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L.U.S.T.LINE

A Report On Federal & State Programs To Control Leaking Underground Storage Tanks

EPA's Blue Ribbon Panel Takes On the MTBE Specter

by Ellen Frye

On July 27, after six months of meetings, information gathering, and deliberation, EPA's Clean Air Act Advisory Committee Panel on Oxygenate Use in Gasoline, aka "the Blue Ribbon Panel," announced its findings and recommendations. In its report, the panel recognized that MTBE can pose risks to water supplies and that to minimize current and future threats to drinking water, "the use of MTBE should be reduced substantially." The panel also set forth a number of purposeful recommendations designed to "enhance, accelerate, and expand" existing federal, state, and local programs to protect, treat, and remediate water supplies.

The report states emphatically that the recommendations are meant to be "implemented as a *single package* of actions designed to simultaneously maintain air quality benefits while enhancing water quality protection and assuring a stable fuel supply at reasonable cost." There's some wisdom in this thinking—If you've got a holey bucket that won't hold water, and you mend just some of those holes, you've still got a bucket that won't hold water.

The panel urged "rapid" implementation of its recommendations. In announcing the findings, U.S. EPA Administrator Carol M. Browner said, "We must begin to significantly reduce the use of MTBE in gasoline as quickly as possible." She noted that when the panel was assembled, her goal was "to protect public health and the environment by ensuring that Americans have both cleaner air and cleaner water—and never one at the expense of the other."

Browner appointed the panel of leading MTBE-related experts in November 1998 to investigate the air quality benefits and water quality concerns associated with oxygenates in gasoline and to provide independent advice and recommendations on ways to maintain air quality while protecting water quality.

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Inside

■ Blue Ribbon Panel *from page 1*

Many of the findings of the Blue Ribbon Panel are similar to those of the Advisory Panel on the Leak History of New and Upgraded UST Systems, convened by the California State Water Resources Control Board, which issued its report in January 1999. That panel was asked to review existing databases of UST contamination sites to determine whether a leak history is associated with UST systems meeting the 1998 federal and state standards and, if so, to identify appropriate measures that would assure the prevention and detection of oxygenate releases from retail marketing facilities.

Can We Have Our Fuel and Keep It Out of the Environment, Too?

The states of California and Maine have led the charge on the MTBE front. Concern about the presence of MTBE in the environment has prompted both states to take a number of actions to assess the situation and find ways to prevent MTBE from escaping into the environment. These steps include California's decision to phase out the use of MTBE in gasoline sold in the state by December 2002 and Maine's decision to opt out of the federal Reformulated Gasoline (RFG) Program.

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The lion's shares of the recommendations of both the California and Blue Ribbon panels, regarding the UST program, reflect the wish lists, if not the agendas, of state and federal UST regulators across the country.

"The Blue Ribbon Panel's recommendations dovetail real well with the issues we identified a while back," says Sammy Ng, Acting Director of EPA's Office of Underground Storage Tanks, "in terms of evaluating UST systems that are in place to see how they are working and the effectiveness of leak detection systems. We share many of the priorities listed in the panel's report."

Finding the resources and the political will to carry out such recommendations to the fullest extent possible is the prickly part of the picture. UST regulators have their work cut out for them just in dealing with the 1998 deadline stragglers. Yet, here we have a series of recommendations that ask EPA (and the states) to revisit existing standards and regulations, increase enforcement, step up research, and look into expanding the universe of regulated tanks to include underground and aboveground fuel tanks not currently regulated.

Soooo... What Now?

