State-by state
summary of cleanup standards
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Write in 305
High pressure air injection establishes channels to permit greater movement of liquids and vapors.

Breaking up is easy to do

Pneumatic fracturing enhances remediation in low permeable sites

By James Mack

When remediating contaminated soil sites, so often, a breath of fresh air is just what the doctor ordered. But what about the challenge of getting air down to the subsurface when the subsurface is a bedrock or other low permeable geologic formation?

Pneumatic fracturing enhances the permeability of low permeable formations so that the in situ removal and treatment of volatile organic compounds (VOCs) is possible. The patented process consists of injecting high pressure air or any other gas into a contaminated geologic formation at controlled pressure and flowrates to fracture and aerate the contaminated zones.

Pneumatic fracturing establishes conductive channels which permit greater movement of liquids and vapors through the fractured formation. This can enhance the performance of vapor extraction, bioremediation, soil flushing and thermal treatment technologies.

The process to enhance the in situ remediation of low permeability soil and rock formations was developed at the Hazardous Substance Management Research Center (HSMRC), Newark, N.J. The key developer of this process was John Schuring, Ph.D., associate professor of civil and environmental engineering, at the New Jersey Institute of Technology in Newark.

McLaren/Hart Environmental Engineering Corp., Rancho Cordova, Calif., teamed with HSMRC and with Accutech Remedial Systems of Keyport, N.J., to take the technology from the drawing board into the field for clients who are facing costly remediation options.

James Mack is chief geoscientist for McLaren/Hart Environmental Engineering Corp., Warren, N.J.

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Prior to application of the technology in a contaminated area, the team conducted a pre-pilot test at a portion of the property where no contamination was present in the unsaturated zone. The purpose of the pre-pilot was to evaluate the impacts of pneumatic fracturing in the unsaturated portion of the shale bedrock. The main concern with fracturing at this site was whether the process might create possible vertical conduits for contaminant migration.

This issue was of particular concern at this site due to the possible presence of Dense Nonaqueous Phase Liquids (DNAPLs) within the unsaturated zone. The primary contaminant of concern at the site was Trichloroethylene (TCE). An important physical property of DNAPLs is their density, which promotes vertical migration in the subsurface. For example, the density of TCE in its immiscible phase is 1.46 grams per cubic centimeter, compared to 1.0 grams per cubic centimeter for water. As a result, when DNAPL is released into the environment, it tends to migrate downward through both the unsaturated and saturated zones where any physical pathway or opening exists. The pre-pilot test clearly demonstrated that the predominant fracturing was horizontal, with only very minimal vertical fracturing.

Once the pre-pilot test was completed, the team identified a former industrial site in New Jersey for the EPA SITE (Superfund Innovative Technology Evaluation) demonstration. At this site, TCE and other volatile organic contamination in the subsurface soil, bedrock and groundwater were discovered and traced to prior disposal practices associated with the manufacture of computer components, crystal devices and specialty chemicals.

The pilot test was designed to determine:
- effective radius of vertical and horizontal fracture influence,
- increase in post-fracture air flow permeability compared to baseline pre-fracture air flow rates,
- increase in mass contaminant removal from vapor extraction,
- ability of fractured media to be heated and retain heat,
- if hot gas injection will enhance contaminant removal.

The pilot test consists of:
- drilling of boreholes in the unsaturated zone,
- development of baseline site conditions prior to fracturing,
- site conditions during and after fracturing,
- evaluation of the improvement in airflow after fracturing,
- measurement of contaminant removal during vapor extraction,
- measurement of formation temperature increase from hot gas injection,
- determination of contaminant removal increase as a result of hot gas injection.

The pneumatic fracturing extraction system used for the demonstration consists of three elements: the actual fracturing step, vapor extraction and the hot air injection equipment and instrumentation.

The fracturing device consists of two

*Continues on page 52*
Pre-plan to ensure fund payoff

Take steps along the way to qualify for reimbursement

By Clifford Blackman

Far underground storage tank owners and responsible parties in California, as in many other states, one of the last steps in the cleanup process is to apply for reimbursement from the state fund. What factors enter into the approval for reimbursement, and how can one enhance the odds that reimbursement will be approved?

Clifford Blackman, attorney at law, is founder of Blackman Legal Group, Burlingame, Calif. For more information about the California fund, call 1-800-444-5602.

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The chain of responsibilities is a long one. Not only is the owner faced with the responsibility and expense of removing the tanks and remediating the soil to the satisfaction of governmental regulators, but assessing the impact of the leaks on the groundwater as well. This means the owner must also search for and select qualified environmental consultants and engineers, contract with companies for the removal of the tanks and obtain all the necessary permits.

Because the environmental consulting industry is still young, the owner may find that different companies have widely varying recommendations to solve the problem—and at widely varying costs.

Some owners feel the need to hire yet another layer of protection and retain an environmental attorney to help them select a consulting firm that will be more likely to choose technologies and processes most likely to be reimbursed. They use the attorney to negotiate the expensive services of engineering firms and tank removal contractors to optimize their prospects for recovery from the fund.

How the California fund works

California created their Underground Storage Tank Cleanup Fund in December, 1991. The fund is active and accepting applications. The law was created to help eligible owners and operators of underground storage tanks meet federal requirements to demonstrate financial responsibility, obtain reimbursement for cleanup costs and to recover damages awarded to third parties who are injured by petroleum releases.

California’s fund does not cover the removal, repair, retrofit or installation of underground tanks. Only corrective action qualifies for reimbursement. Corrective action is defined as any activity necessary to investigate and analyze the effects of an unauthorized release; propose a cost-effective plan to protect human health, safety and the environment; to restore or protect beneficial uses of water; and to implement and evaluate the effectiveness of the activities.

The maximum amount available from the California fund is $990,000 per occurrence. Claimants are responsible for the first $10,000 of eligible costs.

There are a variety of qualifications which apply to owners

Continues on page 10→
Ensure fund payoff, from page 9

and operators to determine if they quality for reimbursement from the fund. Similarly, there are numerous regulations pertaining to whether costs are of a type eligible for reimbursement. There are also a number of regulations which govern whether applications should be made by joint claimants, such as partners, and how claims can be made separately for different parts of a cleanup. Claims are processed on a first-come, first-served basis. Priorities are assigned to eligible claimants for their funding. The balance of appeals not yet reviewed are primarily priority C and D applications, which the fund will not be able to afford for some time. The fund anticipates review of the remaining 1,100 appeals during the next six to nine months. Although the number of applications denied following the cursory review was approximately 50 percent, it appears that if the trend continues, approximately 4,700—or 75 percent of the original 6,271 claim applications submitted for the initial priority list will eventually be accepted. The most common reason for rejection of claims was the failure of qualifying costs according to four categories. Residential owners form Class A and receive the highest priority for reimbursement. Small businesses, as defined in the regulations, form Class B, and are the next priority. Class C is made up of other businesses, for which there are numerous qualifiers (such as employing fewer than 500 employees and being independently owned and operated). Finally, Class D is for all others who do not fall under A, B or C—major oil companies, local agencies and non-profit organizations, among others. As of August 27, 1992, the California fund had received 6,971 applications. Of this total, 2,620 were rejected. Of the 900 rejected claims that were appealed and have been reviewed, 624 were turned down at that level. The 900 are mostly priority A and B claims, some of which may be processed during the first year of claimants to obtain proper permits for the work completed. As of August 27, 1992, the fund has processed very few Class A priority claims. Most of the A claims are reported to be under $50,000, with some approaching $100,000. While the California State Water Resources Control Board, the actual review body under the fund, has reviewed only the A priority claims so far, it has only approved about 60 claims for payment, and, in fact, has not yet begun to actually write the checks. As additional A priority claims are submitted to the fund, they will go to the front of the line ahead of previously filed B, C or D claims. The review process on the new claims is somewhat different than the process on the initial 6,271 claims. Because the 6,271 claims came in virtually all at once, the cursory review process only allowed perhaps 20 to 30 minutes study, with no
opportunity to contact the claimant for missing information or clarification. The applications currently being received are being reviewed in more detail and claimants are contacted as needed before a decision is reached to accept or deny a claim. As a result, the percentage of denials of new applications is running only about 25 percent.

The flow chart on page 8 illustrates the process in California. The detailed review step is done to evaluate whether the claimant has complied with permit requirements. Thorough investigation of the local agencies and permit regulators determines if compliance requirements have been met.

The regulators visit the local agency to make sure that all permits and compliances are up to date and that all requirements are met. If the claimant checks out, the “letter of commitment” is given to the claimant stating that funds will be obligated.

When the claimant submits invoices and canceled checks, it is necessary to show three bids of all phases:
- Phase 1, preliminary site assessment,
- Phase 2, soil and water investigation,
- Phase 3, corrective action plan implementation,
- Phase 4, verification monitoring.

Most of the claimants are currently in Phases 1 and 2. Claimants whose applications are rejected have certain appeal rights. There are three levels of appeals of the rejection of a claim in California. The first level is the staff decision. At this level, the manager makes the final decision. Should the manager reject the claim again, the claimant can appeal for a Division Decision. At this level, the division chief decides the case. Should the claim be rejected by the division chief, the claimant can appeal to the State Board for a final decision. Most claimants submitting appeals are represented by legal counsel.

The California fund is generated by a six mill ($0.006) per gallon fee paid by owners who are required to have a permit to own or operate an underground storage tank. The fee is based on gallons delivered to the tank and is collected quarterly by the Board of Equalization. While the fund was initially separated from the state’s general fund, it was recently merged into the general fund. The budget crisis in California resulted in a temporary freeze on all payments. But, since the budget has been enacted, payments to claimants have resumed.

To qualify for reimbursement from any state fund requires up front knowledge of the rules. Researching the regulations and rules of any fund must take place early in the cleanup process. Usually, the reasons for rejection cannot be undone or redone. The stakes are too high to walk away from the window empty-handed because of a clerical misstep.

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Write in 234

December 1992 Soils 11
State standards reach for the moon

What is the basis of the state standards?

By Jenifer Heath, Ph.D. and Stanley Atwood

To facilitate regulatory response to environmental contamination by petroleum products, state level regulators throughout the U.S. have developed cleanup standards for soil contaminated with total petroleum hydrocarbons (TPH). As indicated in the summary (page 14), soil criteria for TPH range from a low of 10 ppm to a high of 1,000 ppm. Most states have criteria below 100 ppm.

Based on our experience, state regulators typically cannot provide technical justification for their soil TPH criteria. Rather, the origins of the criteria are unknown, locked in long-forgotten correspondence or project files. Many regulators concede that soil TPH criteria in the range of 50 to 100 ppm probably originated as arbitrary values selected for specific sites.

Yet, owners and operators of sites affected by current or historical leaks from underground petroleum storage tanks typically are expected to remediate to these state criteria when feasible, often resulting in excessively costly remediation and monitoring requirements. Recognizing this dilemma, regulators in some states are beginning to work with owners, operators and their consultants to integrate soil risk assessment into the remediation decision-making process.

A recent evaluation of risk-based approaches to TPH contaminated soils considered the potential for TPH to leach from soil to groundwater. A conservative (protective) U.S. EPA model, the organic Leachate Model, was used to predict potential TPH concentrations in leachate, which would, in reality, be further diluted in the vadose zone and in groundwater. In general, predicted leachate concentrations of TPH are orders of magnitude below acceptable drinking water concentrations (maximum contaminant levels or health-based numbers). The potential exception is benzene, which is highly mobile in soils. For many sites, benzene levels will be much lower than those assumed in the evaluation, either because benzene was not present in significant concentrations in the released product, as in diesel, or because benzene is highly volatile and is present at much lower concentrations in weathered product. Furthermore, analytical data for benzene is available for most sites, obviating the need to apply overly conservative assumptions and leaching models for benzene.

The evaluation of TPH contaminated soil also considered potential human health risks resulting from ingestion of TPH contaminated soil, inhalation of volatiles from TPH contaminated soils, or of TPH contaminated dust and skin contact with contaminated soil.

Using standard equations and assumptions to estimate exposure, cancer risk and non-cancer risk for both workers and residents, this evaluation concluded that soil concentrations of TPH in the range of 100 ppm result in human health risk estimates that are orders of magnitude lower than the risk levels that must be achieved at Superfund sites. This evaluation was based on generic, conservative, health-protective assumptions about both TPH consumption and exposure. Site-specific evaluations for many sites would likely estimate even lower risks to humans from TPH-impacted soils.

Similar conclusions can be drawn on the basis of recent research that develops risk-based soil criteria for Number 2 diesel fuel. A review of the toxicologic literature concluded that soil cleanup targets in the range of 1,000 to 11,000 ppm would be protective of human health.

State derived soil cleanup levels for TPH can reasonably be used as a very conservative screening or ranking tool for soil contaminated with petroleum products. However, use of these levels to determine the need for remediation or as criteria for post-remediation closure for petroleum contaminated sites represents precedent-setting conservatism. Petroleum sites are being remediated to policy based standards that are orders of magnitude more conservative than the human health, risk based standards applied at Superfund sites and Resource Conservation and Recovery Act (RCRA) Corrective Action sites. This inequity would seem to represent a misallocation of scarce resources that could be more effectively applied elsewhere.

State level regulators, owners, operators and consultants grappling with TPH contaminated soil have the opportunity to combine their expertise and resources to identify more reasonable site specific criteria for site closure.||

Write in 629 for more information

Jenifer Heath, Ph.D. is a risk assessment practice associate with Woodward-Clyde Consultants, Denver, Colo. Stanley Atwood is a risk assessment project manager with the Risk Evaluation Group of Geraghty & Miller, Inc., Raleigh, N.C.
Five best tips to work with regulators

To develop an efficient working relationship with regulators could save time and money

Proper management of the regulatory process can only help a company achieve quicker and less costly compliance. Here are five steps to successfully deal with regulators and their regulations:

- **Understand the regulatory process.** Regulatory agencies are often understaffed and are dealing with increasing workloads. An individual regulator’s primary responsibility is to protect public health and the environment, so he or she must focus on strict compliance objectives and consistent enforcement. Therefore, regulators interpret laws conservatively, unless given compelling reasons to do otherwise. Time and money can be saved by knowing what regulatory specifics are negotiable and understanding the manner in which these negotiations may be conducted.

- **Appoint someone to monitor changing laws and regulations.** The regulatory process for environmental compliance is very complex and the body of regulatory material that supports it is vast. It incorporates federal and state laws and the regulations and ordinances of local governments. Regulations also are enforced through sometimes overlapping federal and state jurisdictions. Legislation is continuously being amended, extended, challenged and reinterpreted. Knowing which regulations apply to a particular case, and when, is crucial and requires constant investigation.

- **Advocate innovative and economical treatment alternatives that are based on experience and quantifiable data.** Include site assessments and evaluations of remedial alternatives in order to help regulators establish the most reasonable corrective action plans and treatment goals. It often helps to recommend proven technologies, or, if they’re new, include data and examples from sites where they have been successfully used. Risk assessments also can provide regulators with an objective basis to determine appropriate cleanup levels for a specific site.

- **Package documentation properly.** Errors in format or data can delay processing significantly, raise costs and result in denied approvals and permits. Documents should be submitted in appropriate sequence and format, easy-to-read and clearly labeled. Every submission should be double-checked for inaccuracies or inconsistencies, which will surely create delays. Also, graphic representations of facts contained in reports can make the regulator’s job easier. These might include surface and subsurface three-dimensional computer drawings, exposure scenarios, air dispersion and groundwater models, charts delineating potential risks, graphs of distribution phases of contamination and fate and transport analyses.

- **Practice good human relations.** Companies that develop positive working relationships with regulators earn credibility. This can allow for greater leeway to develop corrective action plans, and minimize formal reviews and inspections. Productive communication with regulators prevents misunderstandings and unnecessary disagreements. It also helps to provide regulators with enough information to make informed decisions. Maintaining a cordial and productive working relationship with regulators is important.

Overall, the key to successful regulatory compliance is to work with your regulators. Provide them with reliable and sufficient information, communicate with them on a regular basis and provide as much assistance as possible. Keep in mind that the regulator’s duty is to protect public health and the environment above all and try to take that point of view into consideration. Keep abreast of the regulatory framework and know the requirements of local, state and federal laws that affect your company’s operations. A cooperative working relationship, which includes a free exchange of information, results in easier, faster and more economical environmental compliance.

