inert or very low (less than two percent) oxygen content atmosphere. These types of systems can process solids with up to 50 percent organic material, since there is little or no oxygen to support combustion.
In indirectly heated systems, offgas volume may be a factor of 10 less than the offgas volume from a directly heated system. Therefore, offgas treatment systems for indirectly heated systems are much smaller and more mobile than those for directly heated systems. However, because of heat transfer considerations, indirectly fired systems are generally limited in physical size and have lower waste processing capacities than comparably sized directly heated systems.
The operating mode influences the exit temperature of the offgas, the arrangement of downstream unit operations and the heat transfer efficiency of the thermal desorber. Counter-current systems typically operate at gas discharge temperatures in the range of 300 to 500°F so the gas will not exceed the inlet temperature limit for the baghouse. Particulates that are potentially contaminated may be collected in the baghouse and may require recycling to the thermal desorber—or must be mixed with the hot solids exiting the thermal desorber. Systems using baghouses that follow counter-current systems may have difficulty treating petroleum products, such as motor oil and No. 6 fuel oil, that contain compounds with high boiling points.
Counter-current systems are more efficient than co-current systems at transferring heat from the purge gas to the solids. A counter-current system transfers a higher fraction of the energy from the purge gas than a co-current system at the same solids processing rate and burner firing rate. Therefore, the exit gas temperature and volume is lower for a counter-current system than a co-current system with equivalent size and capacity. This results in smaller downstream gas cleaning equipment for counter-current systems as compared to co-current systems.
Co-current systems typically have an afterburner downstream of the thermal desorber and a baghouse downstream of the afterburner. Co-current systems typically operate at a gas discharge temperature 50 to 100°F higher than the soil discharge temperature. Particulates in the thermal desorber offgas that are potentially contaminated with organics are treated in the afterburner before they are collected in the baghouse. Therefore, baghouse dust is generally decontaminated and does not require further treatment.
A baghouse placed downstream of the afterburner is significantly larger than a baghouse required in a counter-current system, placed upstream of the afterburner.
In co-current systems, the burner fires over the incoming solids and heats them to the desired operating temperature in less time than a counter-current system. Therefore, the co-current mode results in higher...
average solids temperatures for longer periods of time than are achieved in an equivalently sized counter-current system.

**Contaminant characteristics**

Vapor pressure and concentration levels of petroleum hydrocarbons are the two key contaminant properties that affect performance of a thermal desorber.

Vapor pressure influences the rate at which a contaminant is thermally desorbed. Vapor pressure is the force exerted by a chemical in equilibrium with its pure solid or liquid. The vapor pressure of a compound increases exponentially as a function of temperature.

The maximum concentration of petroleum hydrocarbons that can be treated by a thermal desorption device depends on the gas flow through the device, the oxygen content of the purge gas, the type of hydrocarbon compounds present and exit gas temperature.

For safety, the concentration of hydrocarbons in the exhaust gas of devices operating in an oxygen atmosphere should be limited to less than 25 percent of the lower explosive limit if the temperature of the exhaust gas is above the autoignition temperature of the organic compounds. Lower explosive limits are typically in the range of one to two percent by volume for most hydrocarbons and autoignition temperatures are in the range of 500 to 1200°F. An analysis of the maximum allowable concentration of hydrocarbons in the feed material must, therefore, be conducted for each thermal desorption system based on gas flow through the device, type of contaminant and offgas temperature. Empirical guidelines on maximum allowable hydrocarbon concentrations in feed material have been established for directly heated rotary dryers. For these devices, the maximum concentration of petroleum hydrocarbons that can be treated is in the range of two to three percent. The allowable concentration of hydrocarbon in the soil in some cases may be limited by the capacity of the afterburner to oxidize desorbed materials without exceeding temperature limitations.

Systems that operate in an inert atmosphere, such as a thermal screw, may process materials with concentrations of hydrocarbons up to 50 percent or higher. High concentrations of organics can be processed in inert blanketed systems since there is a limited amount of oxygen available to react with the vaporized contaminants.

**Soil characteristics**

Particle size can influence performance because of pre-treatment requirements to crush or screen soil, potential entrainment of particulates in the process gas and flow characteristics which influence heat transfer.

Thermal devices normally require soils to be screened or crushed to a top size of one to two inches. Size limits depend on mechanical clearances in conveyer systems and heat transfer considerations.

Fine-grained particles, such as silt...

*Continues on page 45 →

---

The new choice for Soil Remediation

**MOBILE RECLAIM, INC.**

For further information please call or write:
Mobile Reclaim, Inc., 4131 NW 13th St., Suite 105, Gainesville, FL 32609
(904) 373-4614, Fax (904) 373-4628

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

NATIONAL SOILS, Inc.
and its subsidiaries

Environmental Soils Management, Inc.
Loudon, New Hampshire

North American Soil Recycling
Fort Edward, New York

Sunbelt Resources, Inc.
Tuscaloosa, Alabama

National Soils Incorporated is a multifaceted environmental management company specializing in the design, permitting and operation of facilities that process petroleum contaminated soils and other contaminated media. Management services encompass dimensions such as market analysis and sales, compliance and regulatory analysis, performance testing, and environmental business development. Its state-of-the-art processing facilities combine innovative environmental controls with advanced remedial technologies to produce the most efficient thermal processes available today.

For more information call: 1-800-950-7645.

FAX INFORMATION
To receive direct information on National Soils, Inc. please fax this page to 518-664-9609. (PLEASE PRINT CLEARLY)

NAME:
PHONE #:
COMPANY:
ADDRESS:
AREA OF INTEREST:

Write in 275
Now you’re cookin’, from page 43

and clays, may become entrained in the process gas and pass through without adequate residence time at the proper temperature. From one to 30 percent of fine grained soils fed to thermal desorption devices may become entrained in the gas stream. This material may have to be recycled back to the thermal desorption unit, reducing the effective treatment capacity.

Thermal treatment of a fine grained soil with a moisture content above the plastic limit is extremely difficult. Plastic soils, when subjected to compressive forces, can become molded into large particles that are difficult to heat because of low surface area to volume ratios. Soils in a plastic state are also difficult to pre-treat to remove rocks and other debris—and tend to stick to materials handling equipment and cause jamming problems. Plastic soils can also coat interior surfaces of thermal desorption systems and reduce heat transfer efficiencies. In some cases, the moisture content of a soil must be decreased below the plastic limit prior to thermal treatment. Pre-treatment methods may include air drying, mixing the waste material with drier soil

Continues on page 46 →

**Figure 6**

**Heat Transfer Requirements Versus Moisture Content**

<table>
<thead>
<tr>
<th>Moisture</th>
<th>Organic</th>
<th>Dry Soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>200</td>
<td>300</td>
<td>400</td>
</tr>
<tr>
<td>300</td>
<td>400</td>
<td>500</td>
</tr>
<tr>
<td>400</td>
<td>500</td>
<td>600</td>
</tr>
<tr>
<td>500</td>
<td>600</td>
<td>700</td>
</tr>
</tbody>
</table>

**BioGenesis**

**Soil Washing**

Demonstrated in the U.S. EPA Superfund Innovative Technology Evaluation Program

MOBILE UNIT CLEANS SOIL CONTAMINATION

- Diesel
- Crude Oil
- Gasoline
- Fuel Oils
- Most Organics

HIGH THRU-PUT AT LOW COST

_BioGenesis Enterprises, Inc._

Chicago • Milwaukee • Washington, DC

(703) 250-3442

Write in 254

June-July 1992 Soils 45
or other inert solids or mechanical size reduction using power screens or crushing operations.

