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Abbreviations and acronyms used throughout articles include:
EPA Environmental Protection Agency
ppm parts per million
UST Underground Storage Tank
ppb parts per billion

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Soil in a day’s work

I must say, I got chewed out pretty soundly for my editorial in the last issue, where I suggested that industry take a sympathetic attitude toward state regulators. And, I would like to take this opportunity to acknowledge all the state regulatory people who took the time to express their appreciation for my defense... I would like to... but I can’t, because I didn’t hear from any! So, this month, for the sake of balanced journalism, let’s roll up our sleeves, and rip up the feds! It’ll be fun.

In fact, it was a particularly virulent (anonymous) fax response to my defending state regulators editorial that planted the seed for this month’s topic: “The real problem industry and the taxpayers should have with the government is the way they waste millions of dollars... Just take a closer look at the Superfund Program...” Let’s just do that, because Superfund is up for reauthorization, and frankly, the thing needs major surgery.

James Lis and Melinda Warren at the Center for the Study of American Business at Washington University in St. Louis, Mo. have released a thoughtful, 44 page policy study, “Reforming Superfund,” in which they suggest that U.S. lawmakers take this reauthorization opportunity to “completely rewrite the Superfund law because the current program generates unnecessarily high expenditures and uncertainties for American producers...which slows U.S. economic growth, costs jobs, and raises prices for American consumers.”

According to Lis and Warren, Superfund’s ultra-broad definition of a responsible party has merely served to get a whole lot of people to hire a whole lot of lawyers to hurl paperwork at one another. They suggest narrowing the definition of a “polluter,” and eliminate the retroactive provisions. “Liability should be based on fault, not status,” they assert.

They also point out that Superfund’s liability structure has driven industrial development away from upgrading existing industrial (polluted) sites, to seek pristine undeveloped areas for new development. They suggest an expanded trust fund, pulling revenue from new taxes on all Superfund stakeholders, including government itself. (Don’t you love this part—where the government taxes itself?) As it stands, government demands impossibly pristine and expensive cleanup standards “because someone else pays the tab.”

But, according to Lis and Warren, the biggest problem with Superfund will be with us until someone finally comes up with the answer to the question, “How clean is clean?” They suggest that Congress should at least “consider a more dynamic definition of how clean is clean, one that is flexible enough to account for tradeoffs between environmental goals and other socially desirable projects... The degree of remediation should be permitted to vary with the expected future use of the land.”

It will be interesting to watch the Superfund reauthorization make its way through Congress. EPA administrator Carol Browner’s introduction of the Clinton administration’s proposal does incorporate Lis and Warren’s suggestion to ease cleanup standards for industrial sites, as well as the Treasury Department’s plan to tax the insurance companies. But watch out! The goal of many of the reforms may threaten the litigator’s pocketbooks, so stand back, we’re in for a fight!
Polymeric resins may send carbon adsorbents to the bench

Resins recycling ability may sideline passive carbon systems

By Paul Blystone

Activated carbon has always been the medium of choice to separate organic compounds from air or water. Carbon still dominates the market, despite the expense of using it to absorb volatile organic solvents.

The main problem with carbon is on site regeneration, usually via a steam cleaning system. Most sites just use a passive carbon system, and haul the spent carbon off site for disposal or treatment. Another problem with activated carbon is its affinity for moisture. Moisture adsorption lowers the carbon's capacity to adsorb organic contaminants. The capacity can decline by as much as three times as the relative humidity exceeds 75 percent.

One company, Purus, of San Jose, Calif., is using polymeric resins as an adsorbent, configured in a series of beds. The system allows one of the beds to treat influent air while the other beds undergo a desorption cycle—all controlled by an on-board switching control system. The system is designed for on site removal of organics from an air stream generated by vacuum extraction or air stripping remediation activities. The units can...

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also control emissions from industrial process waters containing solvents.

The system consists of two identical adsorbent bed stacks. Each stack is subdivided into four beds, allowing the system to be configured for air flows from 7.5 cubic meters per minute to 300 cubic meters per minute. The small bed has a volume of .09 cubic meter and is 15.24 centimeters deep. When configured for 7.5 cubic meters per minute, empty bed contact time is .7 seconds, and the pressure drop is about 40.5 centimeters of water. The choice of the polymeric adsorbent material is based on specific site characteristics, depending on the target contaminants.

Synthetic adsorbents are cross-linked polymers whose adsorbent properties toward specific volatile organic compounds and water vapor vary significantly. The single most critical basis for selecting an adsorbent material is probably the equilibrium isotherm, although adsorption kinetics and relative humidity impact are also important factors. The equilibrium isotherm at an elevated temperature is a critical parameter for removal of the adsorbate from the adsorbent. The difference between room temperature and desorption temperature isotherms is known as the “working capacity.”

Figure two: Mineral spirit isotherms: 30°C vs. 140°C.

Figure 2, above, compares the room temperature and 140°C isotherms of two different adsorbents for mineral spirits. In this case, the one with the highest room temperature capacity

Continues on page 46→
Fluid injection
process uses
vacuum extraction
at Sand Creek
Superfund site near
Denver, Colo.

Fluid injection helps vacuum extract contaminants

System delivers flushing fluid at Superfund site

By Robert E. Cox

Soil vapor extraction is the most popular remediation technique chosen for contaminated soils. As with all soil remediation technologies, refinements and enhancements to the basic technology continue to emerge. Fluid injection is one enhancement that helps coax contaminants out of the subsurface for treatment. One company, OHM Corp., Findlay, Ohio, has put together a process system that combines fluid injection with vapor extraction. Here's how it is working at the Sand Creek Superfund site, located in the Denver, Colo. suburb of Commerce City.

The area is heavily industrialized

Robert E. Cox is technical director of in situ remediation for OHM Remediation Services Corp., Walnut Creek, Calif.
with former land use dedicated to petroleum refining and pesticide processing. The refinery and tank terminal have long been dismantled, and only remnant sheds and a concrete block warehouse remain where pesticide operations once took place. Two fires ravaged the pesticide operation, leaving chlorinated organic compounds to mix with extensive petroleum hydrocarbon contamination in soil and groundwater.

OHM is operating its patented fluid injection and vacuum extraction (FIVE) process at the site. During the first two months of operation, the system extracted in excess of 900 kilograms per day of volatile organic compounds.

The site consists of three well fields, numbered 1, 2 and 3. The ground surface slopes abruptly downward to the north side of the property where the flood plain of Sand Creek begins. The three well fields are situated at different elevations ranging over nine meters of relief. Soils are predominantly sand and interbedded sands and silts becoming silt on the north side of the property. A clay cap had been previously installed over well field 1. In well field 3, a clay layer is situated about nine meters below ground surface.

Depth to groundwater ranges from about nine meters below ground surface at the higher elevation of field 3 on the south side of the property, to 4.8 meters below ground surface in field 1 on the north side. Petroleum and chlorinated hydrocarbon contamination was primarily situated in a stratified smear zone above and within the capillary fringe. Petroleum hydrocarbons were frequently found as non-aqueous phase liquids floating on the water table in areas 1 and 2.

Petroleum hydrocarbons varied from mid-range aromatics to heavier hydrocarbons. Concentrations in soil of total petroleum hydrocarbons, analyzed by Modified EPA Method 8015, varied from highs of 3,600 ppm in the vadose zone, to saturation in some locations of the capillary fringe. Chlorinated compounds targeted for cleanup included tetrachloroethylene, trichloroethylene, chloroform and methylene chloride. Concentrations in soil of the chlorinated compounds were analyzed with EPA Method 8240.

Of the targeted chlorinated compounds, only tetrachloroethylene was detected in significant quantities. Concentrations of tetrachloroethylene in soil gas ranged from non-detectable to 6.9 mg/l. Highest concentrations were observed in field 2, where soils heavily contaminated with pesticides were excavated to a depth of approximately 1.5 meters below...
Fluid injection, from page 9

ground surface prior to placement of clean backfill and vapor extraction. The excavated soils contaminated with pesticides were stockpiled for treatment by thermal desorption.

The FIVE process uses a flushing fluid delivered under pressure and extracted under vacuum through vertical or horizontal wells. The flushing fluid can be water, air, or other gas in liquid or gaseous phase. Wells may be used interchangeably in pressure or vacuum service. The interchangeable well design use for vacuum, pressure, dual vacuum extraction or monitoring enabled flexibility in responding to changing conditions at the site.

Extracted fluids may be treated and partially or fully reinjected to the subsurface, depending on local regulation. Air emission or liquid discharge may be allowed in some jurisdictions. Extraction of contaminant mass is enhanced by high pressure, vacuum, temperature and flow in the process.

At Sand Creek, extraction is achieved by a central process equipment area serving all three well fields. Field 1 contains 13 vertical wells and a central horizontal well approximately 60 meters long, installed beneath railroad tracks and buried debris. The central horizontal well was placed in the core of contamination within the capillary fringe to enable control of subsurface flow along the stratified smear zone. Wellheads were installed at both ends of the horizontal well to assure adequate distribution of vacuum or pressure along its entire length.

Field 2 contains 12 vertical wells and Field 3 has six vertical wells. All wells are completed subsurface and can be used interchangeably in vacuum or pressure service. Wellhead controls are housed in a single, small manifold building in each of the three fields. Use of a single manifold building in each well field to control well operations reduced the size of the field staff needed to operate the facility.

Each well field is served by a pressure and vacuum distribution pipeline connected to the central process equipment area. The vacuum source consists of three positive displacement blowers, each capable of mid-range performance of 1,000 standard cubic feet per minute (28.32 cubic meters per minute) at 20.32 centimeters of mercury vacuum. Two positive displacement injection blowers are each capable of mid-range performance of 42.5 cubic meters per minute flow at eight pounds per square inch pressure (5,625 kilograms per square meter). Nominal flow capacity of the system is 3,000 standard cubic feet per minute (85 cubic meters per minute).

Although the mass of targeted chlorinated compounds at the site could be roughly estimated, quantities of petroleum hydrocarbon contamination was unknown, but considered substantial. To assure an adequately sized vapor treatment design, OHM personnel proposed a hybrid system of carbon adsorption and catalytic oxidation to be used respectively for low and high mass extraction rates of volatile organic compounds.

An on site mobile analytical laboratory quantified concentrations of total volatile organics, tetrachloroethylene, trichloroethylene, chloroform and methylene chloride in soil, groundwater and vapor samples throughout the project. The lab is...

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equipped with a gas chromatograph-mass spectroscopy system. It also has a Hall Detector to measure chlorinated compounds which can be masked by petroleum hydrocarbons. EPA Methods 8240, 8010 and 8015 are routinely used to analyze Sand Creek samples and provide prompt information to make operations decisions.

Process monitoring is conducted and analyzed daily to assure proper adjustment of operating conditions. Off site transport of contamination is prevented by monitoring peripheral wells, which always operate in vacuum mode. Pneumatic and hydraulic control of the contaminant plume are integral to the operation of any injection system.

The use of modular extraction and injection blowers enables routine or unplanned maintenance to take place while other blowers are placed in service or accelerated to compensate for down time. In the first two months of operation, the system was never out of service.

In two months of operation, the FIVE system at Sand Creek removed 1,270 kilograms of targeted compounds. Of this quantity, approximately 98.8 percent was tetrachloroethylene. During this same period, more than 46,900 kilograms of total volatile organics were removed. The cumulative mass of targeted compounds and total volatile organics removed is shown in figure one, page 9.