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Write in 226
December 1992 Soils 13
State-by-state summary of cleanup standards

How clean is clean in what state? As state standards develop and change, “clean” is a moving target

Many states submitted extensive revisions for this year’s summary as standards continue to evolve. Several states are in the process of revising their standards.

By Tamlyn Oliver, and Paul Kostecik, Ph.D., Association for the Environmental Health of Soils (AEHS) Amherst, Mass.

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<tr>
<td>PAH</td>
<td></td>
<td>610, 625</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Source: Dorothy Malaier - Alabama Department of Environmental Management • 205-271-7834

<table>
<thead>
<tr>
<th>Product</th>
<th>Parameter</th>
<th>Lab Test Protocol &amp; No.</th>
<th>Notification Level</th>
<th>Action Level</th>
<th>Recommended Clean-up Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline</td>
<td>Gasoline range</td>
<td>8015 &amp; 8020</td>
<td>Any Amount</td>
<td>&gt;Cleanup Level</td>
<td>50 ppm gas range</td>
</tr>
<tr>
<td></td>
<td>Petro hydrocarbons</td>
<td></td>
<td></td>
<td></td>
<td>0.1 ppm benzene</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10 ppm BTEX</td>
</tr>
<tr>
<td>Diesel</td>
<td>Diesel range</td>
<td>8100</td>
<td>Any Amount</td>
<td>&gt;Clean-up Level</td>
<td>100 ppm diesel range</td>
</tr>
</tbody>
</table>

Source: Dave Belyea - Alaska Department of Environmental Conservation • 907-465-2110

<table>
<thead>
<tr>
<th>Product</th>
<th>Parameter</th>
<th>Lab Test Protocol &amp; No.</th>
<th>Notification Level</th>
<th>Action Level</th>
<th>Recommended Clean-up Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline</td>
<td>TPH</td>
<td>B15-181</td>
<td>&gt;100 ppm</td>
<td>&gt;Cleanup level</td>
<td>50 ppm gas range</td>
</tr>
<tr>
<td>Kerosene</td>
<td>Benzene</td>
<td>8030</td>
<td>&gt;130 ppm</td>
<td>&gt;130 ppm</td>
<td>130 ppm</td>
</tr>
<tr>
<td>Jet Fuel</td>
<td>Toluene</td>
<td>8020</td>
<td>&gt;200 ppm</td>
<td>&gt;200 ppm</td>
<td>200 ppm</td>
</tr>
<tr>
<td></td>
<td>Ethyl Benzene</td>
<td>8020</td>
<td>&gt;68 ppm</td>
<td>&gt;68 ppm</td>
<td>68 ppm</td>
</tr>
<tr>
<td></td>
<td>Xylene</td>
<td>8020</td>
<td>&gt;44 ppm</td>
<td>&gt;44 ppm</td>
<td>44 ppm</td>
</tr>
</tbody>
</table>

14 December 1992 Soils
<table>
<thead>
<tr>
<th>Product</th>
<th>Parameter</th>
<th>Lab Test Protocol &amp; No.</th>
<th>Notification Level</th>
<th>Action Level</th>
<th>Recommended Clean-up Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diesel &amp; Heavy Oil</td>
<td>TPH</td>
<td>BLS-181</td>
<td>&gt;100 ppm</td>
<td>&gt;100 ppm</td>
<td>100 ppm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gasoline 1 or 2</td>
<td>TPH</td>
<td>418.1 or Modified 8015</td>
<td>10 ppm</td>
<td>100 ppm</td>
<td>Site Specific</td>
</tr>
<tr>
<td></td>
<td>BTEX Total</td>
<td>8020 or 8240</td>
<td>1 ppb</td>
<td>10 ppm</td>
<td>Site Specific</td>
</tr>
<tr>
<td>Diesel</td>
<td>TPH</td>
<td>418.1 or Modified 8015</td>
<td>10 ppm</td>
<td>100 ppm</td>
<td>Site Specific</td>
</tr>
</tbody>
</table>

**Arkansas**

Soils from Part 280 remediations only.

Source: Jay Fumusa — Arizona Department of Environmental Quality • Underground Storage Tank Section • 602-207-4285

**California***

Values shown are recommended action levels from the California Leaking Underground Fuel Tank (LUFT) Manual. Cleanup levels are site specific.

<table>
<thead>
<tr>
<th>Gasoline</th>
<th>TPH</th>
<th>DHS recommended</th>
<th>1 ppm &gt;10 ppm</th>
<th>&gt;0.3 ppm</th>
<th>0.3 to 1 ppm *</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Benzene</td>
<td>8020</td>
<td>1 ppm</td>
<td>&gt;0.3 ppm</td>
<td>0.3 to 50 ppm *</td>
</tr>
<tr>
<td></td>
<td>Toluene</td>
<td>8020</td>
<td>1 ppm</td>
<td>&gt;1 ppm</td>
<td>1 to 50 ppm *</td>
</tr>
<tr>
<td></td>
<td>Ethyl Benzene</td>
<td>8020</td>
<td>1 ppm</td>
<td>&gt;1 ppm</td>
<td>1 to 50 ppm *</td>
</tr>
<tr>
<td></td>
<td>Xylene</td>
<td>8020</td>
<td>1 ppm</td>
<td>&gt;1 ppm</td>
<td>1 to 50 ppm *</td>
</tr>
<tr>
<td></td>
<td>HVOs</td>
<td>8010</td>
<td>1 ppm</td>
<td>&gt;1 ppm</td>
<td>Site Specific *</td>
</tr>
<tr>
<td>Diesel</td>
<td>TPH</td>
<td>DHS recommended</td>
<td>1 ppm &gt;100 ppm</td>
<td>100 to 10,000 ppm *</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TRPH</td>
<td>418.1</td>
<td>1 ppm &gt;100 ppm</td>
<td>100 to 10,000 ppm *</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Benzene</td>
<td>8020</td>
<td>1 ppm &gt;0.3 ppm</td>
<td>0.3 to 1 ppm *</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Toluene</td>
<td>8020</td>
<td>1 ppm &gt;0.3 ppm</td>
<td>0.3 to 50 ppm *</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ethyl Benzene</td>
<td>8020</td>
<td>1 ppm &gt;1 ppm</td>
<td>1 to 50 ppm *</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Xylene</td>
<td>8020</td>
<td>1 ppm &gt;1 ppm</td>
<td>1 to 50 ppm *</td>
<td></td>
</tr>
</tbody>
</table>

* California has 9 Regional Water Quality Boards throughout the state and 107 sub-jurisdictions. Each jurisdictional unit enforces site specific clean-up levels per the regional basin plan, drinking water standards, detection levels, etc. There are three action levels for TPH and BTEX for sites which fall into categories of low, medium or high leaching potential. The LUFT Manual gives the values for these categories. BTEX levels are not applicable at a TPH concentration of 10 ppm for gasoline or 100 ppm for diesel.

Source: Paul Johnson — California State Water Resources Control Board • 916-739-4400

**Colorado**

Action level is known as “Guidance Level”

<table>
<thead>
<tr>
<th>Gasoline (C6-C10)</th>
<th>TPH</th>
<th>Modified 8015</th>
<th>Any Amount &gt;100 ppm</th>
<th>100 to 500 ppm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diesel</td>
<td>TPH</td>
<td>Modified 8015</td>
<td>Any Amount &gt;20 ppm</td>
<td>20 to 100 ppm</td>
</tr>
</tbody>
</table>

* Continues on page 16

---

**Sen-Tech ENVIRONMENTAL**

**Thermal Remediation Services**

**Why Not Treat Your Petroleum Contaminated Soils On-Site And Avoid The Long-Term Liability Associated With Landfilling . . . . . . .**

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1-708-371-3350 • 1-800-325-SOIL

• Completely Portable
• 25-35 Tons Per Hour
• Quiet, Clean Operations
• Wide Range Of Treatment Capabilities
• Gasolines thru #6 Oil

Write in 318

December 1992 Soils 15
<table>
<thead>
<tr>
<th>Product</th>
<th>Parameter</th>
<th>Lab Test Protocol &amp; No.</th>
<th>Notification Level</th>
<th>Action Level</th>
<th>Recommended Clean-up Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>(C1-C28) &amp; Weathered Gas</td>
<td>BTEX Total</td>
<td>8020</td>
<td>Any Amount</td>
<td>&gt;20 ppm</td>
<td>20 to 100 ppm</td>
</tr>
<tr>
<td>Source: Joelle Robertson — Colorado Department of Health • Underground Storage Tank Division • 303-692-2000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connecticut</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standards are in the process of being revised. Direct inquiries to Peter Zuck — Connecticut Department of Environmental Protection • 203-566-4630</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gasoline</td>
<td>TPH</td>
<td>9071</td>
<td>Any Amount</td>
<td>Site Specific</td>
<td>40 mg/kg (100 ppm at a Class B Site)</td>
</tr>
<tr>
<td>Delaware</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organic Vapor Analysis</td>
<td>OVA with Flame</td>
<td>10 ppm</td>
<td>&gt;500 ppm*</td>
<td>TRPH &lt;10 ppm**</td>
<td></td>
</tr>
<tr>
<td>Diesel, Organic Vapor Analysis</td>
<td>OVA with Flame</td>
<td>10 ppm</td>
<td>&gt;50 ppm*</td>
<td>TRPH &lt;10 ppm**</td>
<td></td>
</tr>
<tr>
<td>Fuel Oil, Bulk Organic Vapor Analysis</td>
<td>OVA with Flame</td>
<td>10 ppm</td>
<td>&gt;50 ppm*</td>
<td>TRPH &lt;10 ppm**</td>
<td></td>
</tr>
<tr>
<td>Florida</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gasoline, Aviation Fuel, Diesel, Kerosene, etc</td>
<td>BTEX Total</td>
<td>602</td>
<td>Any Amount</td>
<td>&gt;20 ppm</td>
<td>&lt;20 ppm*</td>
</tr>
<tr>
<td>Georgia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gasoline</td>
<td>TPH</td>
<td>418.1</td>
<td>Any Amount</td>
<td>&lt;100 ppm</td>
<td>&lt;100 ppm*</td>
</tr>
<tr>
<td>Hawaii</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gasoline</td>
<td>TPH</td>
<td>5030.8015 or LUFT</td>
<td>0.5 ppm, 1.7 ppm</td>
<td>TRPH &lt;10 ppm**</td>
<td></td>
</tr>
<tr>
<td>Benzene</td>
<td>5030.8015, 5030/8020, or 5030/8240</td>
<td>7.0 ppm, 1.4 ppm</td>
<td>TRPH &lt;10 ppm**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethylbenzene</td>
<td>same as Benzene</td>
<td>10.0 ppm, 21.0 ppm</td>
<td>TRPH &lt;10 ppm**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Toluene</td>
<td>same as Benzene</td>
<td></td>
<td>TRPH &lt;10 ppm**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diesel, Jet Fuel TPH</td>
<td>3550/8015, 3540/8270, or 3550/8270 or LUFT</td>
<td>0.5 ppm, 1.7 ppm</td>
<td>TRPH &lt;10 ppm**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kerosene, Benzene</td>
<td>5030.8015, 5030/8020, or 5030/8240</td>
<td>7.0 ppm, 1.4 ppm</td>
<td>TRPH &lt;10 ppm**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethylbenzene</td>
<td>same as Benzene</td>
<td>10.0 ppm, 21.0 ppm</td>
<td>TRPH &lt;10 ppm**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Toluene</td>
<td>same as Benzene</td>
<td></td>
<td>TRPH &lt;10 ppm**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acenaphthene</td>
<td>3540/8310, 3550/8310, 3540/8270, or 3550/8270</td>
<td>100 ppm, 100 ppm</td>
<td>TRPH &lt;10 ppm**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Naphthalene</td>
<td>same as Acenaphthene</td>
<td></td>
<td>TRPH &lt;10 ppm**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluoranthene</td>
<td>same as Acenaphthene</td>
<td></td>
<td>TRPH &lt;10 ppm**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benzo(a)pyrene</td>
<td>same as Acenaphthene</td>
<td></td>
<td>TRPH &lt;10 ppm**</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

No cleanup criteria based on TPH, however that does not preclude use as screening method. The first figure given in ppm is above the drinking water. 

Continues on page 18
Griffolyn: Control and Containment for Your Contaminated Soil Problems

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

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

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Reef Industries, Inc.
P.O. Box 750250
Houston, Texas 77275-0250
In Texas or outside the continental U.S. call collect 713-943-0070
Fax: 713-947-2053
<table>
<thead>
<tr>
<th>State-by-state summary, from page 16</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Product</strong></td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>Gasoline</td>
</tr>
<tr>
<td>Diesel</td>
</tr>
<tr>
<td>* Washington, California or TPH methods with limitations defined by Idaho.</td>
</tr>
<tr>
<td>Source: Carolyn Winters—Hawaii Department of Health • Environmental Management Division • 808-586-4225</td>
</tr>
<tr>
<td>-----------------------------</td>
</tr>
<tr>
<td><strong>Idaho</strong></td>
</tr>
<tr>
<td>-----------------------------</td>
</tr>
<tr>
<td>Gasoline- Benzene</td>
</tr>
<tr>
<td>Middle Distillate Fuels(MDF) - Aviation Jet, Diesel, Gas Turbine, Heating Fuel, Illuminating Oils, Kerosene</td>
</tr>
<tr>
<td>Benzene</td>
</tr>
<tr>
<td>Naphthalene</td>
</tr>
<tr>
<td>Acenaphthene</td>
</tr>
<tr>
<td>Anthracene</td>
</tr>
<tr>
<td>Fluoranthene</td>
</tr>
<tr>
<td>Fluorene</td>
</tr>
<tr>
<td>Pyrene</td>
</tr>
<tr>
<td>Total Carcinogenic PNAs</td>
</tr>
<tr>
<td>Total Non-Carcinogenic PNAs</td>
</tr>
<tr>
<td>*Any SW-846 analytical lab procedure (USEPA) methods 5030, 8020, 8240 and 8310 may be used to determine contaminant levels as long as the method chosen meets the acceptable detection limits listed.</td>
</tr>
<tr>
<td>Source: G. Tod Kowe — Leaking Underground Storage Tank Section • Illinois Environmental Protection Agency • 217-782-6761</td>
</tr>
<tr>
<td>-----------------------------</td>
</tr>
<tr>
<td><strong>Indiana</strong></td>
</tr>
<tr>
<td>Gasoline, Kerosene</td>
</tr>
<tr>
<td>Gasoline, Naptha, diesel</td>
</tr>
<tr>
<td>Waste Oil</td>
</tr>
<tr>
<td>Source: Lynette Fogle — Indiana Department of Environmental Management • Office of Environmental Response • UST Program • 317-240-6215</td>
</tr>
<tr>
<td>-----------------------------</td>
</tr>
<tr>
<td><strong>Iowa</strong></td>
</tr>
<tr>
<td>Gasoline</td>
</tr>
<tr>
<td>Diesel</td>
</tr>
<tr>
<td>Administrative rules effective in February 1992 establish procedures for preparing a site cleanup report and determining the site risk classification. Sites classified as high risk must be remediated to these levels.</td>
</tr>
<tr>
<td>Source: Jim Humeston - Iowa Department of Natural Resources • 515-281-8957</td>
</tr>
<tr>
<td>-----------------------------</td>
</tr>
<tr>
<td><strong>Kansas</strong></td>
</tr>
<tr>
<td>Gasoline</td>
</tr>
<tr>
<td>Diesel</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>* TPH analysis must use extraction and detection methods which are appropriate for lighter hydrocarbon fractions.</td>
</tr>
<tr>
<td>** TPH analysis must use extraction and detection methods which are appropriate for heavier hydrocarbon fractions.</td>
</tr>
<tr>
<td>Source: Thomas Winn — Kansas Department of Health and Environment • Storage Tank Section • 913-296-1500</td>
</tr>
<tr>
<td>-----------------------------</td>
</tr>
<tr>
<td><strong>Kentucky</strong></td>
</tr>
<tr>
<td>Gasoline</td>
</tr>
<tr>
<td>Diesel</td>
</tr>
<tr>
<td>Source: Doyle Mills — Kentucky Department for Environmental Protection • 501-564-6716</td>
</tr>
<tr>
<td>-----------------------------</td>
</tr>
<tr>
<td><strong>Louisiana</strong></td>
</tr>
<tr>
<td>Gasoline</td>
</tr>
<tr>
<td>Diesel</td>
</tr>
<tr>
<td>Source: Brenda Coon — Louisiana Department of Environmental Quality • Office of Solid and Hazardous Waste • 504-765-0243</td>
</tr>
<tr>
<td>-----------------------------</td>
</tr>
<tr>
<td><strong>Maine</strong></td>
</tr>
<tr>
<td>Gasoline</td>
</tr>
<tr>
<td>Diesel</td>
</tr>
<tr>
<td>Source: Fred LaValle—Maine Department of Environmental Protection • Bureau of Hazardous Materials and Solid Waste Control • 207-289-7688</td>
</tr>
</tbody>
</table>

18 December 1992 Soils
<table>
<thead>
<tr>
<th>Product, Parameter</th>
<th>Lab Test Protocol &amp; No.</th>
<th>Notification Level</th>
<th>Action Level</th>
<th>Recommended Clean-up Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline, Diesel TPH</td>
<td>Modified 418.1</td>
<td>Any Amount</td>
<td>&gt;Background</td>
<td>Non-detectable or Equal to background levels*</td>
</tr>
<tr>
<td>BTEX</td>
<td>601, 602, 624, or 625 based on field screening</td>
<td>Any Amount</td>
<td>&gt;Background</td>
<td>Non-detectable or Equal to background levels</td>
</tr>
<tr>
<td>MTBE</td>
<td>601, 602, 624, or 625 based on field screening</td>
<td>Any Amount</td>
<td>&gt;Background</td>
<td>Non-detectable or Equal to background levels</td>
</tr>
</tbody>
</table>

* 100 TPH ppm proposed for underground tank soils only that remain in the excavation.