The moisture content of contaminated soils may range from five to 30 percent or higher with typical moisture concentrations in the range of 10 to 20 percent. The moisture may be either absorbed to the surface of soil particles or chemically bound as a hydrate. Moisture content of a soil will affect both the amount of energy required to heat the soil to the target treatment temperature and the physical handling properties of fine grained soils.

The soil processing rate, and consequently the operating cost, of a thermal desorption device is strongly influenced by the soil moisture content. Moisture can be the major heat sink in a thermal desorption system treating contaminated soils. Figure 6, page 45, shows an example of the total energy that must be transferred to heat a contaminated soil versus the moisture content of the waste.

Steam stripping may be an important thermal desorption removal mechanism for some compounds. One study has indicated that the presence of moisture in the waste material significantly affects the removal efficiency for organic compounds.

Permitting thermal devices
There are no federal regulations that establish performance

---

**THERMAL SOIL REMEDIATION**

- Full Incineration of Organic Contaminants Including Petroleum Hydrocarbons
- Capable of Treating All Soil Grain Sizes, i.e., Sand, Silt, Clay
- 3 Off-Gas Emission Control Devices
- Post Treatment Analysis and Certification
- High Capacity Production Process
- Cost Effective Results
- Mobile Plant

PET-CON Soil Remediation, Inc.
P.O. Box 205
Spring Green, Wisconsin 53588
Phone (608) 588-7365
FAX (608) 588-2530

---

"Moisture content of a soil will affect both the amount of energy required to heat the soil to the target treatment temperature and the physical handling properties of fine grained soils. Moisture can be the major heat sink in a thermal desorption system treating contaminated soils."

---

problems reported in the use of EPA 418.1 including:
- loss of volatiles present in the sample;
- extraction of natural organics present in the soil, leading to false positive results;
- incomplete extraction of petroleum hydrocarbons;
- variable hydrocarbon recoveries depending upon petroleum product type;
- interferences caused by the absorption of infrared radiation by suspended soil particles in sample extracts.

How much does it cost?
Hopper to hopper treatment costs to treat petroleum contaminated soils range from $50 to $125 per ton for mobile systems and $35 to $80 for fixed base systems. Treatment costs are highly application specific and depend
on the type and size of the equipment used, type and quantity of soil at a site, moisture content of the soil and the type of contamination. Mobilization, permitting and demobilization costs may be a significant fraction of the total cost for mobile systems. Soil transportation costs must be considered in evaluating total project costs for using fixed based systems.

Operating costs include materials handling, equipment rental, fuel, labor, electricity, waste disposal, capital depreciation, insurance, maintenance, taxes, health and safety supplies, analytical costs and contractor profit.

Further costs may result from remedial investigations, analytical costs to characterize soils, excavation, soil transportation, disposal or site closure.

Trends and developments
Over the last few years, thermal desorption equipment vendors and service contractors have improved their designs and are beginning to use high temperature alloys as materials of construction. These changes enable higher soil treatment temperatures than can be achieved in carbon steel devices. Higher temperatures allow the newer systems to treat soils contaminated with crude oils and heavy hydrocarbons, such as No. 6 fuel oil.

Rotary dryers are currently available that can attain soil temperatures of 1,200°F and some thermal screw systems can reach temperatures of 900°F. The trend to construct equipment that can operate in temperature ranges of 600 to 1,200°F will likely continue.

While thermal desorption treatment costs more than landfilling, the results are low hydrocarbon soil residuals which essentially eliminate future liability from the treated soils.

"Hopper to hopper treatment costs to treat petroleum contaminated soils range from $50 to $125 per ton for mobile systems and $35 to $80 for fixed base systems. Mobilization, permitting and demobilization costs may be a significant fraction of the total cost for mobile systems."

Write in 208

Environmental protection you can see.

If you’re concerned about the impact fuel storage can have on the environment, look at the above ground advantages of Lube Cube Vault tanks. Lube Cube Vaults provide safe storage for flammable and combustible liquids, and are also safe for the environment.

Lube Cube Vaults feature built-in fluid secondary containment and sit on 2” supports to allow visual inspection. Thermal protection is provided by a six inch concrete vault between the two steel tanks.

Lube Cube Vaults provide a two-hour fire barrier and are designed to withstand natural disasters. Lube Cube Vaults feature a UL-142 tested tank and comply with the 1991 Uniform Fire Code and NFPA-30. Sizes range from 250 to 6000 gallons.

For information, call Lube Cube at 800 777-2823.

All the technical and editorial illustrations in this magazine were created by V.U. Graphics

10229 E. Independence Ave. Independence, Mo. 64053
FAX: 816-254-2128

Let us create YOUR slides, overheads, client presentation visuals, brochures, newsletters, catalogs and annual reports.

SAMPLES, FAST QUOTES
CALL 1-800-927-8444
FROM CANADA, CALL 1-816-461-4037

Write in 564 for more information

Write in 224

Write in 208

June-July 1992 Soils 47
Buyer's Guide, from page 28

Foppe Thelen Group Inc.
11415 Century Blvd.
Cincinnati OH 45246
800-486-8144 Sandra Fox
FAX: 513-671-8150
BIO EXC SVE SVT
SFL SWA STA TTR

International Env. Tech.
Box 797
Perrysburg OH 43552
419-865-2001 L. Sherman
FAX: 419-389-9460
BIO SWA

Maumee Bay Env. Inc.
Box 5299
Toledo OH 43611
419-729-2001 Tom Nolan
FAX: 419-729-4848
BIO EXC TTR TDR LFM

Merit Env. Mgt.
781 Beta Dr. Ste. G
Cleveland OH 44143
216-461-7760 David Munson
FAX: 216-461-2873
EXC REC TTR

MHC Env. Inc.
2237 E. Enterprise Inc.
Twinburg OH 44087
216-425-2393 Gary Rall
FAX: 216-425-7266

BIO EXC SVE SVT
SFL SWA LFM

OHM Corp.
16406 US Rt. 224 E.
Findlay OH 45840
800-537-9740 Patricia Ziegler
FAX: 419-423-3526
BIO EXC SVE SVT
SFL SWA STA TTR

O/C Tanks Corp.
One Levis Square
Toledo OH 43699
800-OC-TANKS Rick Garitz
FAX: 419-248-8977
MF: TANKS

Qsource Env. Svcs. Inc.
2490 Technical Dr.
Miamisburg OH 45342
513-866-1711 Mike Henry
FAX: 513-866-7473
BIO EXC SVE SVT
STB LFM

Soil Remediation Inc.
1721 Pine St.
Warren OH 44483
216-536-6825 David Gennaro
FAX: 216-536-6838
EXC REC STB TTR

Stoneco Inc.
Box 29A
Maumee OH 43537
419-893-8731 Joseph Czajka
FAX: 419-891-3013
TDR