Another measure of system performance is periodic measurement and trend analyses of equilibrium wellhead vapor concentrations of the target compounds. After two months of operation, 29 of 32 total wells exhibited equilibrium vapor concentrations of the targeted compounds below minimum detection levels (.005 mg/l). The remaining three wells, all in Field 2, had very low, but still measurable concentrations of tetrachloroethylene in their vapor samples. The initial vapor concentration is contrasted to that measured after two months of operation in figure two, page 9. In each case, there was more than 97 percent reduction in wellhead vapor concentration.

Mean wellhead vapor concentrations of total volatile organics were reduced 90 percent. Although this is a significant reduction, the lower percentage for total volatile organics may be attributable to the higher volatility of the targeted chlorinated compounds.

Equilibrium headspace samples are only an indicator of the concentration of a volatile organic compound in soil. Confirmatory sampling provides a more reliable determination of whether remediation goals are being reached at Sand Creek. Nevertheless, the system demonstrated contaminant extraction rates that exceeded projections.

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Look at risk to groundwater before remediation

Use of analytical transport models may change urgency and cost of cleanup

By Daniel Burnell and Carol Day

What does it take for a contaminated site to win a “no further action” closure decision from the regulators? In many cases, such a decision is based on the results of a properly managed risk assessment. Federal and state regulations require site assessments to include a determination of the potential threat to human health and the environment—a risk assessment. One application of the risk assessment is to evaluate risks under a “no action” scenario to determine if corrective action is necessary to protect human health and the environment at sites with elevated levels of contaminants in soil, surface water, sediment, leachate or groundwater.

Because groundwater contamination is generally a primary concern of regulatory agencies, risk assessment should evaluate the fate and transport of dissolved contaminants in groundwater to determine if concentrations at the exposure point could exceed standards or health based levels.

Analytical groundwater solute transport models are useful components of risk assessments. These models help to:

- gain acceptance of the no action alternative to close sites with low levels—but exceeding state criteria—of soil and groundwater contaminants;
- determine whether off site migration of contaminants may occur;
- estimate contaminant concentrations in groundwater at potential exposure points.

Analytical transport models are available in the public domain and are relatively easy to implement and document, which make them a cost effective risk assessment tool.

One application of risk assessments is to evaluate the potential of adverse health effects under a no action status in accordance with federal and state laws. These assessments review site data and identify the media and contaminants of concern. An exposure assessment identifies potential exposure pathways, exposure points

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and receptors to contaminants in impacted media—typically groundwater and soil. A receptor is defined as any human or environmental population which could be exposed to contaminants at or released from a site. By incorporating the results of the exposure assessment and the inherent toxicological properties of each pertinent contaminant, the potential risks are estimated for each exposure pathway.

An exposure assessment is an integral part of a risk assessment because without exposure, there is no risk. If it can be shown that there is no exposure—such as contaminants present in subsurface soil under a building—then there is currently no risk and remediation is not necessary to protect human health. However, regulatory agencies are often very concerned with the potential for future exposure. Current or future exposure can occur only if:

- there is a contaminant release,
- there is a receptor, and
- a mechanism exists for transport to a receptor and contact between the released contaminant and the receptor occurs.

An important transport mechanism is the movement of dissolved contaminants in groundwater. At many sites, solute transport models have used site specific (when available) or conservative default assumptions to predict if contaminants in groundwater will or will not ever reach exposure points at concentrations above standards.

Mathematical equations are used in risk assessments to determine remediation goals for contaminants in soils and groundwater. Remediation goals are media-specific and contaminant-specific, health protective concentration values for soil and groundwater which are calculated using assumptions based on potential current and/or future exposure unique to the site. If the future site use is unknown, then conservative remediation goals may be developed for a hypothetical residential exposure pathway.

Analytical solute transport models are based on an exact solution to the governing equations which represent the movement (advection), dispersion, sorption and bioattenuation of dissolved contaminants in groundwater. These models are useful screening tools for sites in which the groundwater flow field is fairly uniform (no pumping wells to influence flow rate and direction, for example) and there are no sharp contrasts in lithology.

For highly heterogeneous aquifers or complex flow fields, only a few exact analytical solutions have been found. As a result, analytical solute transport models may not be applicable at some sites, and more complex numerical finite-difference or finite-element solute transport codes may be required.

The analytical solute transport model chosen for each site differs, based on the type of contaminant source release and source geometry (point source, planar source or three dimensional source). The release rate and timing of the source usually are not known, and if that is the case, then conservative assumptions may be used to represent the source. For example, to assume "continuous injection of contaminants into groundwater at the maximum observed concentrations," is a conservative approach. Continuous source releases are typically used for sites in which the source release into groundwater occurred over an extended period of time—as seepage lagoons, degreasing pits and...
contaminated soil zones. The assumption of an instantaneous release of contaminants generally applies at sites in which spills or underground storage tank ruptures occur. Source release rates which vary with time can also be represented in the model.

Development of a conceptual model is the most important part of any modeling effort, because the mathematical model is only as good as the conceptual understanding of flow and transport of contaminants at the site. A detailed analysis of site history, soil logs, geologic cross sections, water table maps, dissolved contaminant isopleth maps and soil analytical data is necessary to choose the appropriate model assumptions and analytical solution. The model type and assumptions used in the model depend on the objectives of the modeling effort, source characteristics, contaminant properties and the degree of lateral and vertical dispersion of contaminants in groundwater at the site.

Groundwater solute transport models have been used to mitigate regulatory agency concerns about contaminant

“A detailed analysis of site history, soil logs, geologic cross sections, water table maps, dissolved contaminant isopleth maps and soil analytical data is necessary to choose the appropriate model assumptions and analytical solution.”

migration in groundwater away from source areas and to points where exposure could occur. For example, a one-dimensional analytical solute transport model was used at a site in California to demonstrate that contaminants in groundwater would not reach a surface water body approximately 1 1/3 kilometers downgradient of the identified source. The one-dimensional model was appropriate at this site because groundwater flow was primarily horizontal. Furthermore, the one-dimensional model provided conservative estimates of calculated concentrations because it neglected any lowering of concentrations due to lateral and vertical dispersion. Although the source was conservatively assumed to be continuous, model calculations indicated that natural intrinsic bioattenuation removed dissolved contaminants from groundwater before discharge to the surface water body.

A two-dimensional analytical solution was used at two gasoline service station sites in Ohio to technically support both the lack of detection of contaminants in site boundary monitoring wells and to demonstrate that off site migration was unlikely. The modeling results indicated that

Continues on page 16

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Assumptions

(1) The porous medium is homogeneous and isotropic.
(2) There is a uniform groundwater flow field.
(3) The source is a continuous point source that releases contaminants at a rate equal to groundwater flow, and the concentration at the source reaches its maximum value (C₀) the instant of release.

Governing Equations

\[
\frac{\partial C}{\partial t} + \frac{v}{R_d} \frac{\partial C}{\partial x} = \frac{D_L}{R_d} \frac{\partial^2 C}{\partial x^2} - \lambda C
\]

(1)

Initial Condition: \( C = 0 \) at \( t = 0 \)

Boundary Conditions:
\[
C = C_0 \quad \text{at} \quad x = 0
\]
\[
C = 0 \quad \text{as} \quad x \to \infty
\]

(2)

Solution

\[
C = \frac{C_0}{2} \exp \left( -\beta x \right) \cdot \left\{ \exp \left( -\beta x \right) \cdot \text{erfc} \left( \frac{x - \left( \frac{v^2 + 4\lambda C_0}{R_d} \right)^{\frac{1}{2}} t}{2\left( \frac{D_L}{R_d} \cdot \frac{1}{2} \right)^{\frac{1}{2}}} \right) + \exp \left( \beta x \right) \cdot \text{erfc} \left( \frac{x - \left( \frac{v^2 + 4\lambda C_0}{R_d} \right)^{\frac{1}{2}} t}{2\left( \frac{D_L}{R_d} \cdot \frac{1}{2} \right)^{\frac{1}{2}}} \right) \right\}
\]

(3)

where:

\( \beta^2 = \frac{v^2}{4D_L} + \frac{\lambda R_d}{D_L} \)

\( a_L = \) longitudinal dispersivity;

\( D_L = a_L v = \) longitudinal dispersion coefficient;

\( \tau_{1/2} = \) contaminant half life;

\( \lambda = \) decay constant = \( \ln(2)/\tau_{1/2} \); and

\( \text{erfc} = \) complementary error function (tabulated in Abramowitz and Stegun, 1970)

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contaminant concentrations in the plume would be below maximum contaminant levels and/or laboratory detection limits before reaching the property boundary. Health-protective soil remediation goals were developed assuming the site was to be converted to a residential property and adults were directly exposed to the soil.

Based on the results of the risk assessment, the Ohio Bureau of Underground Storage Tank Regulations formally accepted the no action alternative for closure of one of these sites, and verbally accepted the results at the other. Based on the results of the risk assessment, the responsible parties have been released from active remediation of groundwater and associated costs.

The goal of this hypothetical modeling effort is to determine the maximum downgradient migration distance that dissolved benzene in groundwater is above its detection limit—assuming a continuous source release of benzene to groundwater. The primary and chemical processes at the site are assumed to be advection, dispersion, sorption and biodegradation. Benzene was chosen because it is a known human carcinogen and is generally the most mobile and persistent of the typical hydrocarbon compounds (benzene, toluene, ethylbenzene and xylene). The source concentration of benzene was assumed to be fixed at 1,000 ppb. In addition, the following assumptions were made: hydraulic gradient of .005, effective porosity of .25, longitudinal dispersivity of 34.88 meters, retardation factor (sorption) of two, and anaerobic biodegradation half-life of benzene of two years.

The model assumptions, governing equations and analytical solution developed by J. Bear in 1972, are shown in figure one, page 14. Figure two, page 16, plots steady state benzene concentration vs. distance from the source along the direction of groundwater flow for various hydraulic conductivity values.

The maximum downgradient migration distance of benzene can be estimated with site specific hydraulic conductivity values from slug tests or pump tests. Furthermore, the maximum benzene concentration predicted at exposure points at any distance from the source can be estimated in order to calculate the level of risk at each exposure point and for each exposure pathway to humans.

Applying analytical solute transport modeling to risk assessments in support of a no action scenario for groundwater is just one of many creative and cost effective ways to demonstrate that active remediation is not always required to protect human health and the environment—and save money in the process. In most instances, the small investment cost to perform the modeling returns excellent cost savings.

Write in 529 for more information

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March 1994 Solts 17
Will the ASTM Transaction Screen provide protection from CERCLA liability? The short answer is, "maybe..."
The American Society for Testing and Materials has developed two standard practice guidelines for performing environmental site assessments for commercial real estate transactions. (See, "ASTM Releases New Assessment Standard," Soils, June-July 1993, page 6.) ASTM Standard Practice E1527 is the "traditional Phase 1" process, while ASTM Standard Practice E1528 is the Transaction Screen process. They are designed to be fundamentally distinct practices. The October 1993 issue of Soils, "Concern About ASTM Standard," page 46, quoted concerns expressed by Ethan Eldon, president of Eldon Environmental Management Corp., Westbury, N.Y. that the new standard is "so superficial" that it may not satisfy regulatory due diligence under CERCLA (Comprehensive Environmental Response, Compensation and Liability Act).