Source: Bill Seiger—Maryland Department of Environment • UST Program • 410-631-3442

**Massachusetts**

Currently there are no promulgated cleanup standards for site remediation. All decisions on "how clean is clean" are made via a site-specific risk characterization, based upon risk management standards promulgated in state regulations CMR 40.00, and risk assessment guidance contained in Guidance for Disposal Site Characterization and Related Phase II Activities in Support of the Massachusetts Contingency Plan, May 17, 1989. Statewide regulations and guidance on the proper assessment and cleanup of petroleum contaminated sites should be in place by July 1993.

<table>
<thead>
<tr>
<th>Gasoline</th>
<th>Benzene</th>
<th>602</th>
<th>20 ppb</th>
<th>&gt;20 ppb</th>
<th>≤1.4 ppb</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Toluene</td>
<td>602</td>
<td>16 ppb</td>
<td>&gt;16 ppb</td>
<td>≤16.0 ppb</td>
</tr>
<tr>
<td></td>
<td>Ethyl Benzene</td>
<td>602</td>
<td>1.4 ppb</td>
<td>&gt;1.4 ppb</td>
<td>≤1.4 ppb</td>
</tr>
<tr>
<td></td>
<td>Xylene</td>
<td>602</td>
<td>6.0 ppb</td>
<td>&gt;6.0 ppb</td>
<td>≤6.0 ppb (total)</td>
</tr>
<tr>
<td>Diesel, Kerosene, TPH</td>
<td>418.1</td>
<td>100 ppm</td>
<td>&gt;100 ppm</td>
<td>≤100 ppm</td>
<td></td>
</tr>
<tr>
<td>light petroleum</td>
<td>Benzene</td>
<td>602</td>
<td>20 ppb</td>
<td>&gt;20 ppb</td>
<td>≤20 ppb</td>
</tr>
<tr>
<td>products, Naptha, Toluene</td>
<td>602</td>
<td>16 ppb</td>
<td>&gt;16 ppb</td>
<td>≤16 ppb</td>
<td></td>
</tr>
<tr>
<td>Mineral Spirits, Ethyl Benzene</td>
<td>602</td>
<td>1.4 ppb</td>
<td>&gt;1.4 ppb</td>
<td>≤1.4 ppb</td>
<td></td>
</tr>
<tr>
<td>New Oil or Xylene</td>
<td>602</td>
<td>6.0 ppb</td>
<td>&gt;6.0 ppb</td>
<td>≤6.0 ppb (total)</td>
<td></td>
</tr>
<tr>
<td>Waste Oils</td>
<td>PNA</td>
<td>8100 or 8270</td>
<td>300 ppb</td>
<td>&gt;300 ppb</td>
<td>≤300 ppb</td>
</tr>
</tbody>
</table>

Values given are for soils according to Act 307, Type B, 1/8/92 standards. Different criteria exist for health based drinking water, aesthetic drinking water, direct contact in soils and surface water environmental protection.

Source: George Carpenter — Michigan Dept. of Natural Resources • Environmental Response Division • 517-373-8815

**Michigan**

**Gasoline**

<table>
<thead>
<tr>
<th>TPH</th>
<th>418.1</th>
<th>100 ppm</th>
<th>&gt;100 ppm</th>
<th>≤100 ppm</th>
</tr>
</thead>
<tbody>
<tr>
<td>BTEX Total</td>
<td>*</td>
<td>Any Amount</td>
<td>≥40 ppm**</td>
<td>Site Specific****</td>
</tr>
<tr>
<td>MTBE</td>
<td>*</td>
<td>Any Amount</td>
<td>≥40 ppm**</td>
<td>Site Specific****</td>
</tr>
</tbody>
</table>

*Continues on page 20→

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PHONE: 515-322-4220, FAX: 515-322-3527

Write in 279

December 1992 Soils 19
<table>
<thead>
<tr>
<th>Product &amp; Parameter</th>
<th>Lab Test Protocol &amp; No.</th>
<th>Notification Level</th>
<th>Action Level</th>
<th>Recommended Clean-up Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline 2 BTEX</td>
<td>*</td>
<td>Any Amount ≥40 ppm**</td>
<td>Site Specific**</td>
<td></td>
</tr>
<tr>
<td>Gasoline 2 MTBE</td>
<td>*</td>
<td>Any Amount ≥40 ppm**</td>
<td>Site Specific**</td>
<td></td>
</tr>
<tr>
<td>Gasoline 2 TPH</td>
<td>*</td>
<td>Any Amount ≥40 ppm**</td>
<td>Site Specific**</td>
<td></td>
</tr>
<tr>
<td>Diesel, Kerosene, BTEX</td>
<td>*</td>
<td>Any Amount ≥10 ppm***</td>
<td>Site Specific***</td>
<td></td>
</tr>
<tr>
<td>Jet Fuel, Fuel Oil TPH-fuel oil</td>
<td>*</td>
<td>Any Amount ≥10 ppm***</td>
<td>Site Specific***</td>
<td></td>
</tr>
</tbody>
</table>

* All samples unless specifically noted, should be analyzed using a US EPA approved method or equivalent.

** Soil vapor headspace analysis ≥40 ppm.

*** Visual evidence of contamination or soil vapor headspace ≥10 ppm.

**** Additional investigation needed if base, sidewall soil samples are >50 ppm TPH for sands and gravels, >100 ppm TPH for silts and clays.

Source: Chris Zadaka — Minnesota Pollution Control Agency • 612-297-8318

<table>
<thead>
<tr>
<th>Mississippi</th>
<th>Gasoline 1 or 2 BTEX Total</th>
<th>602, 624, 8020, or 8240</th>
<th>100 ppm</th>
<th>100 ppm</th>
<th>100 ppm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diesel &amp; TPH</td>
<td>418.1 or Miss. method</td>
<td>100 ppm</td>
<td>100 ppm</td>
<td>100 ppm</td>
<td></td>
</tr>
</tbody>
</table>

* Levels applicable at sites where there are no environmentally sensitive receptors; i.e. public and or private wells, etc.

Source: Linda Vaught - Missouri Department of Environmental Quality • 601-961-5171

| Missouri | Gasoline & Diesel TPH | 418.1 Modified | 25 ppm > 50 ppm | 50 to 50 ppm 5
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Diesel</td>
<td>BTEX Total</td>
<td>8020</td>
<td>1 ppm ≥ 2 ppm</td>
<td>&lt;2 ppm 5</td>
</tr>
<tr>
<td></td>
<td>Toluene</td>
<td>0.5 ppm</td>
<td>1 to 10 ppm</td>
<td>≤ 5 ppm</td>
</tr>
<tr>
<td></td>
<td>Ethyl Benzene</td>
<td>2 to 50 ppm</td>
<td>20 to 50 ppm</td>
<td>≤ 5 ppm</td>
</tr>
<tr>
<td></td>
<td>Xylene</td>
<td>25 ppm &gt; 50 ppm</td>
<td>50 to 500 ppm 5</td>
<td></td>
</tr>
<tr>
<td>Waste Oil &amp; Fuel Oils</td>
<td>TPH</td>
<td>418.1 Modified</td>
<td>25 ppm &gt; 2 ppm</td>
<td>2 to 112 ppm</td>
</tr>
<tr>
<td>Waste Oil Only</td>
<td>Heavy Metals</td>
<td>1310</td>
<td>1 ppm &gt; 100 ppm</td>
<td>Site Specific</td>
</tr>
</tbody>
</table>

Source: John Crawshaw — Missouri Department of Natural Resources • 816-755-8655

<table>
<thead>
<tr>
<th>Montana</th>
<th>Gasoline TPH</th>
<th>Modified 8015, GRO*</th>
<th>100 ppm &gt;100 ppm</th>
<th>≤100 ppm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diesel</td>
<td>Toluene</td>
<td>EPA 602/8020</td>
<td>1 ppm &gt;1 ppm</td>
<td>≤1 ppm</td>
</tr>
<tr>
<td></td>
<td>BTEX Total</td>
<td>EPA 602/8020</td>
<td>10 ppm &gt;10 ppm</td>
<td>≤10 ppm</td>
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<tr>
<td></td>
<td>TPH</td>
<td>DRO, 8015 mod., 418.1 site specific</td>
<td>100 ppm &gt;100 ppm</td>
<td>≤100 ppm</td>
</tr>
</tbody>
</table>

Source: Pat Newby - Montana Department of Health & Environmental Sciences • Underground Storage Tank Program • 406-444-5970

<table>
<thead>
<tr>
<th>Nebraska</th>
<th>Gasoline 1 TRPH</th>
<th>418.1</th>
<th>Any Amount</th>
<th>Site Specific *</th>
<th>200C ppb **</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline 2 Benzene</td>
<td>8020, 8240</td>
<td>Any Amount</td>
<td>Site Specific *</td>
<td>5 ppb **</td>
<td></td>
</tr>
<tr>
<td>Diesel   Toluene</td>
<td>8020, 8240</td>
<td>Any Amount</td>
<td>Site Specific *</td>
<td>100C ppb **</td>
<td></td>
</tr>
</tbody>
</table>

* Action levels are based on remedial activity required to get groundwater to the specified levels.

** Cleanup levels in groundwater

Source: Marc Fisher - Nebraska Department of Environmental Control • 402-471-4230

<table>
<thead>
<tr>
<th>Nevada</th>
<th>Gasoline &amp; Diesel TPH</th>
<th>Modified 8015</th>
<th>Evidence of a 25 &gt;100 ppm</th>
<th>&lt;100 ppm</th>
</tr>
</thead>
</table>

Source: Larry Woods — Nevada Division of Environmental Protection • 702-687-5872

<table>
<thead>
<tr>
<th>New Hampshire</th>
<th>Gasoline TPH as gasoline</th>
<th>8020, 8240, 8260</th>
<th>Any Amount &gt;10 ppm</th>
<th>10 ppm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diesel or BTEX as fuel oil</td>
<td>8020, 8240, 8260</td>
<td>Any Amount &gt;1 ppm</td>
<td>1 ppm</td>
<td></td>
</tr>
<tr>
<td>Motor Fuel Oils, TPH as fuel oil</td>
<td>8020, 8240, 8260</td>
<td>Any Amount &gt;100 ppm</td>
<td>100 ppm</td>
<td></td>
</tr>
<tr>
<td>Heating Oils, TPH as fuel oil</td>
<td>8020, 8240, 8260</td>
<td>Any Amount &gt;10 ppm</td>
<td>10 ppm</td>
<td></td>
</tr>
</tbody>
</table>

*For known gasoline spills, TPH methodology is by purge and trap concentration followed by GC/FID or GC/MS analysis (8015 or other WSPCD approved method.) For other fuel oils, methodology is by extraction followed by GC/FID analysis, modified EPA method 8100 or other WSPCD approved alternate.

Source: Greg Kirby — New Hampshire Department of Environmental Services • 603-271-3503

<table>
<thead>
<tr>
<th>New Jersey</th>
<th>Gasoline, Benzene</th>
<th>Any Amount</th>
<th>3 mg/kg**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diesel Ethylbenzene</td>
<td>Any Amount</td>
<td>100 mg/kg**</td>
<td></td>
</tr>
<tr>
<td>Toluene ** Xylenes (Total)</td>
<td>Any Amount</td>
<td>500 mg/kg**</td>
<td></td>
</tr>
</tbody>
</table>

*Any US EPA SW-846 analytical method (8240, 8250, 8270) is acceptable. **Subsurface standards.

Source: Kevin Kratina—New Jersey Department of Environmental Protection & Energy • Division of Responsible Party Remediation • 609-984-3156

<table>
<thead>
<tr>
<th>New Mexico</th>
<th>Gasoline 1 Benzene</th>
<th>M8015, 8020, 8240</th>
<th>10 ppm</th>
<th>10 ppm</th>
<th>10 ppm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M8015, 8020, 8240</td>
<td>50 ppm</td>
<td>50 ppm</td>
<td>50 ppm</td>
<td></td>
</tr>
</tbody>
</table>

20 December 1992 Soils
<table>
<thead>
<tr>
<th>Product</th>
<th>Parameter</th>
<th>Lab Test Protocol &amp; No.</th>
<th>Notification Level</th>
<th>Action Level</th>
<th>Recommended Clean-up Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>BTEX Total with PID or FID (Headspace Analysis)</td>
<td></td>
<td></td>
<td>100 ppm</td>
<td>100 ppm</td>
<td>100 ppm</td>
</tr>
<tr>
<td>Diesel</td>
<td>TPH</td>
<td>418.1 – Freon Ext.</td>
<td>100 ppm</td>
<td>100 ppm</td>
<td>100 ppm</td>
</tr>
<tr>
<td></td>
<td>TPH</td>
<td>M8015–Methylene</td>
<td>100 ppm</td>
<td>100 ppm</td>
<td>100 ppm</td>
</tr>
<tr>
<td></td>
<td>Chloride Extraction</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Anna Richards — New Mexico Environment Department • 505–827–0079

| Gasoline             | Benzene              | 8021 (8020)             | Any Amount 0.7 ppm | 2.4 x 10 ppm  |
|                      | Toluene              | 8021 (8020)             | Any Amount 5 ppm   | 2.0 x 10 ppm  |
|                      | Ethyl Benzene        | 8021 (8020)             | Any Amount 5 ppm   | 8.0 x 10 ppm  |
|                      | Mixed Xylenes        | 8021 (8020)             | Any Amount 5 ppm   | 2.0 x 10 ppm  |
|                      | Naphthalene          | 8021                    | Any Amount 10 ppm  | 3.0 x 10 ppm  |
| Fuel Oil             | Benzene              | 8021 (8020)             | Any Amount 0.7 ppm | 2.4 x 10 ppm  |
|                      | Toluene              | 8021 (8020)             | Any Amount 5 ppm   | 2.0 x 10 ppm  |
|                      | Ethyl Benzene        | 8021 (8020)             | Any Amount Site Specific | 8.0 x 10 ppm  |
|                      | Mixed Xylenes        | 8021 (8020)             | Any Amount Site Specific | * |
|                      | Naphthalene          | 8021                    | Any Amount 10 ppm  | 3.0 x 10 ppm  |
|                      | Anthracene           | 8270                    | Any Amount 50 ppm  | 2.0 x 10 ppm  |
|                      | Fluorene             | 8270                    | Any Amount 50 ppm  | 3.0 x 10 ppm  |
|                      | Phenanthrene         | 8270                    | Any Amount 50 ppm  | * |
|                      | Pyrene               | 8270                    | Any Amount 50 ppm  | 2.0 x 10 ppm  |
|                      | Acenaphthene         | 8270                    | Any Amount 50 ppm  | 5.0 x 10 ppm  |
|                      | Benzo(a)anthracene   | 8270                    | Any Amount 0.002 ppm | 220 ppm     |
|                      | Fluoranthene         | 8270                    | Any Amount 50 ppm  | 3.0 x 10 ppm  |
|                      | Benzo(b)fluoranthene | 8270                    | Any Amount 0.002 ppm | 220 ppm     |
|                      | Benzo(k)fluoranthene | 8270                    | Any Amount 0.002 ppm | 220 ppm     |
|                      | Chrysene             | 8270                    | Any Amount 0.002 ppm | * |
|                      | Benzo(a)pyrene       | 8270                    | Any Amount 0.002 ppm | 61 ppm      |
|                      | Benzo(g,h,i)perylene| 8270                    | Any Amount 0.002 ppm | *          |
|                      | Indeno[1,2,3-cd]pyrene| 8270                  | Any Amount 0.002 ppm | 14 ppm      |
|                      | Dibenzo(a,h)anthracene| 8270               | Any Amount 50 ppm  | 14 ppm       |

*No values identified. **No TPH

The TCLP Extraction Guidance Values are equal to the NYSDEC groundwater quality standards or the NYSDOH drinking water quality standards or guidance values, whichever is more stringent. Satisfactory soil will meet the groundwater standards for each compound of concern as determined by the TCLP and subsequent analysis, and the human health guidance value for each compound.