Terra Technologies Inc.
2840 Fisher Rd. Ste. D
Columbus OH 43204
614-279-5400 Eric Schulze
FAX: 614-279-5604
BIO

Thermal Earth Sciences
3445 S. Dixie Dr.
Dayton OH 45439
513-298-8882 Brian Bell
FAX: 513-298-7600
TDR

OKLAHOMA

Ages Inc.
1015 Waterwood Pkwy.
Edmond OK 73034
405-348-5332 Ben Short
FAX: 405-340-6582
BIO SVE SVT LFM

Allied-Signal Industrial Catalysts
Box 580970
Tulsa OK 74158
918-266-1400 John Robinson
FAX: 918-266-3251
MFG

American Env. Consultants
210 S. W. 36th Ave. Ste.1-C
Norman OK 73062
405-360-5333 Duane Winegardner
FAX: 405-360-5828
BIO SVE SVT TTR

Eagle Picher Env. Svcs.
36 B.J. Tunnell Blvd.
East Miami OK 74354
800-331-7425 Robert Greer
FAX: 918-540-1659
MFG

Hitech Remediation
3304 N. Lewis
Tulsa OK 74110
918-258-8378 Kermit Hoffmeier
FAX: 918-428-3293
SVE

OREGON

Bioemediation Services Inc.
Box 2010
Lake Oswego OR 97230
503-624-9464 David Emery
FAX: 503-684-5268
BIO EXC SVE SVT
SFL SWA STB

Cascade Earth Science Ltd.
3425 Spicer Dr.
Albany OR 97321
503-926-7737 Terry Rahe
FAX: 503-926-6091
BIO EXC REC SVE
SFL LFM

Donald Camp & Assoc.
Box 1116
Jacksonville OR 97530
503-899-7127 Don Camp
BIO EXC LFM

Emcon Northwest Inc.
15055 S.W. Sequoia Pkwy. Ste. 140
Portland OR 97224
503-624-7200 Jim Maul
FAX: 503-620-7658
BIO EXC SVE SVT
TTR LFM

H2 Oil Recovery Equipment Inc
Box 9028
Bend OR 97708
503-382-7070 James Hatcher
FAX: 503-382-2242
BIO EXC SVE SVT
TTR LFM

PEMCO
437 N. Columbia Blvd.
Portland OR 97211
503-283-2151 Richard Wayper
FAX: 503-283-6388
BIO EXC TDR LFM

Write in 189
48 June-July 1992 Soils
Pegasus Prof. Svcs. Corp.
30250 SW Parkway Ave. Ste. 2
Wilsonville OR 97070
503-682-5802 Paul Hopkins
FAX: 503-682-1967
CON

**PENNSYLVANIA**

Almega Corp.
366 Ridge Rd.
Spring City PA 19475
215-495-7662 Merrill Walters
FAX: 215-495-7682
EXC REC TTR

Alternative Waste Disposal Inc.
7 Parkway Center Ste. 611
Pittsburgh PA 15220
412-928-8885 Kim Hammill
FAX: 412-928-8371
REC

American Geosciences Inc.
3925 Reed Blvd.
Murrysville PA 15668
412-733-7003 Lynne Casper
FAX: 412-733-1003
BIO EXC REC SVE
SVT TTR LFM

Baker Environmental Inc.
420 Rouser Rd Bldg 3 Airport Office Park
Corapolis PA 15108
412-260-6000 Alan Wojdyla
FAX: 412-269-6097
BIO EXC LDF REC
SVE SVT SWA STB
TTR

BCM Engineers
One Plymouth Meeting
Plymouth Meeting PA 19462
215-825-3800 Mark Hanlon
FAX: 215-834-8256
BIO TTR

Bioscience Inc.
1530 Valley Center Pkwy. #120
Bethlehem PA 18017
215-974-9693 R. D. Bleam
FAX: 215-961-2170
BIO EXC SVE SVT
SFL SWA LFM

Burns & Roe Env. Svcs. Inc.
601 S. Henderson Rd.
King of Prussia PA 19406
215-354-0500 Steven Gertz
FAX: 215-354-9347
CON

Calgon Carbon Corp.
Box 717
Pittsburgh PA 15230
412-787-6700
FAX: 412-787-6713
SVT

Centre Analytical Laboratories
3048 Research Dr.
State College PA 16801
814-231-8032 Rick Grazzini
FAX: 814-231-1253
LAB

D’Appolonia Engineering
One Monroeville Center
Monroeville PA 15146
412-856-9440
FAX: 412-856-9535
CON

Decon International Inc.
2986 Industrial Blvd.
Bethel Park PA 15102
412-831-3000 Jim Beard
FAX: 412-835-9555
BIO EXC REC SVE
SVT TTR TDR LFM

Earth Sciences Consultants Inc.
One Triangle Drive
Export PA 15632
412-733-3000 Thomas Trent

FAX: 412-325-2219
BIO EXC REC SVE
SVT SFL SWA STB
TTR TDR LFM CON

Enviro Pure Inc.
105 Mall Blvd. Ste. 348
East Monroeville PA 15146
412-372-7686 John Purcell
FAX: 412-372-6246 CON

Environmental Mgt. Alternatives Inc.
USX Tower Ste. 3260 600 Grant St.
Pittsburgh PA 15219
412-471-9936 Beau Sechan
FAX: 412-471-9818
REC TTR TDR

Continues on page 50

---

**ON-SITE TPH ANALYSIS**

THE GAC PORTABLE TPH ANALYZER FOR RAPID DETERMINATION OF HYDROCARBON CONTAMINATION IN SOIL AND WATER

- Two models available:
  - TPH Standard—reports total hydrocarbons
  - TPH-Plus—reports aromatic and aliphatic hydrocarbon concentrations individually

- Portable, ruggedly constructed, battery operated

- Our new Field Extractor Kit provides TPH analysis on-site or in the laboratory within 10 minutes

- Both models display concentrations digitally in mg/liter over a broad concentration range

- Infrared based, EPA compatible

For details, contact Susan Weisheit. Phone:203-852-8999 Fax:203-838-1551

**gac GENERAL ANALYSIS CORPORATION**
140 Water Street ▲ South Norwalk ▲ Connecticut 06854

Write in 167

June-July 1992 Soils 49
R.E. Wright Assoc. Inc.
3240 Schoolhouse Rd.
Middleton PA 17057
717-944-5501 Ned Wehler
FAX: 717-944-5642
BIO SVE SVT SFL
SWA LFM

Remediation Inc.
4331 Fox Run Rd. Box 97
Dover PA 17315
717-292-4432 Kenneth Johnson
FAX: 717-292-7569
BIO EXC REC STB TTR

RT Env. Svcs.
215 W. Church Rd.
King of Prussia PA 19406
215-265-1510 Gary Brown
FAX: 215-265-0687
EXC REC SVE SVT

Skelly & Loy, Inc.
2601 N. Front St.
Harrisburg PA 17110
717-232-0593 Sandi Loy
FAX: 717-232-1799
EXC

United Energy Env. Svc.
Manor Oak II Ste. 333 1910 Cochran
Pittsburgh PA 15220
800-837-4212 Joseph McLean
FAX: 412-341-5563
EXC STB TTR TDR

RHODE ISLAND
D’Ambra Construction Co. Inc.
800 Jefferson Blvd.
Warwick RI 02887
401-737-1300 Jenny Parker
EXC REC