Appendix X to the standard lays out the legal background for the standard, as viewed by the Legal Section of the ASTM E50.02 subcommittee. The Legal Section noted correctly that the "due diligence" defense under CERCLA is available to a defendant if... "at the time the defendant acquired the facility, the defendant did not know and had no reason to know that any hazardous substance which is the subject of the release or threatened release was disposed of on, in or at the facility..." CERCLA goes on to require that:

To establish that the defendant had no reason to know...the defendant must have undertaken, at the time of acquisition, 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... [T]he court shall take into account 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 reasonably ascertainable information about the property, the obviousness of the presence or likely presence of contamination at the property, and the ability to detect such contamination by appropriate inspection.

The key as to whether the Transaction Screen holds up under CERCLA due diligence lies in the phrases, "good commercial or customary practice" and "specialized knowledge or experience on the part of the defendant." How will these principles be applied? Good commercial or customary practice could be defined either by application to type of transaction or to the consulting industry, or other professionals that typically provide traditional Phase 1 services.

Some types of real estate transactions obviously require detailed consideration of the historical background of a property. Acquisitions of industrial properties, manufacturing facilities, and facilities with underground storage tanks commonly go far beyond a Phase 1 site assessment, let alone a Transaction Screen. On the other hand, transactions involving residential property do not customarily receive even a Transaction Screen level of assessment. The level of assessments, and consequently, "customary practice," varies widely, depending on the type of property involved. It might be argued that this does not make "good commercial sense," however, because the commerce reflects the type of property transaction, and no assessment, in some cases, is normal—"good commerce" would reflect the norm, not the exception.

"Specialized knowledge or experience on the part of the defendant" could also be a key

Continues on page 20.
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Use ASTM guideline with care, from page 18

element to predict whether the Transaction Screen may hold up under CERCLA. The Legal Section asserts that, by inserting that phrase, Congress indicated that it did not intend the appropriateness of the inquiry to be judged by a “bright line standard,” that is, that the same inquiry should be made in every case. Consequently, while a Phase 1 site assessment may be obviously required in certain cases, other, less intensive assessments may be just as appropriate in other circumstances.

In fact, a Transaction Screen may be suitable for assessment of some properties involved in a real estate transaction, and may even provide the protection of the due diligence defense under CERCLA—assuming that several other components of the defense are met. The circumstances of the assessment, however, must be amenable to application of the Transaction Screen, and not overly require use of a Phase 1 assessment. For instance, a Transaction Screen performed on a manufacturing facility probably would not be considered sufficient because that is not the norm for such facilities.

The last component of the case must consider who can perform a Transaction Screen. Section 4.3.2 of E1528 states:

*The Transaction Screen process may be conducted either by the user (including an agent, independent contractor or employee of the user) or wholly or partially by an environmental professional. The Transaction Screen process does not require the judgment of an environmental professional.*

The philosophy behind the development of the Transaction Screen was to eliminate any requirement for professional judgment from the process, to allow non-professionals access to a process that could identify obvious problems—primarily in transactions that normally would not receive any assessment. This would elevate the standard of assessment for such properties from nothing to a Transaction Screen, while not requiring an environmental professional to do the work. All the data collected during a Transaction Screen is designed to be pigeon-holed. That is, a “yes” answer to a question means that additional work is needed, a “no” signifies no further action required.

The standard states in Section 5.7:

*Presumption—A presumption exists that further inquiry is necessary if an affirmative answer is given to a question.*

Users of the Transaction Screen are allowed to make business decisions based on their own risk management principles. They are at liberty to proceed with a transaction without more inquiry in the face of a “yes” answer, but they probably do so at the risk of losing their chance to qualify for the due diligence defense.

Will consulting firms that complete a Transaction Screen provide clients with the due diligence defense? The answer lies in examining the key phrases in the standard and how they apply to consulting firm practices. Consulting firms provide a professional service, using
expert knowledge gained from years of experience. The Transaction Screen is specifically designed to exclude use of professional judgment. A professional who provides Transaction Screen service will be held to a higher standard than a novice because the professional has “specialized knowledge and experience” beyond that of the novice. Consequently, if a professional consultant performs a Transaction Screen on a residential property, but fails to examine issues that commonly would be considered by other professionals, even though such issues are not included in the scope of a Transaction Screen, the professionals might be judged as failing to meet the due diligence standard.

Similarly, consulting firms typically provide a scope of services somewhat beyond the requirements of a Transaction Screen. Transaction Screens might not, therefore, meet the definition of good commercial or customary practice if applied strictly to the practices of professional consulting firms. Professionals performing Transaction Screens, therefore, may not be providing their clients a CERCLA defense.

Professionals also open themselves to significant liability for “failure to detect” and errors and omissions by performing a Transaction Screen. Professional conduct is traditionally measured against the “standard of care” which is separate and distinct from a “standard” such as the ASTM standards. The “standard of care” is defined as the ordinary practice of other professionals in your geographic area at the same time your services were provided—what is normally done by other competent professionals. Because professionals provide assessment services that require judgment and that go beyond the requirements of a Transaction Screen, professionals providing Transaction Screen services are not in compliance with the standard of care. Consequently, any damages arising from a professional’s failure to detect contamination could be charged to the professional’s failure to meet the standard of care—even if the failure did not result in CERCLA liability. In this instance, meeting a due diligence test for CERCLA liability will not be an issue, and will not see the light of day in court.

There is no advantage for a professional firm to perform a Transaction Screen. In certain cases, the process may be suitable to provide a portion of the due diligence defense to unsophisticated property purchasers. However, the process was not designed for application by a professional, even though use by a professional is not prohibited by the standard.

The Transaction Screen process does not go far enough to meet a reasonable definition of the standard of care. Consequently, professionals performing Transaction Screen assessments could be opening themselves to liability claims for errors and omissions, or failure to detect. Write in 530 for more information.

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March 1994 Soils 21
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- **National Association of Safety & Health Professionals**
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- **Environmental Science Services**

- **Foxboro Co. Training Institute**

- **National Ground Water Association**
  Fracture Trace and Lineament Analysis, April 18-21, University Park, Pa.
  Safety at Hazardous Materials Sites, April 18-22, Valhalla, N.Y. Call 800-551-7379 for information on all the above courses.

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22 March 1994 Soils

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March 1994 Soils 23
Three refinements in soil vapor extraction technology have been developed recently:

- Bisco Environmental, Boston, Mass., offers a custom-built, turnkey soil vapor extraction package, customized to the specific needs of each site. Equipped with blowers manufactured by EG&G Rotron, a custom system can be completed as quickly as about two weeks, says the company. Each basic unit includes the blower, inlet filter and element, pressure relief valve, vacuum gauges, filtered fresh air inlet and influent and effluent test ports. Custom options include a 114 liter moisture separator tank, vibration isolators on the base, inlet and outlet mufflers, temperature gauge and transfer pump for separator effluent.

"Businesses can avoid the complex work of building a system themselves. They can avoid the wait for shipment of individual components and the disruption of on-site assembly," with this custom package, says Edward Tierney, sales engineer for Bisco.

- BCM Engineers, Inc., Dallas, Texas, says their two-phase vacuum extraction system is a single treatment method applicable to all states of volatile hydrocarbon contamination. According to Steven Morrow, assistant vice president, and co-inventor of the system, the single treatment method applies to all states of volatile hydrocarbon contamination. The process is illustrated in figure one.

The key to the system is construction of a well with its screening extending both below the natural water table and upwards into the vadose zone. This placement allows soil gases drawn into the well under the influence of a vacuum to entrain the liquid phase so that both phases are transported to the surface where the two phases are separated in a vapor-liquid disengaging vessel.

The hydrocarbons are collected for disposal or recycling, and the water is routed for treatment. The extracted vapor phase is treated by a granular activated carbon unit.

By applying a vacuum to the subsurface via such a well,
H.A.V.E. system uses hot air

Water is drawn from the aquifer by the fluid dynamic effects of sweeping air and soil gases over the aquifer surface toward the well, and by the artificial creation of a low water pressure head inside the well casing. The low head in the well casing makes it a low point in the hydraulic system so the water flows to it more readily, says the company.

Write in 563 for more information

- M.D. Ikenberry invented the Hot Air Vapor Extraction System, which features a network of hot air injection ducts, configured within a soil pile so that hot air must pass through the soil to reach the vapor extraction ducts. As the hot air moves through the contaminated soil, it volatilizes and absorbs the contaminants, which are then carried in the air stream through a burn chamber where 96 to 99 percent of contaminants are destroyed on the first pass.

Set-up begins with creation of a perimeter berm over which heavy poly sheeting is placed. A contaminated soil pile is built on the sheeting, integrating the injection ducts and the extraction ducts. The soil pile and all duct entries are sealed. Neutral to negative air pressure is maintained within the pile so no contaminated vapors escape to the atmosphere.

The trailer mounted system is pulled alongside the pile and connected to the duct system with flexible ducting. The burn chamber head is supplied by twin burners, field convertible for either natural gas or propane. Heated air enters the soil at 315 to 400°C. The burner flame through which the vapor passes is in the 1,000°C range with residence time in excess of half a second. Stainless steel grills and baffles in the chamber create air flow turbulence and direct the air flow back to the burner flame prior to escape from the chamber. Only 10 to 15 percent of the clean air stream is exhausted through the catalytic reactor bank where any remaining contaminants are destroyed prior to release to the atmosphere. On board instruments monitor carbon monoxide and hydrocarbon levels in exhausted air to insure no contaminants or particulates reach the atmosphere.

Depending on soil type and carbon weight of the contaminants, AccuChem™ Sales, Inc., Everson, Wash., distributors and operators of the system, says it takes from 48 to 96 hours of continuous system operation to remediate 370 cubic meters (612 metric tons) of contaminated soil. AccuChem sells and leases the system, as well as operating it in a turnkey, on site remediation service.

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March 1994 Soils 25
Surfactants can trap contaminants

Research seeks the best substance to immobilize compounds

Some surfactants are known to alter the surface characteristics of soil, substantially increasing its ability to sorb contaminants—that is, to hang on to them, thereby slowing their movement. In particular, ionic surfactants have been shown to enhance the capacity of oppositely charged soil constituents to sorb hydrophobic organic contaminants such as polyaromatic hydrocarbons (PAHs). Because soil is generally negatively charged, researchers at the University of Michigan are examining combinations of cationic (positively charged) and cationic/nonionic-mixed surfactants to determine how best to treat aquifer soils in order to reduce the mobility of contaminants such as PAHs and keep them from migrating into nearby water supplies. Such treatment is necessary because, although in situ biodegradation is considered to be one of the most attractive methods to remediate PAHs, the process can be slow, and without help, the contaminants are likely to reach the water table before they can be remediated.

New tool supports surfactant research

In related research at Great Lakes/MidAtlantic Hazardous Substance Research Center, another group at the University of Michigan has developed an apparatus to measure the relationships between capillary pressure and saturation, and between relative permeability and saturation for contaminated soils. The researchers hope to develop the device commercially.