The real question that we as a society have not truly answered is this: Are we willing to commit the resources required to minimize the presence of MTBE in the environment? The Blue Ribbon Panel came up with recommendations that are meant to keep MTBE from escaping into the environment. What remains to be seen is how big a commitment our legislatures, regulators, local governments, and John Q. Citizens are willing to make to achieve this goal. That being said, let's see what the Blue Ribbon Panel had to say. ■

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LUSTLine

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BLUE RIBBON PANEL ISSUE PAPERS TO BE POSTED ON THE WEB

Issue Summary papers will be posted on the Blue Ribbon Panel on Fuel Oxygenates Web page (http://www.epa.gov/oms/consumer/fuels/oxypanel/blueribb.htm) early this fall. The papers will cover the following topics:

- **Water Contamination**
- **Air Quality Benefits**
- **Fuel Supply and Cost**
- **Comparing the Fule Additives**
- **Prevention, Treatment, and Remediation**

The Findings and Recommendations of the Blue Ribbon Panel on Oxygenates in Gasoline (Condensed)

THE FINDINGS...

Based on its review of the issues, the panel came up with the following overall findings:

- The distribution, use, and combustion of gasoline pose risks to our environment and public health.
- RFG provides considerable air quality improvements and benefits for millions of U.S. citizens.
- Due to its persistence and mobility in water, MTBE is more likely to contaminate ground and surface water than the other components of gasoline.
- The occurrence of MTBE in drinking water supplies can and should be substantially reduced.
- MTBE is currently an integral component of the U.S. gasoline supply in terms of both volume and octane. As such, changes in its use, with the attendant capital construction and infrastructure modifications, must be implemented with sufficient time, certainty, and flexibility to maintain the stability of both the complex U.S. fuel supply system and gasoline prices.

THE RECOMMENDATIONS...

According to the panel, the majority of these recommendations could be implemented by federal and state environmental agencies without further legislative action. The panel urges all parties to work with Congress to implement those recommendations that require legislative action.

FOR ENHANCING WATER PROTECTION

Prevention

- Take the following actions to enhance significantly the federal and state UST programs:
  - Accelerate enforcement of rules requiring the replacement of existing tank systems to conform with the federally required December 22, 1998, deadline for upgrade, including, at a minimum, moving to have all states prohibit fuel deliveries to nonupgraded tanks and adding enforcement and compliance resources to ensure prompt enforcement action.
  - Evaluate the field performance of current system design requirements and technology and, based on that evaluation, improve system requirements to minimize leaks/releases, particularly in vulnerable areas.
  - Strengthen release detection requirements to enhance early detection, particularly in vulnerable areas, and to ensure rapid repair and remediation.
  - Require monitoring and reporting of MTBE and other ethers in groundwater at all UST release sites.
  - Encourage states to require that the proximity to drinking water supplies, and the potential to affect those supplies, be considered in land-use planning and permitting decisions for siting of new UST facilities and petroleum pipelines.
  - Implement and/or expand programs to train and license UST system installers and maintenance personnel.
  - Work with Congress to examine and, if needed, expand the universe of regulated tanks to include underground and aboveground fuel storage systems that are not currently regulated yet pose a substantial risk to drinking water supplies.
- Enhance implementation of the federal and state Safe Drinking Water Act programs in the following ways:
  - Accelerate, particularly in those areas where RFG or oxygenated fuel is used, assessments of drinking water source protection areas required in Section 1453 of the 1996 Safe Drinking Water Act Amendments.
  - Coordinate the Source Water Assessment program in each state with federal and state UST programs using geographic information and other advanced data systems to determine the location of drinking water sources and to identify UST sites within source protection zones.
  - Increase ongoing federal, state, and local efforts in Wellhead Protection Areas as follows: enhance permitting, design, and system installation requirements for USTs and pipelines in these areas; strengthen efforts to ensure that nonoperating USTs are properly closed; enhance UST release prevention and detection; and improve inventory management of fuels.

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- Enhance efforts to protect lakes and reservoirs that serve as drinking water supplies by restricting use of recreational watercraft, particularly those with older motors.
- Implement expanded programs to protect private well users.
- Implement, through public-private partnerships, expanded public education programs at the federal, state, and local levels on the proper handling and disposal of gasoline.
- Develop and implement an integrated field research program into the groundwater behavior of gasoline and oxygenates that includes the following steps:
  - Identifying and initiating research at a population of UST release sites and nearby drinking water supplies, including sites with MTBE, sites with ethanol, and sites using no oxygenates; and
  - Conducting broader, comparative studies of levels of MTBE, ethanol, benzene, and other gasoline compounds in drinking water supplies in areas using primarily MTBE, areas using primarily ethanol, and areas using no or lower levels of oxygenates.