Source: Christopher O'Neill — Bureau of Spill Prevention & Response • N.Y. State Department of Environmental Conservation • 518-457-4351

---

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Write in 317

Write in 321

December 1992 Soils 21
## State-by-state summary, from page 20

<table>
<thead>
<tr>
<th>State</th>
<th>Parameter</th>
<th>Lab Test Protocol &amp; No.</th>
<th>Notification Level</th>
<th>Action Level</th>
<th>Recommended Clean-up Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>North Carolina</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gasoline</td>
<td>TPH</td>
<td>418.1 or DHS*</td>
<td>Any Amount 100 ppm</td>
<td>&lt; 100 ppm</td>
<td></td>
</tr>
<tr>
<td>&amp; Diesel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*California Department of Health Services Method</td>
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<td><strong>North Dakota</strong></td>
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<tr>
<td>Gasoline</td>
<td>TPH</td>
<td>8015</td>
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<td>Site Specific***</td>
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<td></td>
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<td>Any Amount**</td>
<td>Site Specific***</td>
<td>Site Specific***</td>
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<tr>
<td>Middle</td>
<td>BTEx</td>
<td>8020</td>
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<td>Site Specific***</td>
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<td>Distillates</td>
<td>Aromatic Hydrocarbons</td>
<td>8100 modified TPH</td>
<td>Any Amount**</td>
<td>Site Specific***</td>
<td>Site Specific***</td>
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<td>TPH</td>
<td>418.1</td>
<td>Any Amount**</td>
<td>Site Specific***</td>
<td>Site Specific***</td>
</tr>
<tr>
<td>*Kerosene, diesel fuel, jet fuel and light oils</td>
<td></td>
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<tr>
<td><strong>Ohio</strong></td>
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<tr>
<td>Gasoline</td>
<td>TPH</td>
<td>8015</td>
<td>Any Amount &gt;50 ppm</td>
<td>50 ppm*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Any Amount &gt;0.5 ppm</td>
<td>0.5 ppm*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Any Amount &gt;40 ppm</td>
<td>40 ppm*</td>
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<tr>
<td></td>
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<td></td>
<td>Any Amount &gt;15 ppm</td>
<td>15 ppm*</td>
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<tr>
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<td></td>
<td>Any Amount &gt;200 ppm</td>
<td>200 ppm*</td>
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<tr>
<td>*Spills or overfills of 25 gallons or less that do not reach a surface water body and that are cleaned up within 24 hours need not be reported.</td>
<td></td>
<td></td>
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<tr>
<td><strong>Oklahoma</strong></td>
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</tr>
<tr>
<td>Gasoline,</td>
<td>TPH</td>
<td>8015</td>
<td>Any Amount</td>
<td>Further Testing Required</td>
<td>Site Specific**</td>
</tr>
<tr>
<td>Diesel and</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Kerosene</td>
<td>Toluene</td>
<td>8020</td>
<td>Any Amount &gt;50 ppm</td>
<td></td>
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<tr>
<td></td>
<td>Ethylbenzene</td>
<td>8020</td>
<td>Any Amount &gt;0.5 ppm</td>
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</tr>
<tr>
<td></td>
<td>Xylene</td>
<td>8020</td>
<td>Any Amount &gt;40 ppm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>*Oklahoma uses a Remediation Index to determine cleanup standards on a site by site basis.</td>
<td></td>
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<tr>
<td><strong>Oregon</strong></td>
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<tr>
<td>All Petroleum Hydrocarbons</td>
<td>TPH-HCID*</td>
<td>Any Amount</td>
<td>Any Amount</td>
<td>Further Testing Required</td>
<td>Site Specific**</td>
</tr>
<tr>
<td>Products</td>
<td></td>
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</tr>
<tr>
<td>Gasoline</td>
<td>Gasoline Range Organics</td>
<td>TPH-G*</td>
<td>Any Amount</td>
<td>Site-Specific**</td>
<td>40-133 ppm**</td>
</tr>
<tr>
<td>Diesel, Heating</td>
<td>Diesel Range Organics</td>
<td>TPH-D*</td>
<td>Any Amount</td>
<td>Site-Specific**</td>
<td>100-1300 ppm**</td>
</tr>
<tr>
<td>Oil &amp; Kerosene</td>
<td>Organics</td>
<td>SW 846 Method</td>
<td>Any Amount</td>
<td>Site-Specific**</td>
<td></td>
</tr>
<tr>
<td>*Analytical Methods available from the Oregon Department of Environmental Quality</td>
<td></td>
<td></td>
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<td><strong>Pennsylvania</strong></td>
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</tr>
<tr>
<td>Gasoline and</td>
<td>TPH</td>
<td>GC/FID Method</td>
<td>Any Amount</td>
<td>Site Specific</td>
<td>10 ppm</td>
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<tr>
<td>Benzene</td>
<td>8020</td>
<td></td>
<td>Any Amount</td>
<td>Site Specific</td>
<td>.01 ppm</td>
</tr>
<tr>
<td>Toluene</td>
<td>8020</td>
<td></td>
<td>Any Amount</td>
<td>Site Specific</td>
<td>.02 ppm</td>
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<tr>
<td>Ethyl Benzene</td>
<td>8020</td>
<td></td>
<td>Any Amount</td>
<td>Site Specific</td>
<td>.02 ppm</td>
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<tr>
<td>Xylene</td>
<td>8020</td>
<td></td>
<td>Any Amount</td>
<td>Site Specific</td>
<td>.07 ppm</td>
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<tr>
<td>Gasoline</td>
<td>Lead</td>
<td>Not Specified</td>
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<td>Site Specific</td>
<td>Site Specific</td>
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<tr>
<td></td>
<td>Heavy Metals</td>
<td>1310</td>
<td>Any Amount</td>
<td>Site Specific</td>
<td>Site Specific</td>
</tr>
<tr>
<td>*Cleanup levels are determined on site proximity to groundwater and threat to health and human safety. Analytic test methods are being revised to target specific ranges of organic compounds. Source: Doug Cordelli — Pennsylvania Department of Environmental Resources • Storage Tank Program • 717-657-4080</td>
<td></td>
<td></td>
<td></td>
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<td>Gasoline</td>
<td>VOCs***</td>
<td>Organic Vapor Anal. and 8240</td>
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<td>&gt;40 ppm****</td>
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<tr>
<td>Diesel</td>
<td>TPH**</td>
<td>418.1</td>
<td>Any Amount &gt;100 ppm***</td>
<td>&gt;300 ppm****</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>418.1</td>
<td>Any Amount &gt;100 ppm***</td>
<td>&gt;300 ppm****</td>
<td></td>
</tr>
<tr>
<td>*Recommended cleanup levels are based on nature of contaminant, classification of subject property, groundwater contamination potential, and for soil vapor transport factors. ** Field inspectors are on-site at all tank removals and screen soils with an organic vapor analyzer; further analytic investigation is determined by inspectors *** Denotes groundwater sensitive areas. Source: Bruce Catterall and Dave Sheldon — R.I. Department of Environmental Management • Underground Storage Tank Section • 401-277-2234</td>
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<tr>
<td><strong>South Carolina</strong></td>
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<td>GC/FID Method</td>
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<td>BTEX</td>
<td>8020</td>
<td>Any Amount</td>
<td>Site Specific</td>
<td>Site Specific</td>
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<tr>
<td></td>
<td>Naphthalene</td>
<td>8100</td>
<td>Any Amount</td>
<td>Site Specific</td>
<td>Site Specific</td>
</tr>
<tr>
<td>*Recommended cleanup levels are based on nature of contaminant, classification of subject property, groundwater contamination potential, and for soil vapor transport factors. ** Field inspectors are on-site at all tank removals and screen soils with an organic vapor analyzer; further analytic investigation is determined by inspectors *** Denotes groundwater sensitive areas. Source: Mark Berenbrok — South Carolina Department of Health and Environmental Control • Underground Storage Tank Section • 803-734-5331</td>
<td></td>
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Source: Gary Berreth • 701-221-5166

Source: Raymond Row — Ohio Department of Commerce • Underground Storage Tank Division • 614-752-7941

Source: Oklahoma Corporation Commission • Underground Storage Tank Program • 405-521-3107

Source: Larry Frost — Oregon Department of Environmental Quality • Underground Storage Tank Program • 503-229-5769

Source: Doug Cordelli — Pennsylvania Department of Environmental Resources • Storage Tank Program • 717-657-4080

Source: Bruce Catterall and Dave Sheldon — R.I. Department of Environmental Management • Underground Storage Tank Section • 401-277-2234

Source: Mark Berenbrok — South Carolina Department of Health and Environmental Control • Underground Storage Tank Section • 803-734-5331
<table>
<thead>
<tr>
<th>Product</th>
<th>Parameter</th>
<th>Lab Test Protocol &amp; No.</th>
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<th>Recommended Clean-up Level</th>
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<tr>
<td>Gasoline</td>
<td>TPH</td>
<td>CDHS *</td>
<td>10 ppm</td>
<td>&gt;10 ppm ***</td>
<td>10 to 100 ppm **</td>
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<tr>
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<td>Benzene</td>
<td>8020 or 8240</td>
<td></td>
<td>Report Findings</td>
<td>Site Specific</td>
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<td>Toluene</td>
<td>8020 or 8240</td>
<td></td>
<td>Report Findings</td>
<td>Site Specific</td>
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<tr>
<td></td>
<td>Ethyl Benzene</td>
<td>8020 or 8240</td>
<td></td>
<td>Report Findings</td>
<td>Site Specific</td>
</tr>
<tr>
<td></td>
<td>Xylene</td>
<td>8020 or 8240</td>
<td></td>
<td>Report Findings</td>
<td>Site Specific</td>
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<td>Lead</td>
<td>1310</td>
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<td>MTBE</td>
<td>8010</td>
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<td>Diesel</td>
<td>TPH</td>
<td>CDHS *</td>
<td>10 ppm</td>
<td>&gt;10 ppm ***</td>
<td>10 to 100 ppm **</td>
</tr>
</tbody>
</table>


** Cleanup Level determined by groundwater depth & other site factors

*** TPH Action Level > 10 ppm triggers need to run appropriate BTEX, Lead, MTBE, Heavy Metals, and PCB analyses.

Source: Doug Miller — South Dakota DENR • 605-773-3296

<table>
<thead>
<tr>
<th>Tennessee</th>
<th>TPH Modified 418.1</th>
<th>100 ppm</th>
<th>&gt;100 ppm</th>
<th>100 ppm *</th>
</tr>
</thead>
<tbody>
<tr>
<td>or Diesel BTEX Total</td>
<td>5030, 8020, 8240</td>
<td>10 ppm</td>
<td>&gt;10 ppm</td>
<td>10 ppm *</td>
</tr>
</tbody>
</table>

* Cleanup Levels as high as 1000 ppm TPH & 500 BTEX may be allowed if soil permeability and groundwater studies justify.

Source: Curtis Hopper — Tennessee Department of Environment and Conservation • 615-741-4081

| Texas | TPH 418.1 | Any Amount | 100 ppm | 100 ppm * |
|       | BTEX Total 8020/5030 | Any Amount | 30 ppm | 30 ppm * |

* Cleanup levels applicable where there is no threat to the groundwater table or health & human safety.

Source: Tanya Pena — Texas Water Commission • UST Program • 512-908-2247

| Utah | TPH Modified 8015 | 1 ppm | 10 ppm | 30 to 300 ppm * |
|      | Benzene 8020 | 200 ppb | >200 ppb | 0.2 to 1 ppm * |
|      | Toluene 8020 | 200 ppb | >200 ppb | 100 to 300 ppm * |
|      | Ethyl Benzene 8020 | 200 ppb | >200 ppb | 70 to 600 ppm * |
|      | Xylene 8020 | 200 ppb | >200 ppb | 1000 to 10,000 ppm * |
|      | Naphthalene 8020 | 200 ppb | >200 ppb | 2.0 to 10 ppm * |
| Gasoline 2 | Lead 7421 | 10 ppm | >10 ppm | 100 to 1000 ppm * |
| Diesel | TPH Modified 8015 | 1 ppm | >1 ppm | 100 to 500 ppm * |
|        | Benzene 8020 | 200 ppb | >200 ppb | 0.2 to 1 ppm * |
|        | Toluene 8020 | 200 ppb | >200 ppb | 100 to 900 ppm * |
|        | Ethyl Benzene 8020 | 200 ppb | >200 ppb | 70 to 600 ppm * |
|        | Xylene 8020 | 200 ppb | >200 ppb | 1000 to 10,000 ppm * |
|        | Naphthalene 8020 | 200 ppb | >200 ppb | 2.0 to 10 ppm * |
| Waste Oil | TPH 418.1 | 200 ppm | >200 ppm | 100 to 500 ppm * |
|        | Oil & Grease 413.1 | 200 ppm | >200 ppm | 300 to 1100 ppm * |
|        | Benzol(aryl) 8100 | 200 ppm | >200 ppb | 0.2 to 0.2 ppm * |

* Recommended cleanup levels are based on site proximity to groundwater and potential threat to health and human safety. Utah uses site environmental sensitivity data to determine site cleanup standards on a case-by-case basis.

Source: Robin Davis Jenkins — Utah Division of Environmental Health • 801-536-4100

<table>
<thead>
<tr>
<th>Vermont</th>
<th>TPH as Volatiles</th>
<th>20 ppm by PID</th>
<th>Site Specific *</th>
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<tbody>
<tr>
<td>BTEX Total</td>
<td>Any Amount</td>
<td>20 times MCLS</td>
<td>Site-Specific *</td>
</tr>
</tbody>
</table>

* Additional analytic testing for specific contaminants may be required when preliminary data is received.

Source: Chuck Schwer — Vermont Agency of Natural Resources • Hazardous Materials Management Division • 802-244-8702

<table>
<thead>
<tr>
<th>Virginia</th>
<th>TPH</th>
<th>Any Amount</th>
<th>Site Specific</th>
<th>Site Specific</th>
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</thead>
<tbody>
<tr>
<td>Gasoline</td>
<td>EPA approved</td>
<td>Any Amount</td>
<td>Site Specific</td>
<td>Site Specific</td>
</tr>
</tbody>
</table>

Source: Dave Chance — Virginia Water Control Board • 804-527-5000

<table>
<thead>
<tr>
<th>Washington</th>
<th>TPH WTPH — G **</th>
<th>Any Level *</th>
<th>&gt;100 ppm</th>
<th>100 ppm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline 1</td>
<td>Benzene 8020 or 8240</td>
<td>Any Level *</td>
<td>&gt;0.5 ppm</td>
<td>0.5 ppm</td>
</tr>
<tr>
<td></td>
<td>Toluene 8020 or 8240</td>
<td>Any Level *</td>
<td>&gt;40 ppm</td>
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<tr>
<td></td>
<td>Ethyl Benzene 8020 or 8240</td>
<td>Any Level *</td>
<td>&gt;20 ppm</td>
<td>20 ppm</td>
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<td></td>
<td>Xylene 8020 or 8240</td>
<td>Any Level *</td>
<td>&gt;20 ppm</td>
<td>20 ppm</td>
</tr>
<tr>
<td>Diesel</td>
<td>TPH WTPH — D **</td>
<td>Any Level *</td>
<td>&gt;200 ppm</td>
<td>200 ppm</td>
</tr>
</tbody>
</table>

* Values must be reported only in conjunction with tank closures.