Many methods exist to measure capillary pressure and permeability. However, most of these methods are intended to measure one or the other of these soil transport properties, but not both. Furthermore, many of the traditional methods are fairly time consuming. If one is investigating several surfactants at a range of concentrations in various soils, the task of making soil transport property measurements is daunting. Thus, developing a rapid technique to simultaneously measure both properties is critical if the research on the use of surfactants is to proceed cost-effectively.

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26 March 1994 Soils
Aquifer soils are rich in clay minerals, so the researchers looked at which clays offered the greatest potential for increased sorption after being modified with surfactants. They chose a group called smectites, which have extensive surface area compared with other clays—between layers as well as on their external layer—giving the surfactant more material with which to interact. Consequently, surfactant-modified smectites offer greater potential to retard contaminant plumes. As test clays, the researchers selected montmorillonite and hectorite.

Of course, some soils contain little or no clay. In such soils, quartz sands (silicon dioxide or silica) are often one of the mineral constituents with the most surface area and reactivity potential. Therefore, the researchers chose to use silica for studies of surfactant modifications in soils with low clay content.

The objective of the project is to study such surfactant characteristics as adsorption/desorption and stability as a soil particle coating—whether a surfactant adheres permanently to the particle or tends to come back off—and link these characteristics with the surfactant-treated soil’s ability to sorb PAHs. The researchers are also seeking to understand the similarities and differences in the sorption behavior of surfactant-modified clay.

Continues on page 28

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March 1994 Soils 27
and silica surfaces. They are interested in differences that may result because of the extensive interlayer surface area of clay particles such as montmorillonite and hectorite, compared with the surface area of particles such as silica. For the montmorillonite and hectorite clay systems, using cetylbenzyl dimethyl ammonium (CBDAM) as the cationic surfactant with phenanthrene as the pollutant, researchers have learned:

- To immobilize PAH compounds, it is not necessary to completely saturate a clay surface with surfactant. A lower coverage is sufficient and is more likely to resist desorption.
- The bulk of the sorbed cationic surfactant at low coverage is located in the interlayer space of the soil particle. This configuration imparts greater chemical stability to the sorbed surfactant, even at low coverage.

For the silica soil systems, researchers looked at two surfactants, cetyl trimethyl ammonium (CTA) and cetyl pyridinium chloride (CPC) with phenanthrene as the target pollutant. These surfactants have the same hydrocarbon tail, but different cation heads—the part that clings to the soil. The researchers wanted to see whether the shape and structure of the surfactants and the way they attached made one better at sorbing phenanthrene. They learned:

- CPC sorbs more strongly and irreversibly than CTA to silica particles, suggesting that surfactants with aromatic functional groups, as pyridine in CPC, would be more effective than those with tertiary alkyl groups, as trimethyl in CTA, for in situ treatment of low clay content soil.
- Both CPC and CTA act upon soils that are originally hydrophilic, making them hydrophobic and therefore attractive to organic pollutants such as phenanthrene, which want to get out of water. The relative hydrophobic properties of CPC and CTA are equivalent for a given amount of coverage. Although less CPC is required to get coverage, once an equal amount of coverage is attained, CTA actually sorbs more phenanthrene per unit carbon of surfactant coating than CPC. The researchers attribute this to a greater accessibility of the CTA coated silica to phenanthrene, compared to CPA—that is, because of the structure of the CTA coated silica molecule, phenanthrene is more easily able to get to its core, where it is sorbed.

Plans are to continue to study the dynamics of pollutant desorption from surfactant treated smectite surfaces and silicas, effects of aging, and effects of wetting and drying cycles on desorption dynamics. The researchers want to see how these effects relate to the stability and sorption properties of surfactant modified soil particles and the sorption properties of PAH compounds in the unsaturated vadose zone.

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Calm approach and a little patience bring economical closure

By John J. Hardy and Sunand Mabbula

Everyone has heard that frightening EPA number—average cost of a remediation event is estimated to be $100,000... and that’s just the soil remediation cost. That estimate does not include cost to excavate and repair or replace the tanks. But that $100,000 average estimate draws attention away from the growing number of manageable, affordable and successful remediation projects that don’t carry a six-figure price tag. Consider the numbers on these two cases—one site signed off as clean for $3,060 and the other for $2,750.

In 1992, Hardy Environmental Services, Inc., New Castle, Del., removed a 3,800 liter underground gasoline storage tank from a site in Wilmington, Del. In 1993, a 3,800 liter underground diesel storage tank was pulled from a site in the Fenwick Island area in the southeast area of the state.

At the Wilmington site, initially, two samples were taken, a grab sample from 60 centimeters below tank bottom, and a composite sample from the excavation pile. The samples were analyzed for TPH (Total Petroleum Hydrocarbons) and BTEX (Benzene, Toluene, Ethylbenzene and Xylenes) in Hardy’s mobile lab, using EPA 418.1 and 8020 methods. This initial sampling and use of the mobile lab cost: approximately $480.

At the Fenwick Island site, prior to...
the removal of the diesel tank, three borehole samples were collected around the tank field with a Geoprobe™ system fitted with 2.54 centimeter diameter rods and zero contamination sampling tube. These samples were analyzed for TPH only, as required by Delaware regulation. Two of the three samples showed high levels of TPH.

Then, during the actual tank removal, three grab samples were collected from three sides of the excavation at the soil/groundwater interface, about 1.5 meters below the surface. A composite sample was taken from the excavated soil pile. All the samples were analyzed for TPH in the mobile lab. Borehole and tank removal soil sampling and analysis cost $1,200.

A bioremediation approach was chosen to treat the excavated soils. The paramount factor in the selection of bioremediation was the low cost of treatment. Thermal remediation at the nearest thermal facility would cost $52 per ton at the gate, with cost of transportation calculated at $3.50 per mile per truckload. And, additional cost of analysis of a soil sample for acceptance for thermal treatment is at least $200 above analysis costs for bioremediation. This is because in addition to TPH and BTEX tests required for bioremediation, soils for thermal treatment must be tested for TCLP (Toxicity Characteristic Leaching Procedure) metals, PCBs (polychlorinated biphenyls), ignitability, reactivity and determination of moisture content.

At these rates, the cost for thermal remediation at the Wilmington site continues on page 32 →

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March 1994 Soils 31
Close a site for $3,000, from page 31

would be about $82 per ton, and $99 per ton at the Fenwick Island site. The Wilmington site is about 16 kilometers away from the nearest thermal facility, while Fenwick Island is about 169 kilometers away.

For both sites, the cost of bioremediation, including labor, material, soil sampling and analysis was estimated to be about $40 per ton or less. The cost estimate included 20 hours of labor at $200; equipment costs of $565; fill and sand, $366; polyethylene liner, $90; fertilizer, $50; and sampling, analyses and project management costs of $1,500.

In addition, both sites had ample space to lay out a bioremediation soil pile, and hot summer climate to enhance bacterial activity.

At the Wilmington site, excavated soils were residual dark yellow clays with small amounts of silt, formed as a result of weathering of the underlying gneiss. The excavated soils from the tank removal and other overexcavation amounted to about 34 cubic meters, weighing about 56 metric tons. The soils showed TPH levels of 362 ppm and total BTEX content of 641 ppm, far above state groundwater protection limits for gasoline of 100 ppm for TPH and 10 ppm for BTEX. The site owner agreed to help prepare and construct the soil pile, and to cultivate the soil pile and add fertilizer under the technical management of Hardy personnel.

At the Fenwick Island site, the soils from the tank field contained gray medium sands with minor clay content. Over 37 cubic meters of soil were removed, weighing over 61 metric tons. The excavated soils had a mean composition of 3,492 ppm TPH. The state does not require BTEX analysis at leaking diesel tank sites.

The bioremediation treatment at both sites was basically the same. The procedure was adopted from the recommended steps outlined in the Technical Guidance Manual of the Delaware Natural Resources and Environmental Control. The soil pile at Wilmington was three meters wide, 23 meters long and about a half meter high. The pile at Fenwick Island was a bit wider, 4.5 meters, but only 16.5 meters long and also a half meter high.

Soils were spread on a 20 mil polyethylene sheeting that had been spread with a 1-1/4 centimeter layer of clean sand of contrasting color using a front end loader and small backhoe. The sand served as a visual indication against too deep cultivation to aerate the soil pile, and its porosity supplied oxygen to the bacteria. Since the Wilmington soils contained some clays, wood chips were mixed with the soils to further enhance porosity.

Some 2.25 kilograms of high nitrogen agricultural fertilizer were evenly applied over the top surface of the pile per square meters. The amount of fertilizer was calculated on the basis of available carbon to nitrogen, phosphorus or potassium ratio. At both sites, a simple lawn fertilizer spreading machine was used to apply the fertilizer. The nitrogen material supplies the resident bacteria with nutrients.

Continues on page 34→
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Write in 459
Wilmington soil pile was 23 meters long.

Close a site for $3,000, from page 32

Each soil pile was covered with a 20 mil plastic sheet and the edges secured with hay bales to prevent the escape of volatile organics, erosion, runoff and to retain soil moisture levels essential for bacterial growth.

After two weeks, the plastic cover was removed to cultivate each pile. At the Wilmington site, a hand operated tiller was sufficient to mix the soil. At Fenwick Island, a rototiller was used. After two more weeks, fertilizer was added, again at the ratio of 2.25 kilograms per 9 square meters, and cultivated.

At the six week mark, the piles were cultivated row by row, taking care not to touch the underlying sand layer.

At the end of the ninth week at the Wilmington site, the pile was divided into eight grids for sampling. Five samples were taken from the center, and from the four corners of each grid for a total of 40 samples. These were mixed to form a composite. This composite sample was analyzed for TPH and BTEX off site in a state approved, certified laboratory.

The analytical results showed 69 ppm TPH—below regulatory limits, but 18,130 ppb BTEX—still out of compliance with the 10,000 ppb limit. So, the treatment was extended for another eight week session, essentially repeating the steps taken in the first eight week treatment.

At the end of the 17th week, another composite sample was collected and analyzed. This time, both TPH and
BTEX were down to non-detect levels.

At the Fenwick Island site, at the end of the eighth week, the pile was divided into 12 grids and a sample taken from the center of each. Again, the samples were mixed to form a composite, which was analyzed for TPH. Results indicated 580 ppm, far below the target of 1,000 ppm.

At Wilmington, the total cost of the remediation was $3,060, which amounts to $49.35 per ton. The cost included 44 hours of labor totalling $660, materials and equipment costs of $900 and sampling and analysis costs of $1,500. The off site thermal treatment option would have cost $3,064, or $81.68 per ton—which breaks down as treatment cost of $3,224 at $52 per ton, transportation costs of $140 and sampling and analysis cost of $1,700.

At Fenwick Island, the final balance sheet totalled $2,750—$40.44 per ton. The price included labor at $134.08, equipment use of $630, fill and sand cost of $355, plastic sheeting, $90, fertilizer, $50 and sampling and analysis costs of $1,500. Thermal remediation at this site would have cost $6,720, or $98.82 per ton because transportation costs would have jumped to $1,484, since this site was 106 miles from the thermal facility.

If space is available at a site to construct the soil piles, bioremediation can be a simple, and relatively fast treatment for hydrocarbon contaminated soils... and can cost well under $100,000 to accomplish. II

Write in 532 for more information
Process recycles copper from bay

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At the bottom of the San Diego Bay, near the 24th Street Marine Terminal in National City, Calif., the sediment contains enough copper to make several hundred dollars worth of pennies.