Treatment and Remediation

- EPA should work with Congress to expand resources available for the up-front funding of the treatment of drinking water supplies contaminated with MTBE and other gasoline components to ensure that affected supplies can be rapidly treated and returned to service, or that an alternative water supply can be provided. This effort could take a number of forms, including but not limited to:
  - Enhancing the existing federal LUST Trust Fund by fully appropriating the annual available amount in the fund, ensuring that treatment of contaminated drinking water supplies can be funded, and streamlining the procedures for obtaining funding;
  - Establishing another form of funding mechanism that ties the funding more directly to the source of contamination; and
  - Encouraging states to consider targeting State Revolving Funds (SRF) to help accelerate treatment and remediation in high-priority areas.
- Given the different behavior of MTBE in groundwater as compared with that of other components of gasoline, states in RFG and oxyfuel areas should reexamine and enhance state and federal "triage" procedures for prioritizing remediation efforts at UST sites based on their proximity to drinking water supplies.
- Accelerate laboratory and field research, as well as pilot projects, for the development and implementation of cost-effective water supply treatment and remediation technology, and harmonize these efforts with other public/private efforts already under way.

FOR BLENDING FUEL FOR CLEAN AIR *AND* WATER

Inasmuch as even enhanced protection programs will not give adequate assurance that water supplies will be protected, changes need to be made to the RFG program to reduce the amount of MTBE being used, while ensuring that the air quality benefits of RFG, as well as fuel supply and price stability, are maintained.

Given the complexity of the national fuel system, the advantages and disadvantages of each of the fuel blending options that the panel considered, and the need to maintain the air quality benefits of the current program, the panel recommended an *integrated package* of actions by both Congress and EPA that should be *implemented as quickly as possible.* The key elements of that package are as follows:

- Action to reduce the use of MTBE substantially, and action by Congress to clarify federal and state authority to regulate and/or eliminate the use of gasoline additives that threaten drinking water supplies;
- Action by Congress to remove the current 2 percent oxygen requirement to ensure that adequate fuel supplies can be blended in a cost-effective manner while quickly reducing usage of MTBE; and
- Action by EPA to ensure that there is no loss of current air quality benefits.

Reducing the Use of MTBE

The panel agreed broadly that, to minimize current and future threats to drinking water, the use of MTBE should be reduced substantially. Several members believed that the use of MTBE should be phased out completely.

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The panel recommended that Congress act quickly to clarify federal and state authority to regulate and/or eliminate the use of gasoline additives that pose a threat to drinking water supplies.

Initial efforts to reduce additive levels should begin immediately, with substantial reductions to begin as soon as the removal of the 2 percent oxygen requirement is implemented. Accomplishing any such major change in the gasoline supply without disruptions to fuel supply and price will require adequate lead time—up to four years if the use of MTBE is eliminated, sooner in the case of a substantial reduction (e.g., returning to historical levels of MTBE use).

The other ethers (e.g., ETBE, TAME, and DIPE) have been less widely used and studied than MTBE. To the extent that they have been investigated, they appear to have similar, but not identical, chemical and hydrogeologic characteristics. The panel recommended accelerated study of the health effects and groundwater characteristics of these compounds before they are placed in widespread use.

In addition, EPA and others should accelerate ongoing research efforts into the inhalation and ingestion health effects, air emission transformation by-products, and environmental behavior of *all* oxygenates and other components likely to increase in the absence of MTBE. This program should include research on ethanol, alkylates, and aromatics, as well as on gasoline compositions containing those components.