Inland Waters Pollution Control
275 Scituate Ave.
Johnston RI 02919
401-943-5300 Peter Marshall
FAX: 401-943-5716
BIO TRA

UST Corp.
1179 Elmwood Avenue
Providence RI 02907
401-785-4090 Robert Mancini
FAX: 401-785-4093
SWA

SOUTH CAROLINA

CleanSoil Inc.
3195 Leaphart Rd.
West Columbia SC 29169
803-796-1644 Bart Lehman
FAX: 803-609-0413
TTR

Giants Resource Recovery Co.
Highway 453 Box 29448
Harleyville SC 29448
800-786-0477 Rick Familia
FAX: 803-496-5380 REC

SOUTH DAKOTA
Tank Trailer Tech. Inc.
3500 Teem Dr. Box 187
Sioux Falls SD 57101
605-336-1131 Ken Olson
FAX 605-336-6270
TTR

TENNESSEE
C W Env. Svcs. Inc.
2308 Watauga Rd. Ste. #2
Johnson City TN 37601
615-926-3999 Dennis Whittington
FAX 615-926-3999
BIO EXC SVE SVT SFL LFM

Focus Env. Inc.
9050 Executive Park Dr.
Knoxville TN 37923
615-694-7517 James Cudahy
FAX 615-531-8854
CON

Pickering Enviro Ram Inc.
1750 Madison Ave.
Memphis TN 38104
901-726-0810 Kenneth Lee
FAX 901-272-6911
BIO SVE SVT SFL SWA LFM

Soil Purification Inc.
Box 72515
Chattanooga TN 37407
404-861-0069 Wendell Feltman

Continues on page 52→
CALIFORNIA UST OWNERS
You may be eligible for up to $990,000 to reimburse your clean up costs.
Funds are available on a first-come, first-serve basis.
Call us now to prepare your application.
1-800-444-5602
Feeling left out?

If your company is not listed in this Buyer’s Guide, and if you wish to be listed next year, mail company’s information to:

SOILS BUYER’S GUIDE 93
10229 E INDEPENDENCE AVE
INDEPENDENCE, MO. 64053

Include: company name, address, city, state, zip, phone number, fax number, a contact person and describe the remediation services you provide (refer to the key in this Buyer’s Guide). Or, if you prefer, fax the information to 816-254-2128. The deadline to be included next year is April 1, 1993.

SOIL PROCESSING
USED AND NEW EQUIPMENT

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® Environmental
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)
THERE'S A GOOD REASON TO CALL US.
WE RECYCLE!

Recycling Alternatives Inc. is a company dedicated to developing innovative processes to recycle waste materials into a marketable product. RAI is committed to finding environmentally compatible solutions to today's and tomorrow's complex disposal problems. We provide turnkey services, managing petroleum waste projects from the initial site assessment through remediation to material recycling. Whether it is thermal desorption, bioremediation, soil vapor extraction, or a ground water treatment, RAI's technical staff provides the most efficient remedial solution for you.

THE ADVANTAGES OF RECYCLING WITH RAI

MINIMIZE LIABILITY
In the recycling process, the soil contaminants are destroyed. As a result, the potential of future liability for the handling of these soils is avoided.

RESTORE SOIL VALUE
RAI's processes convert soils into reusable products for the manufacture of asphalt, road subbase, brick or landscaping material.

PROTECT THE ENVIRONMENT
Recycling soil reduces the dependance on new excavation and its associated impacts. In addition, recycling of petroleum-contaminated soil prevents the material from entering the solid waste stream, thereby conserving valuable landfill space needed for non-recyclable materials.

IMPROVE PUBLIC RELATIONS
Environmental issues are now a mainstay of the public agenda. Therefore, recycling is essential not only for environmental reasons, but also to cultivate positive public perceptions.

Now that soil management has become a key responsibility in the business sector, you can benefit from the recycling services of RAI. Call us today for more information.

Recycling Alternatives, Inc.
P.O. Box 1896 • Salisbury, MD 21802-1896 • Tel. (301) 860-0268 • Fax (301) 860-0269
Facilities located in: Virginia, North Carolina, Maryland, Georgia, Alabama and Texas.

Write in 154
Field test results for PCBs in 20 minutes

Ensys, Inc., of Research Triangle Park, N.C. says their immunoassay Petro Risc test kit provides accuracy comparable to laboratory-based methods—in 20 minutes. The kit measures gasoline or diesel contamination. The kit tests samples at 100 and 1,000 ppm and results are obtained by a color change in a test tube.

Write in 570 for more information

WE SOLVE ENVIRONMENTAL CONCERNS FOR THE MOST COST CONSCIOUS COMPANIES IN THE WORLD.

The list of those who utilize our cost effective environmental solutions reads like a who’s who of industrial companies, small and large, including other subsidiaries of The Coastal Corporation.

In fact, Coastal Remediation Company has earned its reputation by satisfying the most cost-conscious clients — other Coastal subsidiary companies who demand cost-effective, fast-track solutions to a wide variety of complex environmental concerns including UST Management, Environmental Site Assessments, soil and groundwater remediation, wastewater treatment and design, and air modelling and permitting.

If you, too, want practical, permanent remediation tailored to your needs, call us at 1-800-776-5733.

Coastal Remediation Company
A SUBSIDIARY OF THE COASTAL CORPORATION
The Energy People

Roanoke, VA          Norman, OK          Philadelphia, PA          Tampa, FL

Compact mobile unit is self-contained

Enviro-Klean Soils, Inc., Snoqualmie, Wash., announces their low temperature thermal desorption machine can clean 300 tons of petroleum contaminated soils in 40 hours. Mounted on a 25 foot trailer, the compact machine can access congested sites. Treated soils can be backfilled immediately, the company says. Burner capacity is two million BTUs per hour, sufficient to generate temperatures up to 1,500°F, even when processing wet, clayey soils. The unit has a cyclone and baghouse to reduce particulate emissions.

Write in 569 for more information

Comprehensive Analytical & Sampling Services related to:
Contaminated Soils • Groundwater • Wastes
Wastewater • Air

General Testing Corporation
Rochester, NY (716)454-2760
Hackensack, NJ (201)488-5242
Buffalo, NY (716)634-0454

A Full Service Environmental Laboratory Since 1971

Write in 190

DATA ■ DISPOSAL COSTS ■ NEWS CONTAMINATED SOILS REPORT

...A New Monthly Newsletter That Has It All!
■ All landfills that accept contaminated soil, their avg. daily intake and $/ton
■ Issues in state and federal legislation
■ New product technologies
■ List of projects, proposals and permits

1-800-234-8692
CALL NOW FOR A FREE 3/92 ISSUE!
Cambridge Environmental Group, Inc.

Write in 241

soils advertising gets results.
Call or fax for rates and information.
Darcy Case,
816-254-8735,
FAX: 816-254-2128
Back to the Heartland

The marketers attending this meeting, October 3-6, are the owners and decisionmakers in their companies. If your company does business with petroleum marketers and you are seeking a top quality audience, this is your show!