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Greenfield began pilot testing in February 1992. At a processing rate of only .9 metric ton per hour, approximately 90 metric tons of sediments with copper concentrations ranging from 9,000 to 29,000 ppm were processed successfully over the pilot project’s tight, 11 week deadline.

Due to the wide variety of copper concentrations within the bay area, George Trezek, Ph.D., vice president of research and development at Greenfield designed a system to physically separate the material into fractions of high and low concentration constituents, isolating the volume of material containing higher levels of copper. The separation process reduced the need for chemical extraction, and increased the availability of recyclable copper.

In June, the pilot project was successfully completed, and

A load of copper-contaminated sediment, dredged from the bottom of San Diego bay, awaits processing to be recycled.

the Board of Port Commissioners authorized Greenfield to implement a full scale system to complete the cleanup.

Continues on page 38→

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Sediments extracted/recycling process

After screening, the sediment slurry proceeds to chemical treatment which creates a soluble copper salt, acceptable for smelting.

Process recycles copper, from page 37

Using data from the pilot project, an overall mass balance of processed fractions indicated that approximately 47 percent of dredged material contained enough copper to justify sending it to a smelter for recycling. Another 40 percent of the recovered material had concentrations significantly below the land-based copper standard of 2,500 ppm, allowing it to be used as fill material.

The remaining 13 percent of the dredged material contained intermediate fractions of elevated levels of copper which could be transformed into a useful fill material through chemical extraction.

The physical separation, or mechanical processing portion of the system separates the material into various size fractions through a series of screens and cyclones after large objects (rocks, ship parts) are removed from the feed hopper.

The first screen cyclone removes the +20 size shell fraction from the dredged sediments. The sediment slurry proceeds through more screens and cyclones in which the liquid fraction is recycled to the initial dilution tank and the solids are separated into three mesh size fractions. The -20 to +140 mesh fraction, the sand fraction, has a copper concentration in compliance with the land-based standard for copper—below 2,500 ppm—and requires no further processing.

Any material fraction less than 200 mesh enters a screw classifier where dewatering is often sufficient to enable direct smelter recycling.

Typically, the sediment fraction of -20 to +200 mesh is not of a quality that is appropriate for direct smelter recycling.

So, this material is passed through a chemical extraction system that creates a soluble copper salt which is precipitated as a copper hydroxide solid, acceptable for smelting.

During the chemical extraction process, acid is added to the solids, and the mixture is heated to about 93°C and stirred. After the reaction time, about an hour, the solids are allowed to settle, and the supernatant liquid is drawn off into a precipitator tank. The solids in the reactor vessel are washed with recycled water from the precipitate process to remove any residual copper.

During the final wash in the reactor vessel, the slurried solids are dewatered with a 200 mesh screen. The remaining acid is neutralized by adding sodium hydroxide.

The reactants in the precipitate tank are neutralized with sodium hydroxide and lime. After liquid removal and drying, the solid copper hydroxide material is suitable for smelter recycling. Gaseous materials which emit from the reactor during heating are piped to a scrubber. Here, they pass into a spray column where the nitrous oxide and carbon dioxide gases are removed. Any residual gases are scrubbed further by an injector system using pumped sodium hydroxide solution as the drive fluid. As an added precaution, the treated gas (air and CO₂) must pass an iron gauze reactor sleeve prior to atmospheric discharge.

Greenfield is convinced that the value of this project was the establishment of a technology that remedies the sediments while maximizing the volume of recyclable material.

Write in 533 for more information

38 March 1994 Soils
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Write in 490
Better data means better decisions

Expounded assessment is a faster way to collect better information

Everyone is looking for a faster, cheaper way to characterize a contaminated site in order to expedite efficient planning and get the cleanup underway. But in the rush to save time and money, it is possible to overlook the quality of the data and its relevance for making the best decisions to advance the site to the remediation phase. In many cases, the data derived from an expedited site assessment yields more useful data than traditional approaches.

Typical phased site assessments involve soil borings with a drill rig, monitor well installation, sampling and laboratory analysis, usually taking months to complete. In the conventional approach, a great deal of attention is customarily devoted to defining the boundaries of the contaminant plume, with a great deal less attention focused on the source of the contamination. Actually, knowing the precise plume boundary is less helpful for cleanup decision-making than simply locating and quantifying the contaminant mass, and getting on with the cleanup.

It is possible, in just a matter of days, to collect more pertinent, more useful data than the conventional approach yields, using portable field instruments and innovative analytical methods, to plan an efficient strategy for closure.

Land Tech Remedial, Inc., Monroe, Conn., says their Expedited Site Closure Approach (ESCA®) to assessment can characterize a site and present a cleanup plan in as quickly as three days. Here’s how they do it:

The first element of the expedited approach is careful advance planning. The consultant and the client must first agree on the objectives of the investigation to present to the regulatory agency. Often, the objectives may include:

- determine risk to the environment or human health,
- meet regulatory requirements,
- evaluate potential liability from third party claims,
- restore or improve property value,
- determine the extent of contamination,
- recommend a remediation action plan,
- complete the investigation on budget.

At an underground storage tank site, the investigation is specifically geared to include:

- site history, including as-built drawings and UST location diagrams, subsurface geologic information and documented environmental data about the site and surrounding properties,
- real time horizontal and vertical determination of subsurface soil and groundwater quality,
- identification of factors related to risk of exposure, including groundwater flow direction, possible vapor pathways, and evaluation of potential sensitive receptors of contaminant migration,
- close communication with the client to modify the scope of work to provide a more detailed investigation in one field visit,

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At the Spain Oil site, 11 points were used to define the plume. Ten days after free product was discovered, and assessment began, eight vent points and six sparge points were in place. The tank upgrade contractor laid connecting pipe in existing trenches and the system was operational within 60 days of initial assessment.

- recommendation of a course of action or remediation plan.

The focus on advance planning paid off for Amoco Oil Co., at a site in Atlantic City, N.J. When the New Jersey Department of Environmental Protection and Energy (NJDEPE) traced contamination on a nearby creek back to the site, Amoco quickly took a proactive stance with all parties. The site had been taken over by a former Amoco jobber. Amoco and the jobber had separate estimates for conventional assessments that would cost in the $80,000 to $150,000 range—Land Tech’s was $20,000. Amoco’s regional project coordinator, Mike Erickson, pulled in Land Tech’s expedited approach. “We presented the jobber and the NJDEPE with the assessment procedure and it was accepted,” Erickson says. “The NJDEPE deserves credit for their willingness to listen and work with us.”

More state regulators are jumping on the expedited bandwagon. EPA has also praised the system, suggesting that the speed of the approach helps agency efforts to streamline the regulatory oversight process. In addition to New Jersey, Pennsylvania, Connecticut, Massachusetts, Virginia, Maryland, North and South Carolina and Florida have allowed use of the techniques. And, while the New York State Department of Environmental

Continues on page 42→
Better data, from page 41

Conservation does not endorse any particular product or company, according to a report by Christopher O’Neill and Susan Lasdan of the department, “the methodology used in the expedited site approach and other accelerated approaches could be used more often by contractors and consultants to obtain more contaminant plume information early in the site investigation, enabling a responsible party or New York state to remediate a spill more cost-effectively.”

Implementation of an expedited assessment at the site relies on the use of narrow diameter boring tools, like those manufactured by KV Associates, Inc., of Falmouth, Mass., or Geoprobe Systems, a division of Kejr Engineering, Inc., Salina, Kan. These systems quickly drive narrow, 2.2 to 2.5 centimeter diameter, hollow steel rods to required depths to collect soil gas, soil and groundwater samples for on site analyses. A small vacuum pump withdraws the sample into a poly bag equipped with a septum and valve/hose fitting.

Instead of the traditional, four monitoring wells, intrusively installed with a drill rig, these narrow diameter samplers are used to pull a larger number of samples—perhaps 15 to 20, or more—from a site.

Then, the samples are analyzed immediately, on site using a number of field analytical techniques. For example, total organic vapor detectors allow the analyst to screen soil vapor samples to determine contaminant levels in a few seconds.

Portable, hand held detectors analyze samples for oxygen and carbon dioxide content, since naturally occurring metabolism of petroleum hydrocarbons by aerobic bacteria uses oxygen and produces carbon dioxide, depressed oxygen levels and increased carbon dioxide levels in soil gas can reveal the presence of hydrocarbons.

Specific volatile organic constituent analyses of soil gas samples may also be easily performed in the field with a portable gas chromatograph. At sites contaminated with aliphatic hydrocarbons found in diesel fuel, #2 heating oil or other heavier grade petroleum hydrocarbons, soil samples may be analyzed in the field for total petroleum hydrocarbons by a modified extraction method based on EPA Method 418.1, or by a modified gas chromatograph method. A portable infrared total petroleum hydrocarbon analyzer, along with “Extracpak” components, manufactured by General Analysis Corp., South Norwalk, Conn., analyze soil samples inch which petroleum hydrocarbons have been extracted with freon 113.

Specific volatile organic constituents in soil and groundwater samples are analyzed by the headspace gas chromatograph method. It can analyze samples for specific gasoline constituents such as benzene, toluene, ethylbenzene, xylenes and methyl-tertiary-butyl ether to a detection level of 1 ppb. Using the headspace method, an analyst can determine concentrations of volatile organic constituents in 20 or more samples in an eight hour work day. The rapid turnaround time gives the consultant immediate data at a relatively low cost per sample. The risk of volatile losses, which may occur during sample storage, preservation or transfer, are minimized. And, the technique is non-destructive, which means the sample can be analyzed many times without significant volatile loss. Split sample data collected for BTEx (benzene, toluene, ethylbenzene, xylenes) analysis of water has demonstrated direct correlation between the headspace method and gas chromatographic, mass spectrometric analysis.

Immunoassay testing kits, such as those manufactured by Quantix Systems, Cinnaminson, N.J., and Ensys Corp., of Research Triangle Park, N.C., can also be useful to expedite site assessments. Such techniques can provide quantitative, or semi-quantitative data within 30 minutes of soil or groundwater sample collection. An experienced user can analyze 30 samples per day, using the results either as stand alone data, or as a screening tool to preselect samples for analysis by a mobile gas chromatograph or fixed lab.

Groundwater samples are commonly analyzed for oxygen and carbon dioxide content, pH and oxidation-reduction potential (redox). These field measurements of the inorganic attributes of groundwater that result from subsurface biodegradation are useful—both to screen sites and to evaluate the potential for naturally occurring biodegradation to mitigate groundwater contamination. Like oxygen levels, redox values, expressed in millivolts, are generally low in groundwater samples collected close to a hydrocarbon source, as oxygen levels become too low to sustain aerobic bacteria. Anaerobic biodegradation becomes predominant as

Continues on page 45→
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Better data, from page 42

the degradation of organic matter depends on the reduction of metals (iron, manganese, etc.) and inorganic ions (sulfate, nitrate, etc.) to complete the oxidation of hydrocarbon contaminants. This results in a higher proportion of metals and ions in their reduced state and causes redox potential measurements to take on negative values. It is therefore possible to define redox zones at a site to help delineate areas of contamination.