** Methods available from Washington Department of Ecology in Appendix L of WAC 173-340; titled "Total Petroleum Hydrocarbons Analytical Methods (WTPH)."

Source: Lynn Coleman — Washington Department of Ecology • 206-438-3073

<table>
<thead>
<tr>
<th>West Virginia</th>
<th>TPH 8015 modified</th>
<th>&gt;100 ppm</th>
<th>Site Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kerosene</td>
<td>Any Amount</td>
<td>&gt;10 ppm</td>
<td>Site Specific</td>
</tr>
<tr>
<td>Diesel &amp; TPH</td>
<td>8015 modified</td>
<td>Any Amount</td>
<td>&gt;100 ppm</td>
</tr>
</tbody>
</table>

* Polynuclear Aromatic Hydrocarbons may be required if contamination levels are high.

Source: Mike Suphin — West Virginia Department of Natural Resources • Solid and Hazardous Waste • Groundwater Branch • 304-558-6731

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## State-by-state summary, from page 23

<table>
<thead>
<tr>
<th>Product</th>
<th>Parameter</th>
<th>Lab Test Protocol &amp; No.</th>
<th>Notification Level</th>
<th>Action Level</th>
<th>Recommended Clean-up Level</th>
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<tr>
<td>Gasoline.</td>
<td>TPH</td>
<td>Modified GRO</td>
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<td>Diesel</td>
<td>TPH</td>
<td>WDWL</td>
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<tr>
<td>Crude Oil</td>
<td>TPH</td>
<td>EPA 9073</td>
<td>Any Amount &gt;10 ppm</td>
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<tr>
<td>No. 6 Fuel Oil</td>
<td>PAH</td>
<td>EPA 8310</td>
<td>Any Amount Report Level</td>
<td>Under Development</td>
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</tbody>
</table>

**Wisconsin**

- Gasoline<sup>1</sup> TPH Modified Calif. Method Any Amount >30 ppm ≤30 ppm<sup>*</sup>
- Diesel, and Waste Oil<sup>1</sup> TPH Modified Calif. Method Any Amount >100 ppm ≤100 ppm<sup>*</sup>
- Lead or, Waste Oil<sup>1</sup> Heavy Metals EPA 1310, 1311 Any Amount >5 ppm ≤5 ppm<sup>*</sup>
- Gasoline<sup>2</sup> TPH Modified Calif. Method Any Amount >100 ppm ≤100 ppm<sup>*</sup>
- Diesel, and Waste Oil<sup>2</sup> Heavy Metals EPA 1310, 1311 Any Amount >C<sub>s</sub>=(f)x(Koc)x(Cw)<sup>*</sup> ≤C<sub>s</sub>=(f)x(Koc)x(Cw)<sup>*</sup>
- Hazardous Substances Specific Appropriates EPA Methods Any Amount (Koc)x(Cw)<sup>*</sup> ≤C<sub>s</sub>=(f)x(Koc)x(Cw)<sup>*</sup>
- G. D. WO<sup>1</sup> Sites where contamination is limited less than 50 feet from groundwater.
- G. D. WO<sup>2</sup> Sites where contamination is located greater than 50 feet from groundwater.

<sup>*</sup>If RCLs cannot be achieved, C<sub>s</sub>=(f)x(Koc)x(Cw)<sup>*</sup> is used, where (Cw) is the Wyoming drinking water standard in ppb, (Koc) is the contaminant-specific partition co-efficient, and (f) is an assumed soil organic content of approximately 2.5%. Above listings are guidelines only. Wyoming is presently working on developing standards. Please contact Wyoming DEQ with any questions.

Source: Laurie Ege — Wisconsin Department of Natural Resources • 608-267-7560

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Write in 158
Put states in the loop

Communication is the key to encourage states to accept innovative plans

By Gilberto Alvarez

If regulators had better access to information about newer or alternative technologies, corrective action plans could be approved much more quickly.

Once a leaking tank is confirmed, the responsible party typically hires an environmental consulting firm to comply with regulations. The consultant must be thoroughly familiar with the local, state and federal requirements regarding cleanups. At the same time, the state regulator must be thoroughly familiar with how the selected cleanup technology works and whether sufficient data has been collected and if a proper design is being suggested prior to approval of the corrective action plan.

Although many factors influence the process, it is common knowledge in the industry that there is a widening gap between sites currently under remediation and sites closed. As of August, 1992, there were 166,731 leaking tank sites confirmed in the U.S. Of those, only 44,008 (26 percent) are considered closed.

If regulators had better access to technology evaluation reports, it might be possible to increase the closure rate by 10 percent each federal fiscal year.

Because the U.S. EPA is a regulatory agency, our first line of contact is with our state agencies. Region 5, for example, is typically allocated $10 to 15 million in federal LUST Trust funds each year, which are then distributed to the six environmental agencies in the Region 5 states (Illinois, Indiana, Michigan, Minnesota, Ohio and Wisconsin). The majority of federal funds help pay for state staff who are ultimately responsible for proper oversight of each cleanup.

An important factor is the state funds, which help responsible parties offset cleanup costs by reimbursing them up to state specified levels. These funds are usually financed by a tax on motor fuel products entering the state.

One of the goals of the state funds is to protect the small petroleum marketer. But because of the source of the fund, it is only a matter of time before consumers begin to scrutinize how the money is being spent. Some funds have already been subjected to strict legislative controls because of their rapid depletion rates. For this reason, state fund managers are becoming increasingly concerned about corrective action costs, and are more willing to approve alternative technologies if it can be demonstrated that they work and cost less.

The federal leak detection compliance deadlines imposed

Gilberto Alvarez is an environmental engineer and corrective action officer for U.S. EPA, Office of Underground Storage Tanks, Region 5, Chicago, Ill.
in December 1989, 1990 and 1991 resulted in thousands of tank removals in a short period of time. The residual of so many “tank yanks” is the existing leaking tank site universe. For many of these sites, the path of least resistance to deal with contaminated soils was to excavate and dispose of them in a local landfill. While the case can be made that limited disposal of soil is sometimes appropriate, there were altogether too many cases of two to three thousand cubic yards of soil carted off to landfills. The problem only seems to be exacerbated by bogged down state fund reimbursement systems.

Because of this, there has been a natural progression in most states towards the acceptance and use of alternative corrective action technologies. In Region 5, federal and state regulators have attempted to identify the major factors which influence the acceptance of new technologies within the regulated community.

For each new technology, our process can be generalized into three basic questions: 1) Does the technology work? (and under what conditions), 2) Is it cheaper than traditional methods? (cost per unit), 3) Will the state regulator approve it? (identification and resolution of bureaucratic obstacles).

Of these three areas, Region 5 focused on the state regulator, reasoning that if a state reviewer is familiar with the technology, he or she is more likely to approve it. Similarly, if the state fund reviewer is able to accomplish a cleanup for a fraction of traditional method costs, the fund will be stretched to achieve maximum environmental benefit.

The region identified four action steps.
1) To improve the way the states currently review corrective action plans by applying total quality management principles to eliminate wasteful steps.
2) To conduct technical assessments (field demonstrations) of several of the new technologies and document the results.
3) To encourage states to create policies promoting the use of alternative technologies.
4) To educate state fund program staff about comparative costs of various technologies.

To improve corrective action review processes on the state level, Region 5 examined an analysis of every step of the process, from the moment of the first phone call until case closure. This intensive examination consistently resulted in the identification and elimination of wasteful steps.

Region 5 also attempted to conduct a demonstration program to evaluate new technologies, patterned after the Office of Superfund’s Superfund Innovative Technology Evaluation (SITE) program. While not as formal, Region 5 focused on soil and groundwater remediation technologies specifically applicable to leaking tank sites.

The goal of the technology demonstration effort was to produce technical design manuals for state regulators and

Continues on page 28→

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<tr>
<th>PRICE LIST</th>
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<tr>
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<tr>
<td>2.5” x 6”</td>
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environmental professionals. It was important that the demonstrations be conducted at actual leaking tank sites in cooperation with the responsible party. The projects were coordinated among state regulators, U.S. EPA researchers from the Risk Reduction Engineering Lab in Edison, N.J., a willing responsible party and their retained consultant.

The three technologies considered for evaluation were (in order of priority): 1) air sparging/soil vapor extraction, 2) bio-moulding and 3) low temperature thermal desorption. An air sparging site was selected in Cleveland, Ohio. The responsible party was BP Oil Co. Air sparging was selected because, at the time, air sparging was not widely used, but initial reports suggested the technique showed promise.

A quality assurance plan was prepared to assure state regulators of the validity of the project. Among the obstacles confronting alternative technologies is the lack of state specific policies encouraging new approaches.

The lack of policy usually creates disincentives among environmental professionals who only need one bad experience to hinder their willingness to make future requests. Unorganized or confusing permit requirements certainly result in longer approval processes and delayed startup dates. Although wasteful steps were identified, in many instances, the process was confined to the tank program, omitting important components of the approval process—review by other media programs involving air, water, solid and hazardous waste.

Selected states were encouraged to begin dialogs with their cross-media counterparts to establish baseline procedures for permitting leaking tank site cleanups. In many instances, this was already in place in Region 5 states. However accurate the theoretical discussions were, it was also important to track the actual experiences the consultant faced when applying for the necessary permits at the air sparging site.

During formal evaluations of the state programs, Region 5 paid particular attention to the progress of each state’s written policies and guidance documents, especially those addressing new technologies. One of the more useful tools states have adopted to disseminate this type of information are “consultants days.” In one day, environmental professionals gain an opportunity to become familiar with, and submit reactions to, the state policies. As a result of the Region 5 technology demonstration effort, several states have created specific air sparging guidance documents.

A side benefit to active participation by representatives of the state agency in technology demonstration projects is that it produces a favorable environment to handle similar situations for technologies which are as yet undeveloped.

Environmental professionals have responded to tank requirements with a number of tremendously innovative approaches, both on the manufacturing level and in field technique. State staff was also generally appreciative to receive information on new technologies as part of this process.

In addition, by undergoing this exercise, the Region’s role in the overall scheme of implementing tank
regulations became more clear. It was more important for the Region to act as a clearinghouse for new ideas and new technologies for our states, as opposed to dictating the terms by which the regulations needed to be implemented. It became evident that, with respect to identifying cost effective environmental solutions, there is certainly a great deal of common ground between the regulated community and state petroleum fund managers.

To address the cost question, it was imperative to educate the state fund administrators. The key is to convince the fund reviewer that the new or alternative technology achieves the state specified cleanup goals and is cost effective, compared to traditional methods.

Implementation of this step involved interaction with each of the state fund managers at a Regional roundtable discussion in the summer of 1991, which included alternative corrective action technologies as a topic. Of particular concern to the administrators was the risk associated with the newer, or unproven technologies. If an eligible responsible party attempts to clean up his site using an alternative technology and fails, will the fund have to pay twice to clean up that site?

Based on these concerns, and in order to minimize the risk to the fund administrator, the Region identified BP Oil as a responsible party willing to undertake the risk associated with testing a new technology.

A second roundtable meeting was organized in the spring of 1992 and in general, most fund administrators were more receptive to allow reimbursements for alternative technology cleanups. The policy change can be attributed somewhat to the fact that there were simply too many cases where unnecessary excavation and transportation of petroleum contaminated soils was taking place. This fact, combined with more stringent soil benzene level requirements on landfill disposal, caused the change in attitude—allowing more in situ technologies to be selected.

The most significant accomplishment of this project was to find and work with a willing responsible party. In this instance, BP Oil environmental staff was already interested in trying air sparging at one of their sites to evaluate its effectiveness. Because of common goals—to evaluate air sparging—a partnership made sense.

The air sparging system was designed during the spring and summer of 1991 and began operating in the fall. A detailed monitoring plan was followed throughout the next eight months. While a final report is not yet available, BP Oil has accumulated enough evidence to convince them that the technique successfully remediated the site’s contaminated groundwater. Plans are underway to use air sparging at other BP Oil sites.

BP Oil’s environmental consultant, Engineering Science, Inc., has agreed to document permit obstacles that were encountered and resolved in the project. This information will be included into a corrective action manager’s handbook for use by the Region and state staff.

The most encouraging result of the project was the unique partnership forged among federal regulators and researchers, state regulators and fund administrators, a responsible party and a consulting firm.

Write in 631 for more information
Remediation market slated for growth

*Market should hit $5 billion by 1995 while UST cleanup market slows*

Remediation construction has grown eight percent in the last four quarters, according to a market study by Farkas Berkowitz & Co., Washington, D.C. After no growth in 1991, the increase is seen as a considerable improvement. Joan Berkowitz, Ph.D., management consultant to the environmental protection industry, predicts that, “the remediation construction market, the actual cleanup of contaminated sites, should grow to over $5 billion by 1995—up from a projected $2.5 billion in 1992.” She also notes, “by 1995, the large engineering and construction firms will have displaced many of the smaller firms as market leaders. So far, projects under $5 million, primarily associated with underground storage tanks, have dominated the market. The UST market is slowing down due to a cutback in the rate of spending by petroleum firms.” She also says that large Department of Energy and Department of Defense cleanup projects are poised for growth. “The shift in demand is attracting new entrants that have the financial resources to tackle projects over $30 million.”

Write in 639 for more information

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EPA offers vapor extraction software

EPA’s Office of Underground Storage Tanks announces “Hyperventilate,” a software package originally created by Shell Development Co. for vapor extraction, soil venting, applications. The software package contains a 45-page manual and a 3.5-inch Macintosh computer disk. The software helps users of vapor extraction technology at sites where petroleum has contaminated the soils. It teaches about soil venting and guides users through the structured process to evaluate the applicability of soil venting at a particular site. It identifies and characterizes required site-specific data, indicates whether venting is appropriate, evaluates air permeability test results, calculates the minimum number of vapor extraction wells needed and illustrates results at a specific site. EPA is testing an IBM PC compatible version of the software.

The program will not completely design a vapor extraction, but can perform necessary calculations, defines the equations used, makes unit conversions and gives supplementary information on related topics. It is an educational tool for the novice environmental professional and a functional tool for more experienced users.

“Hyperventilate” is based on an article by P.C. Johnson, C.C. Stanley, M.W. Kemblowski, J.D. Colthart and D.L. Byers, of Shell Oil Co.

The package can be purchased for $178 from the Superintendent of Documents, U.S. Government Printing Office, 202-512-2250. Or write Superintendent of Documents, P.O. Box 371954, Pittsburgh, Pa. 15250.\\n
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30 December 1992 Soils

Write in 151
Vitrification is alive and well

Technology overcomes mishap and misinformation

In situ vitrification is alive and well and picking up momentum as a remediation technology for petroleum contaminated soils. Soils regrets an erroneous report in the August-September 1992 issue that the process had been withdrawn.

Geosafe Corp., Richland, Wash., reports that refinements to the process have overcome the problem that caused fire damage to a fabric off-gas collection hood during a March 1991 test of the process.

An investigation of the incident indicated that the primary factor leading to the molten glass displacement was the presence of water-bearing sealed containers in the setting design. This and other factors contributed to a highly unusual melt shape which resulted in a release of water vapor through the melt at rates sufficient to cause vigorous melt agitation and displacement of molten glass into contact with the hood interior surface.

The investigation and related test and modelling work have identified the analytical tools necessary to assure the safe application of in situ vitrification to contaminated soil.

Because it remediates with electricity, in situ vitrification consumes 20 percent less energy than transporting the soil to a landfill. It takes about 750 kilowatt hours of electrical energy to melt one ton of soil. Nearly all the electrical energy is converted to thermal energy within the molten soil.