The nearly 11,000 petroleum marketing companies represented by PMAA own approximately:

- 46,000 Service Stations
- 15,000 Convenience Stores
- 185,000 Underground Storage Tanks
- 45,000 Trucks
- 278,000 Fuel Dispensing Pumps
- 10,400 Bulk Plants
- 3,000 Car Washes
- 1,700 Truck Stops

Information, please…

☐ Please send me the registration information as soon as it is available.
☐ Please send me information about EXHIBITING at PMAA’s 16th National Petroleum Marketing Exposition.

Name ____________________________________________
Company __________________________________________
Address __________________________________________
City / State / Zip __________________________________

Please mail this coupon to:
Petroleum Marketers Association of America, 1120 Vermont Avenue, NW, Suite 1130
Washington, DC 20005    Telephone (202) 331-1198    Fax (202) 467-6330
Best defensive strategies to survive real estate transactions

Know the best approaches to minimize liability and expense

By James C. Mauch, Esq.

When it comes to environmental liability in real estate transactions, the key to survival is a good defense and a better offense. Since today’s regulations place the cost ofremedying past environmental mistakes on current parties in real estate transactions, there are not many strong avenues of defense. More useful is to adopt an educated offensive strategy to minimize liability and expense.

The federal Superfund Act is the foremost example of placing yesterday’s blame on today’s shoulders.

The Environmental Protection Agency (EPA) is charged to carry out Superfund and recover the costs from legally responsible parties. Although not always clear, the Superfund Act identifies a range of liable parties, the nature of their liability and the types of damages for which they are liable. The courts have construed extremely broad liability for the parties, and the EPA continually seeks more expansive interpretations of its terms. The four categories of responsible parties under Superfund are:

- current owner and operator of a site at which hazardous substances are being released;
- any prior owner and operator;
- generators of hazardous substances at the site;
- transporters who brought the substances to the site.

Under this system, Superfund imposes cleanup liability on those who caused the contamination by disposing of waste on the property and, when they cannot be found or identified, on the current owner or operator of the site—regardless of their fault. In this way, the law maximizes the likelihood that there will be at least one responsible party to pay for the cleanup.

The act imposes “strict liability,” which is liability without fault—and “joint and several liability,” which means that each party is liable for the entire cost of the cleanup. Thus, it is not a defense for a current owner or operator to declare that he or she did not contribute to the contamination. Nor is the owner or operator excused by claiming no knowledge of existing contamination when the property was purchased. Furthermore, a current owner who did not contribute to or know about the contamination may end up paying the entire cost of the cleanup.

Superfund also provides that responsible parties are liable for all costs of the cleanup incurred by the EPA, plus any other necessary costs of response, including environmental studies, testing, temporary provisions for loss of resources and any damage or loss of natural resources. Today, the average cost of an EPA Superfund cleanup is approximately $22 million.

The purchaser’s best defense: look before you buy
Superfund provides three distinct defenses to liability—only one of which has any practical significance for a real estate purchaser...the “innocent landowner” defense. But while the innocent landowner defense does provide a narrow exemption from liability for certain owners and operators, in reality, it is a “carrot-on-a-stick” defense which only protects owners and operators who protect themselves through the exercise of “good commercial or customary practice.”

According to the innocent landowner defense, a person who acquires property or becomes an operator of property after disposal of hazardous material is not liable if that person, at the time of acquisition, made a commercially reasonable investigation and as a result of that investigation has no reason to believe that the property is contaminated.

Specifically, Superfund requires that such persons make “all appropriate inquiry into the previous ownership and uses of the property consistent with good commercial or customary practice in an effort to minimize liability.”

In addition, the act states that when judging the sufficiency of an investigation, the court will consider:

any specialized knowledge or experience on the part of the defendant, the relationship of the purchase price to the value of the property if uncontaminated, commonly known or reasonable ascertainable information about the property, the obviousness of the presence, and the ability to detect such contamination by appropriate inspection.

The assessments: due diligence
The requirement for an environmental due diligence investigation has spawned an industry of environmental consultants as well as a new real estate service known as pre-purchase or Phase I environmental assessments. The term “Phase I” is generally recognized, but the scope of a Phase I environmental assessment varies in the industry.

It is important to keep in mind that a Phase I assessment is not a certification process. Under the innocent landowner defense, it is a due diligence investigation which serves as the basis for a purchaser’s claim that he had no reason to believe the property was contaminated. The innocent landowner defense does not require that the purchaser secure a guarantee that the property is free of all hazardous and toxic contamination. Rather, it requires that the purchaser make a reasonable, due diligence inquiry into facts that may
reveal those conditions. In fact, no affordable testing program gives a guarantee of a “clean” property.

In general, a Phase I assessment should provide practical underwriting information about the investment and provide legal protection from liability under Superfund. Specifically, it should include these components:

- a chain of title review and review of historical data such as maps and aerial photographs to identify prior ownership and uses which represent potential for contamination;
- a government records review to identify regulated hazardous waste sites and recorded hazardous site conditions and violations identified by government agencies;
- a site inspection and assessment;
- on certain commercial and industrial properties, an assessment of current on-site generators of hazardous waste to determine the adequacy of handling and disposal practices;
- a summary report to document all findings.

The consultant must be able to identify prior agricultural, commercial, manufacturing or industrial uses which represent potential for contamination. How far back to dig in the records is determined by the age of any development in the area, the extent of any known hazardous use of the property and, of course, availability of the records.

Current laws in at least 25 states (see box, page 60) require a deed notice or notice of sale of hazardous waste contaminated property—which requires careful title review. The government records search should not neglect examination of records regarding adjacent properties to identify hazardous conditions that are likely to result in contamination of the subject property. Size of the area to review depends on characteristics of the site, such as industrialization, topography and hydrogeological conditions.

The EPA and state and local regulatory agencies maintain data on identified hazardous waste sites as well as records regarding various activities which have potential to impact the environmental integrity of real property. These records may include information about contamination. The records should be searched for any report or incident of contamination on adjacent properties that is likely to affect the subject property. Agencies and records typically reviewed in a Phase I assessment include:

- EPA indexes of Superfund sites and other facilities the EPA investigated during the process of identifying Superfund sites;
- any state or local agencies which maintain indexes of sites identified for hazardous waste cleanup or other remedial measures—or facilities with a history of violations;
- records of landfills or solid waste facilities;
- records of domestic, industrial or hazardous facilities;
- RCRA (Resource Conservation and Recovery Act) notifier lists which identify persons and facilities which handle, store, transport or generate hazardous materials or waste;

Continues on page 60→
Best defensive strategies, from page 59

• records of registered underground storage tanks and leaky tanks;
• electrical equipment records (transformers and generators which may contain polychlorinated biphenyls) from local power companies;
• waste treatment facilities;
• local health or fire department to identify any reports of spills, contamination or generators of hazardous wastes who represent a concern for the area.

The timing between the background records review and the site evaluation is important. The background review of previous ownership and uses and the government records review for incidents of contamination should be developed in anticipation of the site evaluation. In addition, information about soils and groundwater depth and flow may assist the consultant to evaluate the potential threat of contamination of subject and adjacent properties.

The purpose of the site evaluation is to visually identify observable contamination. With the assistance of the information from the background and government records review, the consultant should take into consideration the condition of exposed soil and vegetation, abandoned roads and evidence of dumping and other landfill activities. The consultant should identify such structures as ponds, tanks, septic and sewage treatment facilities, waste disposal sites, storage areas, utilities and electrical equipment.