At a Spain Oil gasoline station site in Newburg, N.Y., the owner had scheduled a facility upgrade—new tanks and pump islands, canopy, the works. About three weeks before the work was scheduled to begin, an employee detected gasoline floating in a pump hole. So, the station was immediately shut down, tanks pumped out, authorities notified. Land Tech consultant, Jim Slaughter joined Spain Oil’s consultant, Jim Perazzo of ERM Northeast, New York, N.Y. to meet with New York state’s oil spill response regulators at the site.

Over the next two weeks, Land Tech used narrow boring sampling and field analysis to design an air sparging and vapor extraction system to install across the site, virtually working alongside the tank upgrade contractor. In fact, the contractor actually installed the piping network for the vapor collection under Land Tech’s supervision. The state regulators gave conditional approval to the plan. Perrazo explains that using an expedited assessment, while the excavation was open, enabled the site to be turned around quickly at considerable cost savings. “It cost us about $50,000 to assess and install the remediation system at this site, where, typically, it could easily cost $40,000 or more just to get a traditional assessment, then another $50,000 to $100,000 to install the remediation system on top of that,” he estimates. Jeffrey Erikson, environmental engineer for Mobil Oil Corp., Fairfax, Va., says Mobil has saved time and money with the expedited approach. During a scheduled tank replacement, contaminated soil was encountered. Mobil proposed to the regulatory agency that drive point sampling and field analysis methods be used to define the lateral and vertical extent of the contamination. The assessment was completed in three days. “It was an interactive and dynamic process guided by information developed from hour to hour,” says Erikson.

On the first day, 28 soil and four water samples were collected and analyzed by gas chromatograph. Thirteen borings were attempted on day two, located based on day one results. On the third day, the investigation was expanded off site, since results were showing that a dissolved plume extended out toward the property line. The neighboring property owner gave immediate permission for six borings to be completed on his property. Erikson feels the neighbor, a fast food restaurant, gave quick permission because of the low profile, non-intrusive nature of the approach. Results indicated that the contamination was contained on Mobil’s site.

The next step was to formulate an action plan. “One of the difficulties an owner typically has in evaluating the costs of the different options is the limited amount of data about subsurface conditions,” Erikson says. “With monitoring wells located sometimes 100 or more feet (30 meters) apart, it is difficult to evaluate the contaminant distribution with a high degree of confidence.” But, at the Mobil site, use of the narrow drive points provided a great amount of data an a clear delineation of the contaminant mass.

The regulatory agency evaluated the methodology and the data, and concluded that the time frame for the assessment was “impressive,” and the strategy to define the plume was “excellent.”

Write in 534 for more information
Figure three: mineral spirit desorption rates

Polymeric resins, from page 7
also has the lowest high temperature capacity.

The speed of desorption is the critical, rate-limiting step, determining how quickly a desorbed bed can be cycled back into service. Figure three, page 46, plots the weight change versus temperature and time as an adsorbent undergoes desorption. The data was collected with a thermogravimetric balance with flowing nitrogen at atmospheric pressure, at a heating rate of 5°C per minute to a maximum of 250°C. As a result of the high temperature isotherm shown in figure two, the Purus PurSorb 200 polymeric adsorbent requires in excess of 140 minutes to desorb to below 10 percent of its weight gain.

The desorption cycle uses a combination of elevated temperature, reduced pressure and purge gas flow. During the desorption cycle, the organic material trapped in the adsorbent material is volatilized, condensed and transferred as a liquid to a storage tank. The condenser system has two stages, one set at 2°C for water condensation, and the other at -45°C to capture solvents with low boiling point temperatures. The recovered compounds may be reclaimed or disposed by solvent recyclers.

At a chemical company site in Union City, California, the client was spending about $10,000 per month to change out saturated carbon vessels recovering volatile organics from leaking aboveground solvent storage tanks.

Contaminants at the site were tetrachloroethylene, 1,1-
dichloroethylene, trichloroethylene and 1,1,1-trichloroethane. Soil vacuum extraction was initiated using activated carbon filters. Early sampling indicated approximately 1,140 liters of solvents were present in the soil. However, from December 1992 to December 1993, over 11,400 liters were removed. A Purus system was installed for nine months, during which time the soil vapor concentration dropped from 300 ppm to less than 70 ppm. Based on these results, the client decided to install a permanent system to treat the groundwater at the site.

Initially, the groundwater was treated with two liquid phase carbon vessels in series. The water was pumped through the vessels at a rate of 380 liters per minute. A Purus stripper unit was placed upstream from the carbon vessels. Nitrogen gas was used to strip the volatile organics as the water passed through the packed tower. After treatment by the adsorbent bed, the gas was returned to the stripper tower in a closed loop, eliminating direct discharge to the atmosphere. The blower maintained air flow of approximately six cubic meters per minute through the system. Analytical results showed an air stripper removal efficiency of over 98 percent. Samples of the return gas showed non-detect levels of volatile organics. The client is saving over $70,000 per year in carbon costs, which translates to total payback from capital costs in less than two years.

At a site in Phoenix, Ariz., a paint manufacturer suffered a leak of approximately 1,140 liters of paint thinner into the soil from an underground tank. An area of about half a hectare was contaminated to depths ranging from nine to 18 meters.

The Arizona Regulatory Air Board requires a reduction in volatile organics of at least 90 percent prior to release into the atmosphere. Initial analysis of the paint thinner concentration in the air stream from the soil venting operation was 1,500 ppmv. Preliminary cost estimate was about $75,000 to clean up the 1,140 liters using vapor phase activated carbon drums. It was estimated that a Purus system could remediate the site in three to four months for less than $40,000:

<table>
<thead>
<tr>
<th>Cost Item</th>
<th>Cost</th>
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<tbody>
<tr>
<td>transportation</td>
<td>$2,500</td>
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<tr>
<td>3 month equipment lease</td>
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<td>3 month operating cost</td>
<td>$5,500</td>
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<td>$9,200</td>
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<td></td>
<td>$38,200</td>
</tr>
</tbody>
</table>

At completion of the project, after seven months, approximately 2,280 liters of paint thinner had been collected, twice than originally expected. Effluent from the Purus system was consistently either non detect, or less than 3 percent of the influent, well within local air district requirements. Initially, the system cycled between two adsorbent beds every six hours. The client saved an estimated 40 percent in treatment costs.

Write in 527 for more information
Soils switches to the metric system:

Editor:

I would like to start this letter by saying that I immensely enjoy Soils magazine and read it thoroughly each month. But, (you knew there would be a “but,” didn’t you?) ...your recent metification of the magazine needs some fine tuning. The major problem, it seems to me, is one of dealing with significant figures. From page 22 of the January-February issue, I quote: “The compound consists of numerous underground storage tanks and several thousand feet of 10.16 centimeter and 15.24 centimeter diameter delivery pipe.”

In that sentence, you converted two of the English measurements, but not the “several thousand feet.” We need consistency if we are to believe that you “...have ruthlessly converted all measurements in Soils articles to the metric system...”

Secondly, to get the 10.16 and 15.24, you multiplied four and six inches by 2.54 centimeters per foot. The problem with this conversion is the problem of significant figures... You have multiplied a number with one significant figure by a three significant figure conversion factor. The rule, from high school math, is that when numbers that are estimations (as these are, with different significant figures) are combined, the answer must have a significant figure equal to the number possessing the lowest of significant figures—in this case, one. I hope this friendly advice is taken that way, because I truly do enjoy your magazine and look forward to receiving many more.

Sincerely,

W. Thomas Todd
Unit Supervisor,
Toxic Cleanup Program,
Department of Ecology,
State of Washington,
Olympia, Wash.

Mr. Todd:
Thanks for helping to guide the mathematically challenged editor. Around the office, (to my face) they call me “Word Goddess—not “Math Maven.” (I don’t know what they call me behind my back!) I’m glad you enjoy the magazine.
Correction

In the "State Summary of Cleanup Standards," December 1993, page 20-21, these errors appeared in the information from Hawaii: Under the heading, "Cleanup Criteria," the two categories should have read: Above and Below the UIC Line, not the "Oil" Line.

Also in the Hawaii listing, all units of measurement should have been ppm. Soils regrets the errors.

Editor:
I applaud your stance on using metric measurements, and I must admit to being surprised at how many other trade magazines have been so slow to take the plunge.
Sincerely,
Flora Smeaton
Vice Consul
British Consulate General
Chicago, Ill.

Editor:
Your suggestion to lead the industry with the metric system, and your suggestion that the conversion in parenthesis is "babyish" shows how shallow, narrow and truly ignorant you are on the issue.
Anonymous

Readers:
The reasons I decided to convert Soils to the metric system:
On more than one occasion, I have allowed myself to feel belittled by a Canadian person who expressed contempt for the persistence of our quaint and quirky imperial system.
Aside from the fact that the U.S. and Liberia are the only two non-metric countries left, and the matter of growing international markets, the thing that pushed me over the edge was that the Federal Highway Administration announced that by October, 1996, all highway signs will be converted to metric measurements. Although, opposition to that announcement is already building.
I figured when both our soda pop bottles and our road signs are metric, the rest of society will have to follow.
The reason I chose not to print both measurements side-by-side is because Soils readers are a sophisticated, highly educated group, and to print information they learned back in the eighth grade would be my second worst nightmare.

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Write in 009

March 1994 Soils 49
State update
Developments of interest from around the country

In California, the Underground Storage Tank Cleanup Fund, Health & Safety Code §25299.10, is funded by a $0.006 tax on every gallon of gasoline sold in the state. The tax generates approximately one hundred million dollars per year for reimbursement of eligible cleanup costs. Each applicant is potentially eligible for reimbursement of up to $990,000 in qualified costs. Recent significant changes in the use of the California fund include:

- The tax-funding mechanism and reimbursement program have been extended from 1998 to at least 2005.
- Thirty percent of all future funds will be reserved for medium and large size businesses, which have not yet received a single dollar in reimbursements for cleanup because all funds were used by small businesses.
- Parties who could not previously qualify for the fund because they did not have a permit to operate the tanks or remove them prior to January 1, 1990, (didn’t know about the tank and/or didn’t remove it until 1991 or 1992) will now be potentially eligible for reimbursement.

As a result of these changes, which became effective January 1, anyone who has incurred costs or might expect to incur costs in connection with the cleanup of underground storage tank contamination, should review their situation with a qualified attorney or consultant as soon as possible to determine if they may now be eligible for reimbursement of their costs.

An application for reimbursement from the fund should be filed as soon as possible because applications are prioritized for funding in the order which they are received in the Water Resources Control Board’s Sacramento office. As of December 8, 1993, there were approximately 1,100 Class C (medium size) businesses and 2,600 Class D (larger size) businesses and non-profit associations on the list—and all have priority ahead of new applications. However, since many persons eligible as Class C and Class D applicants did not apply for reimbursement from the fund because of the limitations of the prior law, it is anticipated they will generate a flood of new applications.

It is strongly recommended that site owners seek the advice of an attorney or consultant to assure compliance with the requirements of the application procedure and to improve the likelihood that the application will be approved for reimbursement.

California information provided by Jonathan Redding, Esq., Fitzgerald Abbott & Beardsley, Attorneys at Law, Oakland, Calif.