Write in 638 for more information

EG & G Rotron, Saugerties, N.Y., introduces a three horsepower EN606M5L, the largest single phase, explosion proof soil venting blower available in a direct mounted design. The EN606 performs in the mid-range of their 0-1500 SCFM flow capability.

Rotron blowers provide soil solutions.

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

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Rotron also has accessories such as moisture separators available.

Call or fax a request for a copy of A Consultant’s Guide to Environmental Applications.

Write in 101

December 1992 Soils 31
When contaminated soil meets the road

Chemical aspects of asphalt concrete made with petroleum contaminated soils prove stable performance

By Stephen Testa and James Conca

Stabilization of petroleum contaminated soils in asphalt cement creates a useful end product instead of a waste requiring disposal. But, it is necessary to demonstrate that the contaminants, especially metals, will be retained by the asphalted soils over long periods of time.

The release of metals and other contaminants from such asphalt and contaminated soil mixtures is coupled with the hydraulic conductivity, diffusivity and structural breakdown of the asphalt, all slow processes. For the same crude source and chemical treatments, the end product asphalt cement formed from a cold-mix emulsion or from a hot mix has the same general structure, composition and properties, such as leachability. The greatest effects between the different preparations are on kinetically controlled reactions and sorption processes. Leaching studies have shown that the evaporation phase of the cold mix process does not enhance contaminant transport.

Asphalt has a complex and poorly understood chemistry and structure. Stephen Testa is president of Applied Environmental Services, Inc., Laguna Hills, Calif. James Conca is professor and research scientist for Environmental Sciences, Washington State University Tri-Cities, Richland, Wash.

that depend on the crude petroleum source and whatever chemical treatment or modifiers that might be added during processing.

Asphalt has a large number of heteroatomic groups with a wide range of chemical activities. Therefore, it seems likely that a number of asphalt-metal-soil reactions that could affect contaminant mobility might occur in soils processed in asphalt. The functional groups found in asphalts are shown in Figure 1, above left.

The number of distribution of these groups varies widely among different asphalts and determines much of their chemical behavior and performance. Carboxylic acids, ketones and anhydrides are generally formed by atmospheric oxidation or caustic pretreatment and are rare in fresh asphalts. However, these may be important in waste disposal situations or EPA methodologies because of possible interactions with oxidizing or alkaline contaminant solutions, or if recycled asphalt is used.

There has been no comprehensive study of asphalt chemistry in relation to the aggregate or to contaminant species, therefore, generalizations about the chemical performance of these systems is difficult. However, extrapolations from studies of asphalt road pavement properties, leaching

Continues on page 34→
The plants pictured here get high approval ratings from their owners. All were built by SPI, 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, unlike some that are pieced together from various sources.

SPI plants remediate hazardous and non-hazardous waste either by high temperature incineration or by low temperature thermal desorption. The plants may be either portable or stationary and may include the following components:

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Figure two: Asphalt/aggregate interface at the molecular level illustrates functional relationships.

Meets the road, from page 32

behavior, sensitivities to moisture damage have provided information that can be used to evaluate the stability of metals and contaminants in soils that have been asphalted. Generally, it is assumed that asphalt cements are colloidal systems made up of a suspension of asphaltene micelles in an oily medium. Micelles are units of various molecules, usually organic with minor inorganic components, that have distinct structural and chemical properties. Micelles play an important role in asphalt behavior. Figure 2, above,
illustrates the structural and chemical components in contaminated soil that has been asphalted. The illustration is approximately to scale and represents the results and implications of separate studies of asphalt components.

The major components are the aggregate mineral grains, the bulk aqueous phase, the sorbed electric double layer on the mineral surface, the resin-peptized asphaltene micelles, the polar micelles in the asphalt, the asphalt pore spaces, the asphalt oily medium and the asphalt functional groups at the interfaces between these different components.

The aggregate mineral grain portrayed in Figure 2 is a clay mineral. Clay minerals are important because of their reactive surfaces and their ability to exchange cations from the interlayer sites with contaminant ions in solution. There are two major types of complexing functional groups associated with silicate mineral grains. The most important is the siloxane ditrigonal cavity, which occurs in tetrahedral silicate sheets and gives the clay minerals their exchange capacities.

However, the most abundant surface functional group is the inorganic hydroxyl groups exposed on tetrahedral silica—silanols. Those exposed on octahedral alumina are called aluminols. There can be more than one type of surface hydroxyl on a given mineral surface with different reactivities.

The siloxane cavity complexes only positive ions and groups whereas the surface hydroxyl complexes both anion and cation species, depending on solution composition and pH.

Asphalt functional groups, as well as contaminant species, interact with these surface complexes. Figure 2 illustrates several mineral surface interactions—a strong complexation with a uranyl anion complex, a weak complexation with a hydrated calcium complex, an exchange of americium with an interlayer cation, sorption of some short chain hydrocarbons at the mineral surface, and bonding of the asphalt quinoline, pyrrolic, phenolic and carboxylic acid functional groups.

The bulk aqueous phase has many of the dissolved inorganic constituents of interest to contaminant transport. Because the simple diffusion coefficient of dissolved species in the bulk fluid is approximately $10^4$ square centimeters regardless of species, diffusion of contaminants through the bulk aqueous phase should be the primary route of contaminant release from the asphalt. But, the release rate depends strongly on the connectivity of the bulk fluid, on the diffusion porosity. In coherent asphalts without moisture damage, this connectivity is small, and the effective diffusion coefficient in the asphalt cement as a whole is low ($10^{-5}$ square centimeters).

Release of contaminant species also depends strongly on the retardation properties of the system. Other

Continues on page 36→

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Write in 085

December 1992 Soils 35
phases in contact with the bulk aqueous phase can sorb species that are present in the aqueous phase. Figure 2 illustrates the strong sorption of strontium and the weak sorption of iodine to a phosphate colloid particle in the bulk aqueous phase.

The asphaltenic micelles and the oily medium make up the bulk of the asphalt. Asphaltenes are molecules composed of polynuclear aromatic groups and long hydrocarbon chains and contain much of the inorganic constituents of asphalt. An asphaltenic micelle is an aggregate of asphaltene molecules bonded through \( \mu \)-electron interactions between the condensed polynuclear aromatic sheets. Asphaltenic micelles can be peptized by hydrocarbon resins into aggregates. The oily medium consists of saturated and unsaturated hydrocarbons and resins, which are a mixture of terpenes, resin alcohols and resin acids and their esters. There may be extensive secondary structures to the micelles. The metals, vanadium, nickel and iron, found in asphalts are thought to be associated with the asphaltenes, although exact molecular sites are not known. They may be associated with sulfides and aromatic groups.

The polar micelle in Figure 2 (page 34) illustrates the possible polar compounds present in polar micelles. There is evidence that agglomerates or micelles of polar asphalt molecules exist separately in the asphalt and sequester certain polar complexes and acids, such as manganese-acid complexes. Certainly, carboxylic acid groups occur in the polar micelles if they exist in a particular asphalt, and polar functional groups such as the phenols, ketones and sulfoxides will be concentrated at the interface. This sequestering chemically removes these species from subsequent reactions in the non-polar phases and aqueous phases of the asphalt. Water molecules and salts may occur in the polar micelles, which has been indicated in Figure 2. The polar micelles could sequester many metals species of interest.

The nature of pore space in asphalt is a highly debated topic. There is a great deal of pore space in asphalt that can be seen in electron micrographs, but it is not well connected. Depending on the condition of formation and history, the pore space may or may not be filled with water. The gaseous components in pore spaces include atmospheric components, introduced during formation and processing, and volatile asphalt compounds. Gaseous contaminants of interest may be incorporated into the pore spaces.

Knowing the structures and components of asphalted contaminated soils is crucial to understand its chemical performance with respect to metal and petroleum contaminants. For example, heavy metal salts of carboxylic acids which are insoluble in water are soluble in strong acids and in strong polar solvents—making polar micelles possible repositories of contaminant metal-carboxylic acid salts in asphalted contaminated soils. Petroleum contaminants in soils are strongly hydrogen-bonded to the asphalt components as well as possibly bonded through reactions with the functional groups. And, oxidation-reduction reactions of metals is affected by the polar and non-polar phases in asphalted contaminated soils.

The chemical stability and environmental performance of asphalted contaminated soils depends on the nature and extent of the asphalt-aggregate bonds. Because of the polar/non-polar and hydrophobic/hydrophilic interactions among the various phases in the system, the function groups in Figure 1 (page 32) are concentrated at the interfaces between phases—the asphalt-aggregate interface, the polar micelle-asphalt oil interface or the asphalt-water interface. The behavior of functional groups at the asphalt-aggregate interface determines the chemical stability of the asphalt to a large degree.

At the asphalt-aggregate interface,
these groups are susceptible to interactions with the aqueous phases and any contaminants present in the contaminated soil. The relative tendency of the asphalt functional groups to be concentrated at the asphalt-aggregate interface, in order of decreasing tendency, is:
- carboxylic acid > anhydride > quinoline, phenolic > sulfoxide, ketone > pyrrolic.

The sorption affinity of the functional groups with the aggregate surface has also been investigated and is given, in order of decreasing tendency, as:
- pyridinic, carboxylic acid > anhydride > quinoline, phenolic > sulfoxide > ketone > pyrrolic, polynuclear aromatic.

The third important tendency of the functional groups affecting environmentally processed asphalt stability is the ability of the functional group aggregate bond to be displaced by water. This tendency, listed in order of decreasing tendency, is:
- anhydride, quinoline, carboxylic acid > sulfoxide > ketone > pyrrolic, phenolic.

Combining these tendencies provides some indications of performance and some guidelines for using environmentally processed asphalt methodology. For the best chemical performance, the asphalt should have high contents of pyridinic, phenolic and ketone groups, which can be achieved by carefully choosing the source material or using additives such as shale oil. Also, the presence of inorganic sulfur, monovalent salts and high ionic strength solutions in the asphalt decreases the chemical stability of the asphalt cement by disrupting the functional group-aggregate bonds and increases the system’s permeability. Addition of lime to the aggregate counters this effect.

Contaminant mobility, especially of metals, in the asphalted cement is affected by many factors:
- diffusivity and permeability of the asphalt cement as a whole,
- solubility of species in the various aqueous, polar and non-polar phases,
- speciation of the contaminants (non-mobile vs. highly mobile),

- complexation with any chelating organics,
- redox reactions of metals across aqueous-organic phase boundaries,
- sorption on aggregate surfaces along the asphalt-aqueous interface or on the colloids,
- precipitation of solid phases and/or colloids of metal salts, especially oxyhydroxide and carboxylic acid salts.

Many of these properties are not known to the degree that specific contaminant release can be predicted. Leaching tests are the primary method of evaluating contaminant mobility in these systems. The low diffusivities and permeabilities of asphalt is obviously the greatest factor in the retention of contaminants in asphalt cements. Conditions which adversely affect the diffusivity and permeability

Continues on page 38→
have the greatest adverse effect on contaminant mobility and release. The asphalt acts primarily as a physical containment to the contaminants and the aggregate. Of course, the physical properties of the asphalt cement result from the composition and structure of the asphalt.

Even though metals such as vanadium and nickel occur in asphalts at the hundreds of parts per million levels, as well as many toxic organic components, asphalt leachates and products have never produced toxic or contaminated solutions that are considered to be hazardous materials by the EPA. Asphalt’s non-volatile, viscoelastic properties result in the general observation that asphalt leachates do not contain contaminant concentrations above EPA drinking water guidelines. Even in asphalts made with metal slags as aggregate, metals do not become solubilized and do not leach from these asphalts in detectable concentrations—even when used with strong acidic and alkaline solutions.

Asphalt leachates that have contained detectable concentrations of contaminants have been obtained in studies of asphalted nuclear wastes. However, in all these studies, high concentrations of salts were used—as high as 50 percent salt, 50 percent asphalt. High salt concentrations in asphalt mixes disrupts the asphalt structure.

On the other hand, in diffusion studies of radioactive wastes with normal salt content, diffusion coefficients were measured to be as low as for normal asphalt conditions, with diffusion coefficients of $10^{-12}$, $10^{-13}$ and $10^{-16}$ square centimeters. In all studies, researchers point out that experimental effects, such as the slicing of thin asphalt membranes, may introduce errors that are not relevant to the field situation and tend to increase the observed diffusion coefficient. A number of unplanned leaching experiments have been taking place with asphalt. Asphalt has been used for years to line domestic water reservoirs, especially in California, and to line fish-rearing ponds, with no adverse effects. There are over 30 asphalt-lined fish-rearing ponds in Oregon and Washington. Trace metal and organic contamination is highly toxic to developing fish. Yet, no adverse effects have been observed from the asphalt liner, indicating a high degree of chemical stability with respect to aqueous solutions, and an absence of any toxicity effects.

Asphalt studies of road pavement properties, leaching behavior, sensitivities to moisture damage and functional group analysis have provided information that can be used to evaluate the stability of metals and contaminants in soils that have been asphalted. These studies indicate that asphalted contaminated soil is highly stable and performs adequately as an end product.

Write in 632 for more information

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38 December 1992 Soils
KVA offers Porta Punch System™

KVA Analytical Systems, Falmouth, Mass., introduces the Porta Punch System™ that installs sampling points to depths of 45 feet for soil gas, soil and groundwater studies.

The portable unit permits installation of sampling devices in basements, underground garages, between buildings, and in other places where truck mounted units cannot reach.

This hydraulic hammer and shaft removal system provides increased speed and ease of sampling for applications like prospecting for contaminant plume boundaries, KVA says.

The system includes a hydraulic generator, up to 100 feet of hydraulic hose, and the Porta Punch. The unit collapses to five feet in length for easy loading into small trucks and vans. [Write in 640]

Brown-Minneapolis introduces double wall steel tank, includes built-in monitoring well

Brown-Minneapolis Tank, Eagan, Minn., introduces the Sure-Check®II double wall steel, two hour, fire-protected aboveground storage tank with a UL listed double wall steel tank system and built-in monitoring well.

UL-approved fire protective components are added to the tank with internal non-metallic reinforcements and additional structural enhancements. The Sure-Check®II is 80 percent lighter than concrete systems, according to Brown-Minneapolis and is available in horizontal or vertical configurations to 50,000 gallon sizes. [Write in 641]

Airport uses Highland oil water separators

Highland Tank & Mfg. Co., Stoystown, Pa., delivered one 40K gallon and three 30K gallon patented oil water separators to the Cincinnati Airport to accommodate areas that will produce storm water runoff around new terminals, Highland says.

The separators separate oil and oily solids from wastewater and runoff being discharged from petroleum marketing facilities, transportation facilities, and many other industrial, military and municipal operations to comply with state and federal oil and grease discharge requirements. [Write in 642]

Series 2000 blower/exhauster

Lamson’s blower improves efficiency

Lamson Corp., Syracuse, N.Y., introduces the 2000 Series blower/exhauster with a patent pending design that improves efficiency and increases flow range, the manufacturer says.

Optional 2000 features include: adjustable base leveling, and a center line support, which minimizes misalignment due to thermal expansion.

The 2000 provides constant pressure at varying flows for environmental and industrial air and gas handling applications. [Write in 643]

Use a small scale model with Enviromac-C

Columbus Instruments International Corp., Columbus, Ohio, offers the Enviromac-C, a newly developed experimental composting reactor that enables users to establish the optimal composting conditions using a small scale model before applying them to larger scale processes, the manufacturer says.

Optimal composting conditions are established through continuous monitoring of O2 consumption and CO2 production while controlling air flow through the compost in order to maintain the ideal temperature. [Write in 644]
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Sampling pump descends to 250 feet
Environmental Instruments Co., Concord, Calif., distributes the Grundfos Redi-Flo2 submersible sampling pump. Measuring just over 11 inches tall, its 1.8 inch diameter permits access to two inch wells to depths up to 250 feet, says the company.

Probe extracts long sample
This sub-soil probe extracts a .9 inch diameter sample three feet long, says Clements Associates, Inc., Newton, Iowa. Either a manual drop hammer or an electric hammer drives the sampling tube to depths exceeding 15 feet. A foot-operated jack retrieves the sampling tube. Samples obtained with this probe remain uncontaminated by surface debris during the sampling procedure, says the company. Each sample is contained in a clear plastic or stainless steel liner. Liners may be capped and sent to a laboratory for analysis.