The consultant should have a background in geology, soil and water issues and hazardous site inspections. In some cases, an industrial hygienist or similar training is required to properly inspect some facilities.

The Phase I evaluation should not include testing (except for asbestos and radon gas). At this stage, environmental sampling is random and usually is a waste of money. If hazardous waste conditions are discovered during the Phase I assessment, a logical basis exists for specific tests to quantify the nature of those conditions in later phases of investigation.

Since the purchase of real estate is an investment, the purchaser or lender must rely on the environmental integrity of the property for the duration of the investment. Moreover, Superfund and other federal and state regulations require that an owner of property exercise due care to prevent the foreseeable future conduct of third parties. For example, an absentee landowner must take precautions against potentially contaminating uses by tenants. The innocent landowner defense is lost if the owner fails to do so.

The Phase I report is not only used by the owner, but by investment or lending officers as well, so it should also address their underwriting needs. A typical Phase I assessment, even on undeveloped property, will yield a substantial amount of information, much of which is neutral or indicates there is no problem. This information is important to document that the owner satisfied due diligence obligations.

In order for the report to be useful, it should begin with a summary outlining the results of the three essential components of the assessment. At a minimum, the summary should state:
• whether the historical records review revealed any potential for contamination;
• whether the government records review related any report which appears likely to affect the property;
• whether the consultant found environmentally hazardous conditions based on the site evaluation.

Further in the report, the consultant will attempt to identify likely sources and probable locations of contamination based on the records reviews. The report should contain conclusions and specific recommendations for testing to uncover additional information about the contamination. If the owner decides to proceed with the recommendations, an outline of the scope and cost of a testing program can be prepared.

In essence, the environmental assessment and report should place the purchaser in a decision-making position—a basis to decide whether to proceed with the investment.

Phase II and beyond

The purpose of a Phase II study is to confirm the existence of the conditions discovered in the Phase I. The additional phases are predominantly engineering tasks and should directly follow from the conclusions of the Phase I report. Engineers can assess the specific risks imposed by the hazardous conditions and develop a remedial or abatement plan with time and cost estimates. Similar to Phase I, the results of the additional phases of assessment put the interested parties in a decision-making position with respect to the potential investment.

There are countless parcels of real estate in this country which are contaminatec with hazardous or toxic substances. All of these properties are potential investments. Although many commercial real estate investment firms, lenders and others scrupulously avoid any contaminated property, these parcels still are potential investment opportunities.

As the technology of detection and remediation improves, and as the regulatory community clarifies its policies and goals, the remediation cost of environmentally hazardous conditions will simply be factored in as part of the investment cost. In any event, the quality and thoroughness of the environmental investigation is the key to assessing risks and properly evaluating real estate investments.

Write in 565 for more information
The Proven Conference and Exhibition in EPA Region VI for Professionals In:

Hazardous Materials Management
Environmental Management • Emergency Response

See the Exhibits!
The nation's leading manufacturers and suppliers will be displaying their newest products and services in over 175 exhibit booths.

4th Presentation

Haz Mat
FALL
SOUTHWEST

Hazardous Materials and Environmental Management Conference & Exhibition/Southwest
October 7-9, 1992
INFOMART Conference & Exhibition Center
Dallas, Texas

Plan NOW to Attend!
Simply complete and mail the coupon or contact the organizer for complete details.

Sponsored by:

HAZMAT WORLD magazine

Organized by:

Tower Conference Management Co.
800 Roosevelt Road
Building E - Suite 408
Glen Ellyn, IL 60137-5835
(708) 469-3373
FAX: (708) 469-7477

Participate in the Conference Program!
Over 100 individual papers will be presented in 22 Technical Sessions. PLUS, 28 hands-on Workshops, Certification Exams and more will offer an unparalleled learning experience.

Don’t Miss these Special Events!

- In-depth Plenary Session: “Environmental Agenda for the Next Millennium - How Do We Get There From Here?”
- The demonstration, “Transportation Accident” will be conducted at the Texas Instruments facility.

TO: Tower Conference Management Co.
800 Roosevelt Rd., Bldg. E - Suite 408
Glen Ellyn, IL 60137-5835

☐ I am interested in ATTENDING HazMat/Southwest. Please send complete Conference Program and pre-registration form when available.

☐ My company is interested in EXHIBITING. Please contact me with full details.

Name ____________________________________________
Title ____________________________________________
Company _________________________________________
Address _________________________________________
City ________________________ State _______ Zip+4 _______
Phone (______)____________________ FAX (______)____________________
What to know to go with the flow

Heat pulse flowmeters can provide gas flow information to help engineers plan vapor extraction remediation

By William B. Kerfoot, Ph.D.

With more contaminated soil sites being treated with vapor extraction techniques, the behavior and flow patterns of vapor in various soil types is attracting more interest.

Direct-reading liquid flow sensors were originally developed to measure groundwater flow. But with certain modifications, they can be adapted to measure soil gas flow to determine direction and rate of gas movement.

Heat pulse flowmeters have been constructed and independently tested to measure capillary water or petroleum product movement below .1 feet per day. Standard procedures have been developed for installation of monitoring wells suitable for direct measurement of rate and direction of groundwater flow.

The application of heat-pulse flowmeters to the direct measurement of soil gas flow, particularly methane movement from landfills, has been under study for about five years. GeoFlo meter systems have been successful in measuring gas seepage rates down to one cubic centimeter per square centimeter per minute (1 cm3/cm2/minute) through a variety of soil types. Further modifications to the sensor systems have brought the level of detection to .1 cm3/cm2/minute—or approximately five feet per day. With proper installation, this dynamic range would allow probes to be used for:

- in-situ determinations of horizontal permeability of layered soils,
- direct monitoring of vapor containment systems.

Theory of operation

Direct flow measurement offers the convenience of rapid, simultaneous determination of gas flow direction and rate for subsurface engineering applications. A heat pulse is transmitted through a porous glass medium in the probe. Interstitial air or vapor movement modifies the heat distribution between paired thermal sensors, yielding a linear response to increased inflow rate.

The rate of heat transfer through a porous material, such as glass beads, is dependent upon the thermal conductance of the spherical solids. The thermal conductance of the type of glass beads used as packing material (2,000 X 10⁻⁶ cal/(sec)(cm²)(°C/cm)) is approximately 40 times greater than the thermal conductance of stationary air (56 X 10⁻⁶ cal/(sec)(cm²)(°C/cm)). The heat pulse through the elemental block of porous solid is directly proportional to the area of the section (A), inversely proportional to the thickness (L) and proportional to the temperature difference across the section (T₂-T₁):

\[ \frac{dg}{dt} = K \frac{A(T₂-T₁)}{L} \]

The constant of proportionality (K) is called the thermal conductance of the material. In porous material where the air is not in motion, K is a composite of the thermal conductance of the solid (Kₕ) and the fluid (Kᵢ). If the fluid motion corresponds to the outward movement of heat through the solid, heat transport is facilitated. If the fluid movement is counter to the outward movement, heat transport is reduced.