The Department of Ecology, which runs the underground storage tank permitting program in Washington state, is looking for unpermitted tanks, and will fine both tank owners and distributors who deliver fuel to unpermitted tanks. The department just completed an amnesty period in which owners of unpermitted tanks were encouraged to step forward and pay permit fees without facing the usual fines. Dale Jenson, the state’s chief regulator of underground tanks, fears there may still be hundreds of tanks operating in the state without permits.
Meanwhile, in Illinois, the legislature is streamlining its LUST response requirements to try to save tank owners money. The new system is based on risk to groundwater. The Illinois EPA has until March to refine the regulations, but basically, the plan calls for stepped up assessments, and if no impact to groundwater or neighboring property is identified, the site may not require remediation. But, the plan does call for a 15 meter boring to physically characterize soil type. If the soil type falls in a low risk category for groundwater contamination, no further action would be required at the site. But, if high risk soil types are encountered, further study would include installation of monitoring wells and sample analysis for three years. Based on such factors as soil type analysis, or presence of contaminated groundwater, sites will be categorized as either no further action, low priority or high priority.

Finally, a bewildering tussle over the Department of Environmental Protection’s reimbursement program in Florida has tank cleanup contractors in an uproar. Consolidated Credit Group, Inc., of Tampa along with the Florida Petroleum Marketers Association filed a rule challenge in late July 1993 of DEP rule 17-773 which governs how DEP reimburses site owners and contractors for cleanup of petroleum contaminated UST sites. The challenge claims the department exceeds its authority in limiting types of reimbursable costs and in limiting the number and percentage amounts of markups in an application. The petroleum marketers group withdrew from the challenge in January. If the challenge is successful, the DEP would appeal. But, the appeal would probably take a year and during that time the DEP would not be able to process any applications for reimbursement, according to Lisa Duchene, DEP’s attorney. The program has a backlog of applications of $158 million, and receives 200-250 new applications each month.

The Consolidated Credit Group is under investigation by the DEP for alleged fraudulent affiliations counter to rule 17-773. The company operates cleanups on some 600 sites in Florida and has been reimbursed about $8 million from the fund since 1990. In July, DEP began to decline the company’s applications for reimbursement that included a 15 percent markup on cleanup costs done in connection with another company, Pollution Abatement Co., Inc. The DEP alleges the two companies are in a “financial, familial or beneficial relationship,” that is counter to rule 17-773.

A date for the hearing has not yet been set.

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Write in 033

March 1994 Soils 51
What's New

BioSolve tackles hydrocarbons
BioSolve™ is a hydrocarbon mitigation agent now available through Midlantic Environmental Enterprises, Inc., Beacon, N.Y., and Western States BioSolve, Fountain Valley, Calif.
It can be used in bioremediation of soil and water, degassing underground pipelines, UST washouts, vapor suppression, spill cleanup, sludge reduction, soil washing and recovery enhancement, the distributors say.
BioSolve™ is a biodegradable surfactant and water-based surfactant that does not contain any enzymes or bacteria cultures.

Write in 539

EnviroVac washes it away
John Tate, Inc., offers EnviroVac, a high pressure washing and recovery system that allows the operator to clean a surface using environmentally safe cleaning agents.
The machine allows water and cleaning solutions to circulate, and dirt and oils are separated from the cleaning medium, the manufacturer says.
It can be used on most surfaces and is ideal for cleaning applications where waste water containment is required and where oily water runoff to drains would be an environmental hazard.

Write in 542

Pump shield prevents overheating
Keck Instruments, Inc., Williamson, Mich., introduces the Pump Saver, a shield that slips onto small diameter Grundfos® Redi-Flow2 sampling pumps to prevent overheating in large diameter wells.
The design allows the shield to slip directly over the pump. It is held in place with do point set screws.

Write in 540

New shear can cut it
Counselor Engineering, Hudson, Ohio, announces a new version of their McIntyre 640HD Shear that can cut over three inches diameter steel.
The shear has a 63.5 cm blade and is available with a diesel or electrical motor.

Write in 543

NutriCAT™ speeds cleanup
Spill Containment Systems, Inc., Houston, Texas, introduces NutriCAT™, a new bioremediation product that cleans hydrocarbon contaminated soil.
Relying on the Capillary Absorption Technology™ principle, NutriCAT™ is used either with indigenous or augmented cultures to hasten hydrocarbon biodegradation, the company says.
NutriCat™ is a light, fluffy particulate material that adds tillth to the soil and expands the surface area available for microbial growth. As the product is tilled and re-tilled through the soil, microbes are further spread to attack the contamination.
These microbes then metabolize and degrade the product as well as the offending absorbed and contiguous hydrocarbons, the company says.

Write in 541

Radar has many uses
GeoRadar, Inc., Saratoga, Calif., introduces ground penetrating radar based on stepped-FM technology.
The radar has many applications, including mapping buried utilities prior to excavation; locating unexploded hazardous waste; mapping soil depths; tunnel, sinkhole and cavity detection; and inspecting concrete and asphalt.

Write in 544

52 March 1994 Soils
REGISTRATION AND CERTIFICATION CONTINUING EDUCATION WORKSHOPS

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Write in 026
DRS offers skid-mounted VES units
Diversified Remediation Southeast, Inc., Apopka, Fla., introduces a skid-mounted vapor extraction unit that removes volatile organic compounds from soils without excavating. Vapors are extracted from the soil through the unit, which routes them through an FRP moisture separator and off-gas treatment system.

Write in 545

Tank gauge comes with alarm
Amprodex, Inc., New York, N.Y., offers a combination tank gauge with low and high tank level alarms and leak detectors.
The gauge comes with a leak alarm for the interstitial cavity of a double-wall tank and a sump alarm for spills or piping leaks into a sump or tank vault.

Write in 546

Adwest does SVE
Adwest Technologies, Inc., Orange, Calif., offers a catalytic oxidizer for soil vapor extraction.
The Katox 300 C55 is skid or trailer-mounted. Other features include integral 55 percent primary shell and tube heat exchanger electric heat, electric pump and totally enclosed, sound proof design. The system is compact and portable for mobile use and can destroy VOCs greater than 99 percent, the manufacturer says.
Blowers better than before
Invisible AirFlow Systems, Baltic, Ohio, develops compact single-stage exhaustors and blowers for soil vapor extraction, soil sparging and air stripping.

The compact TurboFlow features cast-aluminum, spark- and corrosion-resistant construction, variable flow, low discharge temperature and efficiency ratings up to 30 percent greater than conventional exhaustors or blowers, the company says.

They also offers 100,000 hour bearing design and acoustically designed silencer base for quiet operation.

Write in 549

New antennas for radar system

In a new brochure, the company also features their line of low-, medium- and high-frequency monostatic and bistatic antennas for their SIR systems.

Write in 550

Liners branch out
Gundle Lining Systems, Inc., Houston, Texas, offers polyethylene lining systems for ringwalls, retrofit bottoms and other tank applications.

Gunline HDC is an electrically conductive liner; Gundline HDW has a white reflective surface for easier damage detection and reduction of heat-related expansion and contraction problems; and Gundline HDT is a textured liner for greater stability on high angle installations.

Write in 548


The Breeze™ Air Stripping System from Aeromix doesn't get a second look from most people. It's only four feet tall and the self-contained aeration tank is easily hidden. But the Breeze certainly attracts attention from water quality managers. They know how well this stripper works. The patented non-fouling, stainless steel Cyclone diffusers release specifically sized bubbles that quickly and effectively remove dissolved gases and other contaminants. Individual units can purify flows up to 200 gpm, with VOC removal rates reaching 99.9%. There's no packing media. No complicated electronic controls. No extensive maintenance schedule. And it's affordable. The Breeze. It's worth a closer look. Call us today for more information about our entire line of aeration systems.

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March 1994 Soils 55
What’s Happening

• **Fertech Environmental, Inc.**, formerly Fertech Enviro Systems, Moberly, Mo., announces the changing of its name to better reflect the company’s services that include environmental engineering, regulatory and technical support, site assessments and remedial designs, as well as project management and construction.

• **The Millgard Environmental Corp.**, Livonia, Mich., has been awarded the remediation contract for in situ solidification of 135,000 cubic yards of contaminated soil at a Superfund site in Utica, Mich.

• **CleanSoil, Inc.**, West Columbia, S.C., announces the addition of Environmental Remediation Consultants, Inc., Knoxville, Tenn., as a new licensee for their equipment and process that cleans sites contaminated with petroleum hydrocarbon and selected hazardous materials.

• **Omega Environmental, Inc.**, says third-party testing confirms that their TC-1.0 leak prevention system stops leaks from typical breaches in USTs. Conducted by Edison Testing Laboratories, Cortland, N.Y., the tests validated that the leak-prevention technology performed without flaw 100 percent of the time.

Omega Environmental has also acquired the assets and operations of Tecnifo, Inc., St. Petersburg, Fla., a provider of services and products related to storage tanks.

• The Biochemical Division of Sybron Chemicals, Inc. says they have become the first U.S. producer of microbes to receive the coveted ISO-9002 quality assurance certificate, issued by Lloyd’s Register Quality Assurance Ltd. To receive the ISO certification, Sybron adhered to a quality assurance program that required documented procedures for the manufacturing process, from maintaining strain purity to process control, order entry, as well as final packaging and QC testing.

• **Geraghty & Miller, Inc.**, Plainview, N.Y., announces its merger with Heidemij N.V., headquartered in Arnhem, the Netherlands. Geraghty & Miller has become a wholly-owned subsidiary of Heidemij with operations in approximately 90 countries.

Alternative Remedial Technologies, Inc., originally a joint venture between the two firms also announces the conclusion of their soil washing operation at the King of Prussia site.

• **Minproc Technology, Inc.**, Englewood, Colo., and Geochem/Terra Vae, Lakewood, Colo., announces the signing of an agreement to promote technologies developed to leach and recover leach from contaminated soil or sludge. The agreement will allow the firms, which have each previously evaluated meallurgical processes, to share past findings and work together on specific sites.
The plant pictured here is cleaning up in Las Vegas. It's just a few blocks from world-famous casinos, such as the Golden Nugget. Unlike playing the casinos, it makes money for its owners without the element of chance. The amazing thing about this plant is its close proximity to the downtown area. It works quietly without polluting the atmosphere.

The plant is presently cleaning contaminated soil from a maintenance and refueling yard used over 50 years. About 35 acres of the yard will be used for the new seat of Clark County.

SPI built this plant and similar ones throughout the country. SPI is a company operated by people with years of experience in building this type of equipment. Moreover, SPI builds it all at one facility. Thus, the components are designed to work together as a complete system.

Most SPI plants are designed to clean soil contaminated with petroleum products. They clean either by low-temperature thermal desorption or high-temperature treatment. SPI can also design plants for high temperature remediation of soils contaminated with hazardous materials. The plants are custom designed and are either portable or stationary. They may include the following:

- Rotary kilns
- Baghouses
- Shredders
- Scrubbers
- Afterburners
- Feed systems
- Size reduction equipment
- Heat exchangers

Building the equipment is not all SPI does. We provide permitting assistance and plume dispersion modeling. We train your operators and help you with start-up. We help you develop business plans and marketing strategies.