Pneumatic pump is timer free
Clean Environment Equipment (CEE) of Oakland, Calif., says their autopump is now available in stainless and engineering plastic models as both top and bottom loaders. All models have maximum drawdown at rates to seven gallons per minute. The pumps are timer free for less training, maintenance and site visits. All models fit four inch wells.

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Gradiometer detects buried ferrous metals

Schonstedt Instrument Co., Reston, Va., says their newest magnetic gradiometer was designed specifically for hazardous materials and environmental remediation applications. The sensor is lowered into the well at intervals during the drilling of monitoring wells. If the drill is approaching a ferrous object, the magnetic gradiometer will reveal its presence. Steel drums, for example, can be detected up to eight feet away if they are upright, four feet if they are lying horizontal. Ordinance of various types can be detected at distances ranging from two to 15 feet, says the company. The sensor assembly and electronics package are housed in a portable case and run on four C batteries. A digital meter shows the values of the measured magnetic gradient in milligauss (two ranges, ±20 milligauss and ±200 milligauss). The sensor assembly has a 25-foot cable.

HNU introduces field kit and new monitor

HNU Systems, Inc., Newton, Mass., says their hand held gas monitor (left) measures toxic gases. A data logger can be connected to the output. The field test kit (right) allows for direct placement of the sensor into the sample with immediate readout of concentrations from .1 to 200 ppm, says the company. The meter is precalibrated so only a simple one point calibration is required on site.

Vapor monitor sniffs benzene from five ppb

Microsensor Systems, Inc., Bowling Green, Ky., says their vapor monitor can detect benzene concentration levels as low as five ppb—even in the presence of interfering vapors such as carbon tetrachloride or methanol. The unit is suitable for on-site or continuous monitoring of benzene. It combines an isothermal gas chromatograph with detector and microcomputer.

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Plastic pump survives high temperatures

Serfilco, Ltd., Northbrook, Ill., says their plastic, vertical pump can handle a wide range of chemical solutions at temperatures up to 280°F. Flow rates range up to 185 gpm. The steel shaft is cantilevered with vapor seal between the rotating shaft and support column to protect the chemical duty motor from corrosive vapors, says the company.

Write in 651

SRI offers free standing detector

SRI Instruments, Las Vegas, Nev., says their new free standing detector module is offered with PID, ELCID or both in series for VOC analysis. The system can be installed on existing gas chromatographs, requiring only a single 5/16" hole to accommodate the fused silica-lined transfer line. The ELCID has no nickel reaction tubes to contaminate and no solvent pump to wear out, says the company. The system is completely self contained in a compact enclosure.

Write in 652

Pump recovers floating hydrocarbons and groundwater

Brainard-Kilman, Stone Mountain, Ga., says their pneumatic total fluids pumps are designed for the simultaneous recovery of floating hydrocarbons and contaminated groundwater. The dual chamber pump loads from the top to recover hydrocarbons, while loading from the bottom to accommodate groundwater.

Write in 653

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Write in 055

December 1992 Soils 43
Permit battle corners plant

Learning together—one plant’s horror story to gain state permit

It is not difficult to remember way back to the infancy of the soil remediation business—say 1988—when the Environmental Protection Agency (EPA) shot the underground storage tank regulations out of their legal cannon.

Back in those early, rough-and-tumble days, everybody was grooping for ways to make money, ways to save money, for better mousetraps, ultimate solutions and answers. Asphalt plant owners were sifting through the rumors of vast fortunes to be made by somehow running petroleum contaminated soils through their plants.

It was one thing for the private sector to be flailing about, but the federal regulations also threw the state governments into a frenzy. The federal regulations charged the states to come up with their own rules. And, no self-respecting state could fail to pick up the charge. Many of the pioneers in the private sector found themselves caught up in the states’ unfortunate early struggles to establish their programs.

Kary Asphalt, Inc., of Salisbury, Md. was such a pioneer.

In the summer of 1988, an official from the state Department of Environment (DOE) approached the executive director of the Maryland Asphalt Association, Arnold Gardener, to ask for help from the asphalt producers in the state. The official outlined for Gardener the growing problem of petroleum contaminated soils sure to be generated by implementation of the new underground storage tank regulations, and urged Gardener to rally the state’s asphalt producers to investigate the possibility of remediating the contaminated soils through their drum mixers. Gardener put the word out.

About the time Donald Kary, president and Mike Wilkins, vice president of Kary Asphalt, were getting the word from Gardener, Kary was traveling in South Carolina and happened to see a portable soil remediation plant in operation on a gas station site. He was impressed. On the heels of this, a representative of a local company near the Kary plant in Salisbury approached Don Nichols, executive vice president of Kary, offering to be a potential client for soil remediation services if Kary could modify their asphalt plant to run petroleum contaminated soils. Talk about opportunity knocking.

So, in the fall of 1988, Wilkins, Nichols and their potential client went to Baltimore to open the door and meet with DOE officials to get the program rolling. The state officials seemed very pleased that an asphalt producer was expressing a willingness to process petroleum contaminated soils through the plant. The DOE officials included people from the air quality division, hazardous and solid waste division, groundwater division and underground storage tank division.

Little did Nichols and Wilkins know that once that meeting broke up, each division would go its separate way, never to gather together in the same room again—certainly never to coordinate policy toward Kary and the processing of contaminated soils.

In the meeting, the state officials indicated that the rule book on petroleum contaminated soil remediation was more or less a blank slate, but if Kary was willing to try, everyone would get together and make up the rules as they went along. By the spring of 1989, Kary had some petroleum

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contaminated soils, and began to experiment with feed rates, temperature controls and the like. Air management officials came from Baltimore to watch and began to wonder if it might be a good idea for Kary to run a stack test on the emissions.

But, it occurred to Kary executives that before they scheduled the stack test, they might as well go ahead and invest in a thermal oxidizer as the best available technology to deal with hydrocarbon emissions from the contaminants. So, they applied for a permit to install a thermal oxidizer. At this point, the air regulatory people decided to simply add a temporary, six-month soil remediation amendment to Kary’s existing hot mix asphalt air quality permit.

The state agreed the stack test should wait until the thermal oxidizer was up and running.

In May of 1990, the installation of the $300,000 thermal oxidizer began. By July, Kary was ready to apply for permits to operate the plant with oxidizer. Weeks passed—expensive, frustrating weeks. The local representative of the DOE air quality division was at the plant often. Finally, he told Kary just to go ahead and run the test and schedule the stack test. Since this was the local DOE person, who seemed to be in contact with the state level people in Baltimore, Kary went ahead with the run. Kary did not get permit in hand until late August 1990—a frustrating delay, considering the dollar investment wrapped up in the oxidizer equipment.

When it arrived, after the fact, the permit only allowed Kary to run 3,000 tons of material for the purpose of tuning and debugging the equipment. The permit also authorized the stack test.

But, in the process of fine-tuning the equipment, Kary actually had needed to run about 13,000 tons to assure the burner on top would maintain temperature and burn cleanly. This was purely a 20/20 hindsight situation. Kary admits they probably should have known they would need more than 3,000 tons to fine tune the equipment. On the other hand, they did not know what a commotion was going to arise later over the actual tonnage processed.

The stack test passed in all areas, including hydrocarbon destruction and emissions criteria, except for particulate emissions. While the run was close, technically, particulate emissions did exceed maximums allowed, so to the letter of the standards, and in the eyes of the state, the Kary plant failed the stack test.

After the stack test, everybody met back in Baltimore, but this meeting was different. State officials declared that because Kary had a permit (after the fact) to run 3,000 tons, but actually ran 13,000 tons, clearly, Kary was in violation, owed the state a $220,000 fine—and turned the matter over to the states’ attorney for collection!

Horrified, the Kary executives spent roughly the year from September 1990 to October of 1991 negotiating an agreement over the penalty. Kary’s attorney was able to get it reduced to around $20,000. A great deal of that year was spent with Kary in meetings with local zoning people, the media and general public who were alerted to the situation.

Continues on page 46→
and demanded details, explanations and opportunity to comment.
Community groups exerted pressure on the state DOE to produce proof and
documentation of the safety and necessity of remediating petroleum
contaminated soils through asphalt plants. The DOE responded to the
pressure by attempting to demonstrate that a tough stance and a close eye
was being kept on asphalt plants engaged in this work. In general, it
was a slow and painful educational process.
In October 1991, as some of the
smoke was clearing, Kary clenched its
teeth and applied for a temporary
operating permit to run another stack
test, which they received four months 
later, on February 7, 1992. During the
four months, Kary officials consulted
with experts from the soils division of
Tarmac Equipment Co., Inc., Blue
Springs, Mo., manufacturer of the
thermal oxidizer, and other industry
experts to determine what
modifications to make to ensure
sufficient particulate reduction to pass
the stack test.
But, before the test could take place,
Kary received a letter from officials in
the industrial discharge division of the
DOE stating that Kary’s use of a
scrubber system for emissions control
required an industrial discharge
permit.
What this letter basically represented
was the first hurdle Kary had to leap
outside the realm of the air
management division. Until this point,
all of Kary’s dealings with the state
had been through the office of air
management, filing their application
forms, and operating under their
permits. In other words, nearly four
years along in the process, suddenly,
other environmental divisions felt the
time was right to jump into the fray.
Kary applied for the industrial
discharge permit, and received it. But,
again, before Kary could proceed,
another division popped into the case.
This time, the solid waste
management division decided it was
time to inform Kary that, since they
were holding petroleum contaminated
soils on their property, they fell under
the definition of a solid waste landfill!
Before a permit to operate as a solid
waste landfill could be granted,
documentation had to be provided to
be incorporated into the county’s 10-
year solid waste management plan.
Kary officials shook their heads in
disbelief, rolled up their sleeves and
began to assemble documentation to
make the case that they were not
functioning as a landfill, but were
instead recycling the contaminated
material into asphalt paving product.
After six months of consideration,
the state reversed their position,
decided that the process did indeed
constitute recycling, and dropped the
landfill permit requirement.
The celebration at Kary did not last
long. Inside a week, the oil operations
division of DOE wrote Kary a letter
stating that since a landfill permit was
not required, petroleum contaminated
soils must now fall under the oil rules
and permitting requirements.
For Wilkins, one of the most
frustrating aspects of this saga is that
each division within the DOE requires
him to start from the beginning. There
is no evidence that the divisions are
updating each other on the plant’s
the same protocols and letters as I sent to
the air management division back in
November 1990,” Wilkins says.
It would have been nice to be able to
put a happy ending on this story. But
some people fear there may never be
an ending. At this point, Kary is
awaiting a response to their
application for a permit under the oil
operations classification. Kary’s
original first customer for soil
remediation couldn’t wait for the
“legalization” of Kary’s plant and
long ago found another solution for
their problem. So, that cost income for
the plant. For Wilkins, the sad part is
that Kary has now lost the pioneer
status they had back in 1988. More
companies have entered the soil
remediation market, more processing
technologies have been developed
that have driven down the market and
substantially changed the financial
projection basis on which Kary
decided to enter the market.
Kary’s plan is to not let the
regulators wear them down. They
figure they can leap through as many
permitting hoops as the state can set
up. Wilkins admits that several times,
Kary has considered hanging a “For
Sale” sign on the plant—but never
seriously.
“We’re pretty tough. We don’t give
up easily. We’re going to keep
plodding along,” Wilkins says.
It is an astonishing tale, but not a
particularly unusual one. Versions of
the same story are being played out in
many states. It is important that the
states move with caution. The
regulations they make must ultimately
protect human health and the
environment. Yet it is important that
they move. It just may be possible that
the human health and the environment
are not best served by protracted
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Compare leak detection methods

Annual tightness testing and statistical inventory reconciliation are the two most popular methods chosen by tank owners

By Lyle White

The first consideration facing a tank owner aiming for compliance with the federal UST regulations is leak detection. It is imperative to know the status of the tanks and lines. Do they leak? Are they being monitored properly? These questions should be asked every day because leakers can kill a business.

In a recent survey of tank owners who have implemented leak detection compliance programs, the Petroleum Marketers Association of America (PMAA) found that over 55 percent of those surveyed were complying with leak detection by the most cost effective methods available: annual tightness testing with monthly inventory control, (35 percent); and statistical inventory reconciliation (SIR), (20 percent). Of the remainder, vapor monitoring account for 10 percent of users, 18 percent use groundwater monitoring, 13 percent have in tank gauging systems, while four percent rely on secondary containment.

State regulatory officials report that there are still a significant number of tank owners who still haven’t complied with any of the regulations. Many owners are afraid to find a problem they don’t want to face. Others do not have the money for major changes in their operation such as detection systems, retrofits and new installation. But, it is no longer a matter of choice. The starting point is baseline leak detection.

Annual tightness testing and statistical inventory reconciliation are the two leading choices. How do they compare?

Annual tightness testing

Annual tightness testing, paired with monthly inventory control, is an approved compliance method for existing tanks and can be used until December 1998.

The volumetric method involves use of sophisticated sensor systems that analyze the product level of a shut down tank over a period of time. There are two non-volumetric technique. One places a vacuum on the tank and uses sensors to listen for a leak. The other uses tracer chemicals in the tank and probes around the tank to detect traces of the foreign chemical. The typical cost for these kinds of tests is around $300 to $700 per tank and line system.

In all cases except the tracer test, the tanks must be shut down for the test to be performed. Some methods require overfilling the tank. Test times vary from two to fourteen hours per test and are performed on site from specially equipped mobile units. Most volumetric methods can be run on shut down tanks while additional tanks are left in operation. Some, however, require that entire installation shut down.

Key issues for a tank owner to ask a supplier about annual tightness testing service include:

- certification of service company,
- performance accuracy of service company,
- amount of downtime necessary to perform test,
- tank filling requirements
- ullage testing requirements,
- manpower and equipment requirements,
- accuracy of results.

Lyle White is vice president of marketing for EnviroQuest Technologies, Inc., Kansas City, Mo.
Statistical inventory reconciliation

Statistical inventory reconciliation was approved by the EPA in 1990. Firms providing inventory reconciliation services must have third party certification credentials under EPA protocols. Statistical analysis relies on data from product volumes. The system reconciles inventory data from daily tank readings. Daily stickings are taken by the tank owner and evaluated by the service firm once a month.

Several states also permit statistical inventory reconciliation as an annual tightness test. In this method, 60 to 90 days of inventory data is analyzed for a tank and line system. A tight or leaking status can be determined and reported according to a specific state’s protocol. Typical cost for statistical inventory reconciliation monthly monitoring program is $250 to $300 per tank per year. Cost for a tightness test is around $100 to 4120 per test.

The operational requirement to implement statistical inventory reconciliation only involves recording the results of daily stickings. The results are converted to gallons, daily sales or outgo is recorded along with deliveries and water levels. This data is reconciled daily and compiled monthly. The system basically uses statistics and time to determine if a tank is leaking or tight.

The time element is a significant factor when comparing annual tightness testing to statistical inventory reconciliation. A statistical evaluation looks for a problem over a 30 day window, while tightness test takes a few hours. Finding a .1 gallon per hour leak over 30 days is easier than trying to find it in two to 14 hours. A leak of .1 gallon per hour over 30 days amounts to 72 gallons. Over the course of a year, that adds up to 876 gallons. When statistical inventory reconciliation is used as a monthly monitor, the tank owner is getting the equivalent of a tightness test every month. Many regulatory officials prefer to know the leaking status every 30 days, because a 72 gallon release is easier to clean up than an 876 gallon leak.

Related tank system problems, like pump and meter miscalibration, bad sticking procedure, delivery errors, tank chart errors and temperature variations show up as trends in monthly statistical inventory analysis. Operators can address such problems promptly when they have better knowledge and more control over monthly throughput.

One concern about statistical inventory reconciliation is the daily sticking procedure. How much room is there for error? Once enough daily measurements are recorded, sticking errors can be analyzed. Over a month, they tend to set themselves apart. But, it is in the tank owner’s best interests to install good sticking procedures in the site operators. Tank owners who have been retraining site operators are getting better accuracy and immediate benefits.

For tank owners looking for new technology in measurement, there are electronic sticks entering the market. Automatic tank level monitors, costing about $1,500 per tank, take accurate measurements of tank volumes, and are relatively easy to install.