Calibration

A single axis probe with two pairs of sensors oriented along the central axis of flow was placed in a simple flow tube for calibration. The tube was filled with glass beads identical to the packing material for the probe. A calibration curve was constructed by creating a flow from .1 to 10 cm³/cm²/minute. A linear response was observed in the simple flow cell.

The probe was placed in a simple packer containing a mesh bag filled with glass beads. The packer was placed in a section of two-inch polyvinyl chloride (PVC) monitoring well screen, which was in turn placed in a T-chamber that could be sealed. Different gas velocities were produced across the cylinder and the probe response recorded. Resistance of the screen was observed to reduce sensitivity by about 50 percent.

Simple air permeability test for horizontal strata

Vapor flow rates through porous material, such as soil, are affected by the material’s porosity and permeability, as well as by the gas viscosity, density and pressure gradient.

The movement of gas through soil can be approximated by Darcy’s Law which is valid only for laminar, isothermal flow that is uniformly distributed across a given cross-sectional area. A simple formulation of Darcy’s

Continues on page 64...
Griffolyn®
Control and Containment for Your Contaminated Soil Problems

Professionals in the critical area of environmental protection understand the need for control and containment while projects are in progress. Griffolyn, a unique nylon reinforced polyethylene, is the ideal choice for covering almost all environmental applications, including:

- Waste disposal site covers
- Contaminated soil stockpile covers
- Erosion control protection
- Daily landfill covers

Griffolyn covers are designed and manufactured for the dependability and versatility demanded by today's environmental challenges. Griffolyn is available in any size up to 200' x 200', reducing field fabrication costs. Stock sizes are ready for immediate shipment. Different grades of Griffolyn have been developed to last the lifetime of projects, from six months to four years.

For more information on Griffolyn and a FREE TX 1200 sample, Call Toll Free 1-800-231-6074

Lightweight and easy to install, Griffolyn provides the temporary cover for your permanent solutions.

Griffolyn® Division
Reef Industries, Inc.
P.O. Box 750250
Houston, Texas 77275-0250
In Texas or outside the continental U.S. call collect 713-943-0070
Fax: 713-947-2053
A heat pulse flowmeter can measure soil gas movement in various soil strata to less than five feet per day. First, a plastic liner or tarp is placed over the surface to be measured to prevent air or gas from escaping. Two polyvinyl chloride (PVC) well screens are buried through holes in the liner. The pipe in between (B above) is a probe with a heat pulser and a pair of temperature sensors imbedded in glass beads built into its tip.

A vacuum/pressure pump is turned on to create flow between A and C across probe B. The air flows across the flowmeter probe and is exhausted through pipe C. The flowmeter probe measures how fast the air moves from the end pipe to the center. The probes can be installed at varying depths to test gas conductivity at various levels. The measurements can be converted to determine a radius of influence for designing subsurface engineering applications such as soil vapor extraction and containment.

The heat pulse flowmeter can directly measure gas mass transfer and zones of contribution of vapor recovery wells. It determines horizontal permeability in layered soils. And, it can serve as a direct monitor of vapor containment systems. Vapor flow rates through porous material, such as soil, are affected by the material's porosity and permeability, as well as the gas viscosity, density and pressure gradient of the gas. In field situations, soil gas flow may not be uniform and natural gradients may be difficult to measure.

Therefore, a variety of pump tests can be performed to create measurable conditions which can be repeated. Variations in expected velocities might be attributed to changes in horizontal permeabilities.

Write in 566 for more information.
The simplified Darcy equation can be used in conjunction with a simple three well test to directly relate soil permeability to gas viscosity, flow rate and pressure gradient. By rearranging the Darcy equation equivalent of gas flow to solve for k using direct gas velocity, the following equation is derived and compared with its groundwater equivalent:

\[
\frac{k}{K} = \frac{V_{\text{gas}}}{V_{\text{water}}} = \frac{\mu_{\text{gas}}}{\mu_{\text{water}}} \cdot \frac{H_{\text{water}}}{H_{\text{gas}}}
\]

The solution for k can be found for a uniform gradient or tube flow with uniform conditions.

In field situations, soil gas flow may not be uniform and natural gradients may be difficult to measure. Often, a variety of pump tests are performed to create measurable conditions which can be repeated.

A simple two-well test with probe in the center was conducted to measure horizontal changes in conductivity using direct velocity measurements. Variations from the expected velocities would have been due to changes in horizontal permeabilities, assuming no vertical leakage. To prevent vertical leakage, the surface soil was covered with plastic. Air was withdrawn from well A and injected into well C, creating a continual closed cell.

Direct measurements of velocity were taken at position B at one foot inter-

vals. The air injection was performed with a vacuum pressure pump with vacuum gauge.

The wells acted as image pairs, creating a simple flow net. The velocity along the principal axis at a point equidistant from each other reduced to a direct proportion of the hydraulic conductivity of the strata between the equal pressure conditions. Within clay or silt units, the flow dropped to barely detectable levels. Layers containing fine and medium sand showed strong flow and likewise high permeability.

In laboratory and field condition tests to detect gas movement in soils, heat pulse flowmeters were modified to be able to detect soil gas movements of less than 0.1 cm3/cm2/minute—or approximately five feet per day. Direct measurement of natural soil gas flow appears possible and the meter may have numerous applications to predict soil vapor extraction and containment.

Write in 566 for more information

Site Contamination: A Case Of

RELIABILITY

VS.

LIABILITY

With current laws concerning responsibility for the cleanup of site contamination, having reliable information can make a critical difference in helping you reach sound environmental decisions, and protect you from potential liability.

When site contamination from stored fuels or other chemicals is discovered, Sybron bioremediation programs use ABR® cultures containing selectively adapted, naturally occurring microbes to attack and biodegrade contaminants with consistent and permanent results. Sybron bioremediation doesn’t involve containerization or landfilled materials which can escape into the environment, so the risk of contingent liability is eliminated.

YOU CAN RELY ON SYBON FOR:

• In-Depth Site Assessments
• Lab and Full-Scale Treatability Studies
• Ultimate Site Decontamination
• Cost-Effective Cleanup
• Minimal Site Disruption

Our turn-key service means you work solely with us from initial site survey and lab analysis to the implementation of a complete bioremediation program and filing for closure.

Choose reliability vs. liability. Call today for information.
800-678-0020 or 609-893-1100

SOLVING A WORLD OF PROBLEMS
THROUGH BIOTECHNOLOGY

Sybron Chemicals, Inc., Biochemical and Environmental Services Division
Birmingham Road, Birmingham, NJ 08011

Write in 162

June-July 1992 Soils 65
In situ Vitrification

- In situ vitrification, also called glassification, applies large electrical currents to heat and transform contaminated soil into an extremely stable glass-like solid that resembles obsidian. This process was originally developed to treat soils with radioactive contamination by Battelle's Pacific Northwest Lab. Four electrodes are placed in the soil, and a graphite starter path is laid out on the surface between the electrodes. Up to 4,000 volts are applied to the electrodes. The graphite starter path heats to about 3,600°F. The melting temperature for soils is 2,300°F. Surface soils melt first, then a melting zone grows downward between the electrodes. In the melt zone, temperatures are typically greater than 2,000°F, which pyrolyzes (decomposes by heat) organic compounds. As pyrolysis products reach the surface, they are oxidized and collected by an off-gas collection hood and passed through a vapor treatment system. When the current is turned off, the soil cools to form a black, glass-like block, roughly the same shape and size as the spacing between the electrodes. A reduction in the soil volume (glass is denser than soil) of 30 to 80 percent may be observed, usually necessitating backfill material to cover the solidified block. It may take a few months for complete cooling, but the area may be backfilled with clean soil after one to two weeks. The process is most applicable to soils that are heavily contaminated with non-volatile organics and metals. Soils below the water table are difficult to vitrify due to the continuing influx of water. Lots of metal, such as piping, can shoot the electrical system. Each installation of electrodes can treat an area about 25 feet square to a depth of about 50 feet. Power requirements are around 3,500 kW. Depending on the geometry of the system, four to five tons can be done per hour, roughly 200 hours per electrode installation.