Why not simplify your remediation opportunities by using one source for a complete remediation system. Let SPI do it all. You will save money and time. You win with SPI.
**Tarmac plants in three sizes**

Tarmac Equipment Co., Kansas City, Mo., offers three standard size soil remediation plants: 1.66, 2.57 and 3 meter diameter—capable of processing 22.5 to 112.5 metric tons per hour. Heavy oil remediation equipment is available. Options include stainless steel dryers, oxidizer locations before or after the baghouse, and contaminated fines return systems. Tarmac also designs custom oxidizers, air-to-air heat exchangers, kilns and rehydration mills to adapt to existing equipment.

**Ryan-Murphy plant allows on site flexibility**

The Ryan-Murphy Inc., Westminster, Colo., Good Earth Machine has variable operating parameters to allow site specific flexibility. Soil is conveyed over a weigh scale into the rotary dryer where temperature of the soil reaches 340°C within four to six minutes. Heated exhaust gases from the dryer chamber are forced through a baghouse where particles are removed, collected and discharged. Particulate-free exhaust gases are forced through a catalytic oxidizer to destroy any remaining VOCs.

**Stalite Environmental kilns reach 1,200°C**

Stalite Environmental, Salisbury, N.C. operates Allis Chalmers rotary kilns, capable of maintaining temperature profiles of 1,200°C. Kilns are 3.6 meters in diameter and 48.5 meters long. They are fired by natural gas. A baghouse and catalytic oxidizer control particulate and VOC emissions, says the company.
Seaview HT-6 Thermal Distillation plant

Seaview announces thermal distillation process

Seaview Thermal Systems, Blue Bell, Pa., announces the first application of their new thermal distillation process at a 13-acre former gas plant site in Paterson, N.J. Thermal distillation subjects contaminated soil to high temperatures (as high as 1,090°C) with electrically generated heat, vaporizing and separating the hazardous materials into distilled water and oil and purified soil, says the company. The U.S. EPA has named the system a "Best Demonstrated Available Technology (BDAT) for hazardous organic wastes.

Baker Furnace oxidizer converts from thermal to catalytic operation

Baker Furnace Inc., Pomona, Calif., offers automatic dilution and catalytic module, which adapts to site requirements by allowing conversion from thermal operation to catalytic operation, says the company.

Write in 555

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Write in 031

March 1994 Soils 59
ADM refines plant

Asphalt Drum Mixers, Inc., Huntertown, Ind., applies thermal oxidation technology to update their soil remediation equipment. The afterburner funnels contaminated air over or through a burner flame into a residence chamber where it is oxidized. The plant's counterflow design allows soil to be heated to eliminate fugitive dust and work more efficiently with downstream pollution control equipment. Rotating elliptical bars on the wobble feeder allow multi-size, as well as wet, sticky or clay materials to pass without clogging.

Write in 556

No other company make a remediation pu

That's because no other company has the AutoPump, the industry's first controllerless pneumatic pump. The AutoPump's internal float-and-valve design is what makes it so tough. It's fully automatic with absolutely no external controls to calibrate. So service and maintenance costs are kept to a minimum. And it installs in minutes.

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The AutoPump's air valve lever assembly has never jammed. Fluids as thick as 90 weight oil and oily, wet air can pass through the air valve without fouling. So there's no need for expensive air dryers or high-performance filters.

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It uses air only on demand. It doesn't bleed air while filling or depressurize the air line at the end of each cycle. And pumps can be “T'd” together to easily expand or reduce a system.

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The AutoPump can be placed in wells as deep as 250 feet. It pumps in a top-loading, hydrocarbon or bottom-loading, contaminated water configuration from 0.0001 gpm up to 8 gpm.

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Gencor tandem plant offers two stage processing

Thermotech Systems Corp., Orlando, Fl., says their Tandem unit provides a second stage chamber that selectively releases heavy hydrocarbons to be thermally destroyed in the first stage, virtually eliminating highly condensable hydrocarbons from the exit gas stream to the baghouse. Both stages operate with the soil flow, countercurrent to the flow of combustion gases.

Soil-Therm introduces chlorinated cat-ox thermal systems

Soil-Therm Equipment, Inc., announces catalytic destruction of chlorinated vapors extracted from contaminated soils. Temperature is maintained by the addition of natural gas to preheat vapors to 400°C. The catalyst destroys vapors to greater than 97 percent efficiency, says the company. Scrubbers remove hydrocarbon emissions by greater than 99.9 percent.

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Enviro-Tech/CMI floating liner permits hot soil processing

Enviro-Tech Division of CMI Corp., Oklahoma City, Okla., says their patent pending, high temperature alloy floating liner, located in the combustion zone of the desorber, permits soil temperatures as high as 650°C without the need of refractory. The liner design also uses energy recovery technology by preheating air prior to entering the combustion zone. The unit is also equipped with CMI's Roto-Aire Baghouse.

Write in 559

SPI/Astec unit separates drum from flame

SPI/Astec, Chattanooga, Tenn., says their portable thermal desorption unit separates the rotary drum from the burner flame which allows the entire drum to be used for showering the soil, without flame penetration into the drum or impingement of flame on the soil. Efficiency is maximized by preheating all combustion air with energy that would otherwise be wasted. Capacity is 36-54 metric tons per hour at temperatures over 500°C.

Write in 560

Therm Tech oxidizer has dual option operation

Therm Tech, Kingwood, Texas, says their Vapor Check oxidizers operate either thermally or catalytically. The unit can be packaged with a vapor extraction system.

Write in 561

Andersen 2000 incinerator guarantees performance

Andersen 2000, Peachtree City, Ga., says their incinerator and scrubbing systems can process up to 2.3 metric tons per hour of waste. The system is guaranteed up to 99.5 percent removal of acid gas emissions and outlet particulate loadings as low as .01 gr/sdcf. Optional natural gas fired reheater provides plume supression from stack.

Write in 562
Paragon Environmental Systems, Escondido, Calif., introduces its operational brochure for the ExtraTherm, a vapor extraction and treatment system. The brochure features step by step explanation of how the Extra- therm system works. Also included is a specification chart for the 150, 250, 500, 1000 scfm systems and a process and instrumentation diagram. For a brochure, call 800-985-0055.

Sive Services, Alamo, Calif., now offers the design, installation and operation services, as well as the equipment, for the application of steam injection and vapor extraction. The patented SIVE process uses underground steam injection and vapor extraction. The patented SIVE process uses underground steam injection applied in conjunction with conventional in-situ soil and groundwater remedial methods. For their brochure, call 510-820-5449.

Enviro Products, Lansing, Mich., releases their general brochure that highlights sampling and instrumentation equipment, remediation and drilling equipment and well supplies. EPI caters to the environmental soil and ground water industry. For a brochure, call 800-ENVIRO 4.

Dexsil Corp., Hamden, Conn., introduces their 1994 catalog that features field kits and instruments and covers PCB testing, waste oil, waste water analysis, lubricating oil analysis and magnetic field meters. For a catalog, call 203-289-3509.
Horizontal Technologies, Inc., Cape Coral, Fla., has developed a proprietary subsurface control system to install an impermeable barrier wall. The Polywall Barrier System places a continuous sheet of 40 to 100 mil high density polyethylene membrane vertically to depths up to nine meters below grade. The barrier is installed in a 36 centimeter wide trench, which minimizes generation of excavated soils. The wall can be extended to virtually any length because seams in the liner are joined in an interlocking waterproof tongue-and-groove system, says the company. The joints are heat welded to each end of the membrane above ground. Then the membrane is inspected and rolled up for installation. The installation machine can install liner at rates up to 20 meters per hour, depending on soil type and installation depth. Rolled liner is unfurled in the trench by a system of rollers and restraints. Backfill is immediate, making this a one pass system. Roll lengths vary depending on the thickness of the membrane being used; 40 mil thickness can be up to 60 meters long. Joints are sealed below grade with a hydrophilic polymer and can be visually inspected before backfilling. When consolidated stratum is encountered, a pretrenching pass is backfilled with sand before the installation pass. The barrier can control groundwater flow, isolate wetlands and prevent leakage through levees. It can also be used create an in situ bioreactor for controlled treatment with the company's Linear Contaminant Remediation System (LCRS), a series of trenched, sand or gravel packed horizontal wells. At a site in Star Lake, N.Y., Polywall was installed with the LCRS along 400 meters of the Little River to a depth of 4.5 meters to prevent a diesel fuel plume from entering the river, and recover free product. Write in 536 for more information.
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Surface Clean Technology Co., Vista, Calif., is developing a system to remediate railroad trackbeds. With the installation of a tank and sprayer system on a gondola car, Surface Clean’s proprietary pentanonic cleaner, Cleanup™, is mixed with water and sprayed on the tracks as the train makes its usual runs. The pentanonic cleaner works in conjunction with sunlight and naturally occurring bacteria in soils to degrade pollutants. In three or four applications, the mixture can remediate hydrocarbon contaminated soils, concrete ties and heavy gravel. Rainfall reactivates the pentanonic cleaner until all contaminants are gone, then, the pentanonic cleaner degrades. The 3,800 liter water tank is anchored in an open gondola train car. A flywheel measuring device is calibrated to feed the 10 to one water and pentanonic mixture as the train reaches 80 to 130 kilometers per hour. At the 10 to one ratio, the pentanonic cleaner can remediate petroleum contamination up to 9,000 ppm. The applicator bar, made of perforated PVC pipe, can be positioned either above or below the gondola’s air brake hose line. The bar, equipped with sprinkler heads, is only as wide as the inside of the track rails. Gravity and the grading and elevation of the trackbed carry the pentanonic mixture to the edge of the gravel trackbed. A switch in the engineer’s cab turns the system on and off. A 3,800 liter tank of the surfactant mixture would be sufficient to treat approximately 100 kilometers of track length, depending on degree of contamination, says the company.

The system is designed to deal with organic wastes petroleum, diesel fuels, oils and sludges generated by railroad operations, particularly in isolated areas, where pollution may threaten the water table, crops or livestock.

Write in 537 for more information

68 March 1994 Soils
Cooper Equipment Co., San Antonio, Texas, has been selling their Sprayer-Particlizer to enhance bioremediation. Combining particle sizing equipment such as built by Royer Industries, Kingston, Pa., with Cooper's inoculating spray system produces oxygenated soils broken into fine particles, ready for inoculation with the calibrated spray system.

Excavated soil is loaded into a feed hopper and conveyed into an enclosed chamber where the soil is broken into fine particles. Maximum particle sizes can be adjusted from 1.25 centimeters up to 6 centimeters in diameter. The particles are discharged in a thin, horizontal stream to the inoculator which sprays a controlled amount of nutrient, microbe and water solution onto the soils immediately at the point of discharge. Spraying at this point has the added benefit of restricting fugitive air emissions and dust release, says the company. As the inoculated soil pile forms, moisture level within the pile tends to remain more uniform than spread out soils, due to the low surface to volume ratio. The pile remains fluffed, which serves as a continuing source of oxygen for the microbes. Rocks, steel and other chunks that cannot be particlized are ejected to the side via conveyor. The spray application is controlled with a series of six pressure spray bars configured with multiple nozzles. The process is particularly effective on challenging wet clays, which process in the range of 1.7 to 18 metric tons per hour, says the company. Other soils can reach process rates up to 35 to over 90 metric tons per hour, depending on soil type and model. All models are easily towed at highway speeds, and can be set up in less than an hour. It is also possible to fit the system with a separate kiln dust feeder to enhance solidification projects.

Write in 538 for more information
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