Continues on page 50
Compare leak detection from page 49

Some statistical inventory reconciliation firms report "inconclusives" in their data analysis. Some regulatory officials regard an "inconclusive" as a warning flag. Some states are now requiring a verifying mechanical test if the inventory reconciliation of a particular tank shows an inconclusive reading for two consecutive months. Tank owners should review the third party certifications of statistical reconciliation providers for inconclusive rates—the fewer, the better...none is best.

Issues an owner should address to a provider of statistical inventory reconciliation services include:

• certification of service company,
• performance accuracy,
• percentage of "inconclusives" in system evaluation,
• manpower and reporting requirements,
• accuracy of results,
• professional liability insurance,
• availability of a guaranty program.

Annual tightness testing achieves immediate compliance, but will not be accepted after 1998. Statistical inventory reconciliation requires daily tank sticking, but gives continuous leak detection. It is important to choose the method that achieves your goals.

Write in 634 for more information

EPA helps sort leak detection performance

Results of third party testing available to compare features

EPA approved! EPA certified! Best method available! Claims like these abound for leak detection methods. Sales people are just an 800 number away, eager to explain to you why theirs is the best. Perhaps some of the claims are more warranted than others, but how does one sort out what’s what?

For a tank owner trying to buy leak detection service or equipment, for a regulator who must approve such equipment, there is a lot at stake in the decision—the business, liability, the environment.

To help provide facts about leak detection performance, the EPA encourages manufacturers to test their equipment (preferably by a third party) according to a few standard procedures and to report the results in a standard format. The results of these tests provide helpful information to tank owners and regulators. The actual procedures are of more interest to the manufacturers and third party testing organizations.

A separate test procedure is available for each of the following types of leak detection:

A) Automatic tank gauging systems
B) Liquid phase, out-of-tank product detectors
C) Non-volumetric tank tightness testing
D) Pipeline leak detection systems
E) Statistical inventory reconciliation methods
F) Vapor phase, out-of-tank product detectors
G) Volumetric tank tightness testing.

How the methods are evaluated depends on how they work and what is required in EPA’s regulations. For example, tank tightness tests and automatic tank gauging systems are evaluated by conducting a series of tests on a non-leaking tank with various simulated leak rates. The method’s performance (in terms of probability of detection and false alarms) is based on how closely the actual and measured leak rates agree. The evaluation of pipeline leak detection systems determines the same parameters by simulating leaks in a non-leaking pipeline (or by using a large database of results from field testing using the method).

Vapor and liquid monitors are tested in a laboratory setting using various components of petroleum at different concentrations and thicknesses. The detector’s performance is based on its response relative to the amount of product actually present.

statistical inventory reconciliation methods are evaluated by

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supplying the vendor with actual inventory data to which simulated leaks have been added. Performance is determined by comparing the reported to the simulated leak rates.

As a consumer, many of your questions about the performance of a leak detection method should be answered by the short results sheet that is filled out at the completion of the evaluation. For example, the results sheet for tank tightness tests includes the method’s probability of detecting a leak of .1 gallon per hour and the probability of false alarm. The results sheet also provides important limitations on these performance estimates.

Manufacturers can distribute these completed forms as part of their marketing and sales effort. Tank owners can keep the results sheets on file to show inspectors that the method they use meets EPA performance standards.

EPA’s standard test procedures are not the only way to evaluate the performance of leak detection methods. For example, the Edison study of tank tightness testing, which was conducted with a separate test procedure that required a specialized test facility, may also be used to prove that a method meets EPA requirements. Evaluations conducted following a national consensus code or standard, such as ASTM (American Society of Testing Materials), are also acceptable alternatives to EPA’s procedure.

the bottom line is, tank owners and regulators should expect manufacturers of leak detection equipment to provide them with an evaluation that supports the method’s performance claims. Only then can decisions about leak detection be based on facts rather than sales claims. Keep in mind, however, these performance estimates are only valid if the tester or installer follows manufacturer directions. The results sheet provides some consumer guidance by listing the important elements of procedure, so you can check to see that you are getting the method you pay for.

To obtain any of the Standard Test Procedures for Evaluating Leak Detection Methods, write:

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45C-Non-volumetric tank tightness testing
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45E-Statistical inventory reconciliation methods
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45G-Volumetric tank tightness testing

Information for this article was provided by Ellen Frye, editor of LUSTline, a publication of the New England Interstate Water Pollution Control Commission, Boston, Mass.

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Write in 320

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Breaking up is easy to do, from page 7

inflatable packers, rigid air delivery pipe and a patented conical device which evenly disperses the compressed air throughout the “packed off” interval. The process also requires cylinders of compressed air, control manifold and instruments and tilt meters placed on the ground surface to measure surface heave and radius of influence.

Prior to fracturing, a properly designed 3 1/2-inch diameter borehole must be drilled with augers or roller bit. The borehole should be fairly clean to optimize fracturing.

The compressed air cylinders are grouped together with the manifold. Compressed air is transferred from the manifold to the fracturing device via a three-inch flexible hose. The interval to be fractured is sealed off with the two packers, which lock the fracturing equipment in the borehole. The packers are two feet long and designed to allow fracturing within a two-foot interval. Compressed air is delivered to the fracturing interval via a rigid pipe. The end of the pipe is suspended between the two packers. At the base of the pipe is the patented conical device, which evenly disperses the gas throughout the interval. A pressure transducer is incorporated into the two-foot fracturing interval to measure the pressure required to fracture the formation. Air is fed into the interval until the formation fractures, which is indicated by a catastrophic decline in the measurements from the pressure transducer.

Tilt meters are placed about five feet apart in a cross-shaped pattern, radiating out 10 or 15 feet from the fracture well. These meters are highly sensitive to minor changes in surface conditions and are intended to measure the surface heave resulting from the fracturing. Data from these meters is sent to a data logger, which integrates the data and develops a contour of the surface heave using specialized software. The purpose is to provide real time monitoring of surface heave, radius of influence, aperture of fractures and preferred fracture propagation direction.

The vapor extraction unit typically consists of an electric motor driven vacuum pump, a venturi scrubber to extract liquids and/or solids, a vapor phase carbon or catalytic oxidation gas treatment unit, controls to regulate the vacuum and meters to measure vacuum pressure, air flow and gas temperature.

Vent wells must be installed to let surface air enter the subsurface. Normally, when vacuum extraction is applied to high permeable formations, air to replenish what is removed migrates downward from the surface through the formation. However, with low permeability formations, there is no pathway and so vent wells must be installed. By opening and closing vent wells, subsurface air flow and pressures can be controlled to enhance vapor removal.

The hot air injection system introduces hot gases into the subsurface. The equipment is simple, primarily consisting of a blower pump which can either heat ambient air for injection or take the extracted vapor after passing through the carbon and

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re-inject it back into the formation—a closed loop system. Other equipment includes pressure gauges, air flow meters and temperature meters. The theory is that heating the formation will enhance volatilization, thereby increasing removal rates.

Both the vapor extraction and the hot gas injection systems are mounted on a single trailer and require three phase 230-volt power.

Preliminary results from the EPA demonstration show that the fracture orientation was horizontal, with a detectable maximum radius of 25 feet. The pressure required to fracture the formation ranged from 140 to 170 psi. Air flow increased from .5 cubic feet per minute in pre-fracture conditions to as high as 50 cubic feet per minute in the post-fracture condition. Formation temperatures increased five to 10°F. TCE removal was increased 10 times over pre-fracture conditions.

Vapor extraction is probably the technology most directly enhanced by pneumatic fracturing. In low permeability formations, there is not a pathway for surface air to enter the subsurface so vent wells must be installed. By opening and closing selected vent wells, subsurface air flow and pressures can be controlled to enhance vapor removal.

One extraction enhancement approach currently under evaluation is pulsing. Pulsing involves building up the vacuum in the subsurface with the vent wells capped. This enhances volatilization by reducing vapor pressure. Once the vacuum develops to sufficient levels, select vent wells are uncapped to allow a “flush” effect to occur.

Pressurized gas used in pneumatic fracturing can also inject nutrients and microbes deep into an impermeable formation to stimulate bioremediation. Tests are underway to investigate the ability of microbes to survive pneumatic injection under high pressures. Preliminary data indicates that 35 to 50 percent of the microbes survive.

Again, as with soil vapor extraction, vent wells are important. A slight vacuum is placed on the fracture well. Vent wells allow oxygen to enter the subsurface to maintain aerobic microbe activity. Vent wells can also be used to reinject microbes and nutrients.

Another companion technology to pneumatic fracturing is hot gas injection, which also appears to lend itself to pulsing. During the SITE demonstration, soil vapor extraction and hot gas injection removal rates of TCE leveled off after two days. At the end of the five day test, the test plot was allowed to remain dormant over a three day week-end. A “first flush” TCE sample was 2.5 times the leveled off value. This indicates that hot gas injection may cause formation temperatures to build up with vent wells capped and minimal vapor extraction. The hot gas injection is stopped, vapor extraction builds up vacuum with capped vent wells. Finally, the vent wells are uncapped and vapor extraction flushes the formation.

As a potential treatment alternative for low permeability materials, pneumatic fracturing offers practical, cost-effective enhancement for these sites to respond to vapor extraction, bioremediation and thermal treatments. The technology still must prove itself. McLaren/Hart has developed a package pilot test and is looking for suitable sites to apply the process.

Write in 627 for more information.
How dirty is clean?

State standards offer a moving target

By Susan Parker

This issue contains our third annual state-by-state summary of cleanup standards. This is an interesting project on many levels. It is interesting to see the various approaches the states take to establishing standards. In many cases, the levels are “guidelines,” “recommendations” or even “suggestions” rather than “laws.”

Several states that submitted statistical levels last year turned in “site specific” as the target guideline this year. This would seem to indicate a trend toward more site-by-site approaches to petroleum releases. I think everyone is sympathetic to the fact that there is no “single bullet,” best approach for all sites. The variables are mind-boggling.

And, it is interesting to note that while we were able to get specific information from all 50 states last year, this year, three states are in the process of revising standards—unable to submit more than a phone number to call. That seems a bit scary, as “We have laws you must obey, we just have to figure out what they are!”

Perhaps the most interesting aspect of the state-by-state summary, however, is that it begs the old question, “how clean is clean? (how dirty is dirty?)” Can a single, objective quantity of, say, benzene or toluene in the soil be proved to be absolutely safe under all circumstances and for all time?

By collecting all this data, are we really only promoting arbitrary levels of acceptability that apply more to whether a penalty is to be imposed than with human and environmental health?

Indeed, the long term effects of petroleum contamination in the soils is still largely unknown. The state of scientific research in the environmental fate and transport of hydrocarbons in the subsurface has a long way to go.

The other side of the coin is, of course, the need to start somewhere, to establish some boundaries, however imperfect, to provide a framework to identify and deal with contaminated sites.

The outlook for cleanup levels

pneumatic fracturing (article on page 6), in order to better apply the regulations.

Site owners and responsible parties who perceive the regulators and the regulations as “the enemy” would do well to contact any level of government to find help and encouragement—not threats and penalties. (See, “Five best tips to work with regulators,” page 13.) The existence of the state funds should serve as a clear signal to owners and responsible parties that the government is more interested in problem-solving than in passing out punishment. Without exception, the source people cited in the state-by-state summary are eager to help, forthcoming with information and generally approachable. They will not respond to your call with questions about your exact address and handcuff size, but rather with helpful suggestions for anyone trying for compliance.

The whole petroleum contaminated soils problem depends heavily on the exchange of information. Defining the problems and solutions is a massive and ever-changing task. The extensive changes in this year’s summary prove the rapid evolution of the industry.

Changes in the definition of the problem are as dynamic as the changes in the new solutions that are continually being proposed.

In an industry defined and driven by multiple layers of changing governmental regulation, we could probably update the state standards in each issue...maybe every day and twice on Sundays. For now, we’ll leave it as an annual event, unless it eventually becomes 10 pages of “sitespecificsitespecificsite specificsite specificsitespecific...”
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Midland Machinery Co., Inc., of Tonawanda, N.Y., says their mix trailers are specifically suited for easy transport and quick set up at contaminated sites. The unit is a self-contained, portable mixing plant complete with aggregate hopper, conveyor, twin shaft pugmill mixer and asphalt system on trailering frame and axle. At the job site, the mix trailer hydraulically lifts itself off the truck and lowers itself to the ground. The twin shaft pugmill is driven by a hydraulic motor powerful enough to stop and restart under full load. The iron alloy paddle tips are bolted on for replacement. Sticky or dense petroleum contaminated soils flow off the steep sided hopper. Curved mixer liner, of manganese alloy, prevents dead spots in mixing chamber. Closely spaced feeder rollers minimize material leakage. The unit is equipped with optional hopper divider to make two compartments to allow blending of contaminated soils with clean aggregate. Hopper height is eight feet above ground level to eliminate ramping for small loaders. The unit can also be outfitted with a variable speed pumping system to introduce water or other treatment liquid into the mixer. Depending on soil type, the mix trailer can process 200 to 700 tons per hour. The mix trailer can meter, blend and mix liquid or dry reagents with contaminated soil, recycled materials and new aggregates at ambient temperature. Treated soil may be used as road base mix or safely remain on site. The control functions include an option to automatically set mix proportions to weigh aggregate and control asphalt cement introduction into the system. A fines feeder is available to allow the addition of cement or lime type material for soil stabilization projects. The overall size is 8 feet wide by 13 feet high to allow for over the road hauling at highway speeds without special permit, says the company.

Write in 635 for more information.

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In situ soil venting is ideally suited for remediation of the unsaturated zone. The contaminant must be relatively volatile and exert a vapor pressure PVC-.001 atm at the ambient temperature. Examples are gasoline and solvents such as trichloroethylene. It is also possible to remove less volatile compounds by adding heat to the contaminated zone. The soil should also be relatively permeable to airflow. A permeability of more than one darcy (silty sands) is a good guideline. Typically, venting does not efficiently remediate soils contaminated with heavy compounds such as crude oil or jet fuels—or low permeability formations such as soils with high clay content. Venting wells are usually two to four-inch diameter PVC pipe, screened through the contaminated region. They must be sealed properly to minimize "short-circuiting" airflow through the well casing. The vacuum pump should be capable of 100 scfm at 40-200 inches H2O vacuum. Usually vapor flow rates are >20 cfm from each well. A surface covering (tarp, pavement or clay) can minimize vertical air flow from the atmosphere. Information from Shell Remediation Workshop Handbook.

Write in 636 for more information.
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General Analysis Corp. TPH Field Extraction System

- Using a solid phase extraction technique, field personnel can prepare a 20 gram soil sample for infrared analysis in 15 minutes, says General Analysis Corp., South Norwalk, Conn. The method calls for 20 ml of 1,1,2-trichlorotrifluoroethane (Freon-113™) to be added to the soil sample in a glass vial. Shake the vial by hand for five minutes. Allow to settle for one minute. The total petroleum hydrocarbon (TPH)-containing solvent layer is poured into a reservoir containing particulate filters and a silica gel cleaning cartridge. An air syringe pressurizes the reservoir and passes the extract through the cleaning cartridge. The silica gel adsorbs non-petroleum hydrocarbons. The sample extract can be analyzed on most infrared spectrometers in a laboratory, or in the field with a portable TPH analyzer. Infrared analyzers measure the absorption of infrared energy by the petroleum hydrocarbons in the 3.4 micron region. GAC says their TPH-Plus model also uses a separate infrared filter at the 3.3 micron wavelength to detect aromatic hydrocarbons—such as those present in a fresh gasoline spill. A pair of short focal length, large aperture mirrors collect radiation from a glowing wire source and focus it into the quartz cuvette. Exiting radiation is collected by a similar pair of mirrors and focused on the detectors. Filters admit only selected analytical and reference wavelengths. Both aromatic and TPH concentrations are reported simultaneously on separate digital displays. Disposable sampling packages consist of alcohol-washed plastic reservoirs with particulate filters, silica gel cleaning cartridges and vials with caps and septa. The hardware contains air syringe with metal sealer to pressurize the plastic reservoirs, sample rack and spatula to transfer soil to the vials.

Write in 637 for more information.
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Proceedings will be published after the conference and will include manuscripts from both oral and poster presentations. Presenters will be required to submit a manuscript by December 1, 1992. Exhibition space is available. For further information, please contact:
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Write in 228
This is not what we do. This is what we save.

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

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

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

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

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