This information reprinted by permission from: Soil Remediation Workshop handbook, Shell Development, Westhollow Research Ctr., Houston, Texas. Write in 567 for more information.
Perfecting Contaminated Soil Remediation

If you have underground storage tanks or are a geotechnical consultant to clients who do, you already know the importance of proper disposal of soil contaminated with oil. And since environmental regulations will continue to grow more stringent, the threat of liability continues to increase. Compliance with ever-changing requirements is not easy, but the development of new technologies can help. At Continental Paving, we have devoted significant resources to meet the challenge of contaminated soil remediation. We have designed and built a new soil incinerator that performs better than any other equipment currently available.

The Benefits of Our Technology

Our goal was to increase the destruction efficiency of the incineration process and decrease emissions. We achieved both objectives through several key updates to other Hot Mix processes. For example, our new drum is 10 feet in diameter and 30 feet long, unlike other incinerators, whose drums are 8 feet in diameter and 8 feet long. It burns the soil longer—4 minutes versus 1 minute, and hotter—800° versus 550°. These important adjustments provide adequate time and heat to get the moisture out of the incoming soil and to burn the oil completely. Our filtering system, combined with the high temperature at which the soil is burned, enables us to meet some of the toughest criteria for air quality.

603-437-5387

The Benefits to Customers: Quality and Service

Continental Paving operates a clean, state-approved recycling facility. We stay up-to-date on changing rules and regulations that govern the disposal of contaminated soil, understand the necessary paperwork and know the potential liabilities. We work with experts in every phase of the clean-up process, including environmental consultants, labs and transportation providers. You can depend on us to meet your removal schedule and to ensure that prompt, professional action is taken. Because we blend 15% of the remediated soil with virgin aggregate to make a spec road asphalt product, we are able to completely recycle the contaminated soil.

The Benefits to the Environment: A Clean Process and Complete Recycling

The technology we have developed represents the latest in contaminated soil remediation and is environmentally sound—for today and for the future. And while recycling the remediated soil into asphalt protects our customers, it also helps us fulfill our company’s commitment to recycle in every aspect of our operations.

CONTINENTAL PAVING, INC.

1 Continental Drive • Londonderry, NH 03053
The key advantage to the SiteWORKS mobile unit is that its design reduces the need for excessive pre-screening of soils, says the company. Typically, only gross oversized material (concrete chunks, asphalt pieces, tires, large wood debris, scrap metal, etc.) needs to be removed. Material under eight inches in diameter or length can pass through the system. In many site applications, the volume of material over eight inches is typically quite low. The system combines soil washing, froth separation, flotation and bioremediation in a single trailer unit. Contaminated soils are loaded into the first reactor which is partially filled with water. Surfactants are added and agitation begins to remove part of the contaminants, which float to the surface. As the liquids overflow, they are sent to a filter unit where the oil is collected for recycling. The water, which now has less than 10 ppm of oil, is sent to a storage holding tank for reuse. The soil slurry in the first reactor is sent to the second reactor where blending continues. Nutrients, selected bacterial seeding and other additives are added to the slurry, based on pre-test results and rapid field assay tests for type and level of contamination. The air from above the slurry surface is drawn off and recirculated through the slurry. Any remaining volatiles are consumed by the bacteria. Oxygen is added to the slurry to enhance bacterial growth. Under normal circumstances, first stage processing can be completed in 20 minutes or less, second stage in 10 minutes. After nutrient addition and proper retention time, the slurry is discharged into covered curing beds for aging, aeration and final degradation of contaminant in the beds. The reactors capture and treat or recirculate volatile emissions. Process cost estimates range from $45 to $100 per cubic yard.

Write in 568 for more information.
ANNOUNCEMENT
Seventh Annual East Coast Conference

HYDROCARBON CONTAMINATED SOILS CONFERENCE

Analysis, Fate, Environmental & Public Health Effects and Remediation
at the University of Massachusetts at Amherst • September 21-24, 1992

PRESENTATIONS IN THE FOLLOWING AREAS:

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

PAST SPONSORS AND SUPPORTERS:

- AERIS Software Inc./Wastewater Technology Centre
- The Association for the Environmental Health of Soils (AEHS)
- Agency for Toxic Substances & Disease Registry
- American Petroleum Institute
- ARCO
- Association of American Railroads
- Edison Electric Institute
- Electric Power Research Institute
- Health & Welfare Canada
- Massachusetts Department of Environmental Protection
- Shell Oil Company
- Texaco
- 3M
- Union Carbide Corporation/Agri-Diagnostics Associates
- U.S. Department of Defense
- U.S. Department of Energy
- U.S. EPA/Office of Underground Storage Tanks
- Major Environmental Engineering & Consulting Companies

For further information please contact:
Paul T. Kostecki, Ph.D.
Environmental Health & Sciences
N344 Morrill
University of Massachusetts
Amherst, MA 01003
Tel: (413) 545-2934 • Fax: (413) 545-4692

EXHIBITION SPACE is available and potential exhibitors can receive information by calling Chuck Bell at (413) 545-4269
The only solution you should consider for your petroleum contaminated soil problems.

State of the art technology allows you to recycle on-site at an extremely reduced rate and maintain a rapid quantity of material processed daily.

The mobile emulsion unit has been specifically designed for the recycling of contaminated soils. This is the only system of its kind which screens, classifies, weighs, and through computer supervision, thoroughly mixes soils with custom liquid asphalt emulsions. Available in portable or stationary models, with process rates up to 300 tons per hour. Configurations available for additive feed and special features.

The Proven Solution: Valuable construction products are manufactured, while costly environmental liability is avoided. Please direct inquiries concerning:

- Regional Recycling Centers
- Mobile Remediation Services
- Joint Venture Opportunities
- Engineering for Recycling

Please feel free to contact us for price quotes on all your remediation problems.
Soil Contaminated with Heavy Petroleum Hydrocarbons?

Recycle with Thermotech's New Tandem Unit!

- All advantages of counterflow desorption.
- Remediates soils contaminated with heavy petroleum hydrocarbons.
- Two-stage desorption for high temperature decontamination and superior performance.
- Field-convertible for single and tandem modes.
- Most widely used systems to recycle soil.

Now the most popular low temperature Soil Recycling Unit can be adapted to handle heavy contaminants.

THERMOTECH SYSTEMS CORPORATION

5201 N. Orange Blossom Trail, Orlando, FL 32810 • (407) 290-6000 • FAX (407) 578-0577