To ensure that any reduction is sufficient to protect water supplies, EPA, in conjunction with USGS, the Departments of Agriculture and Energy, industry, and water suppliers, should move quickly to:

- Conduct short-term modeling analyses and other research based on existing data to estimate current and likely future threats of contamination;
- Establish routine systems to collect and publish, at least annually, all available monitoring data on use of MTBE, other ethers, and ethanol; levels of MTBE, ethanol, and petroleum hydrocarbons found in ground, surface, and drinking water; and trends in detections and levels of MTBE, ethanol, and petroleum hydrocarbons in ground and drinking water; and
- Identify and begin to collect additional data necessary to adequately assist the current and potential future state of contamination.

The Wintertime Oxyfuel Program

The panel recommends that the Wintertime Oxyfuel program be continued (a) for as long as it provides a useful compliance and/or maintenance tool for the affected states and metropolitan areas, and (b) assuming that the clarification of state and federal authority described above is enacted, to enable states, where necessary, to regulate and/or eliminate the use of gasoline additives that threaten drinking water supplies.

FOR EVALUATING AND LEARNING FROM EXPERIENCE

The introduction of reformulated gasoline has had substantial air quality benefits, but has also raised significant questions that should be answered before the widespread introduction of any new, broadly used product. The unanticipated effects of RFG on groundwater highlight the importance of exploring the potential for adverse effects in all media (air, soil, and water), and on human and ecosystem health, before the widespread launch of any such product.

To prevent such incidents in the future and to evaluate the effectiveness and impact of the RFG program, EPA should:

- Conduct a full, multimedia assessment (of effects on air, soil, and water) of any major new additive to gasoline prior to its introduction;
- Establish routine and statistically valid methods for assessing the actual composition of RFG and its air quality benefits, including the development, to the maximum extent possible, of field monitoring and emissions characterization techniques to assess "real world" effects of different blends on emissions;
- Establish a routine process, perhaps as part of the Annual Air Quality trends reporting process, for reporting on the air quality results from the RFG program; and
- Build on existing public health surveillance systems to measure the broader effects (both beneficial and adverse) of changes in gasoline formulations on public health and the environment.

The "Executive Summary and Recommendations of the Blue Ribbon Panel on Fuel Oxygenates" can be found on the panel's Web page: http://www.epa.gov/oms/consumer/fuels/oxypanel/blueribb.htm.
The "Report of the State Water Resources Control Board's Advisory Panel on the Leak History of New and Upgraded UST Systems" can be accessed at http://www.swrcb.ca.gov/~cwphome/ust/usthmpg.htm.

Standards

A Drinking Water Standard for MTBE?
The Ifs and Whens of Establishing an MCL

by Rachel Sakata

The Long and Winding Road

Many steps are involved in establishing a drinking water standard or maximum contaminant level (MCL). Drinking water standards are regulations that the U.S. Environmental Protection Agency (EPA) sets to control the level of contaminants in the nation's drinking water. The Safe Drinking Water Act (SDWA) identifies several factors that affect the level at which an MCL is set: known or anticipated adverse human health effects, the ability of various technologies to remove the contaminant, their effectiveness, and cost of treatment. All MCLs are set at levels that protect public health. The process of establishing an MCL for a given contaminant from start to finish can take 10 years or longer.

Step number one in developing a regulation is to identify drinking water problems. Currently, there are thousands of contaminants that could affect drinking water quality. Priority contaminants are selected carefully with an eye toward ensuring that expenditures for drinking water protection are effective at the federal, state, and local levels.

If EPA determines that a contaminant poses a threat to human health, it is placed on the agency's Contaminant Candidate List (CCL). Once placed on this list, these contaminants become the focus of EPA's drinking water program over a period of years. EPA receives advice on which contaminants to include on the CCL from scientific advisory panels such as the Science Advisory Board (SAB), the National Drinking Water Advisory Council (NDWAC), and the public. Contaminants on the CCL are classified into three categories: contaminants ready for regulatory determinations, those requiring additional research, and those for which more occurrence data are needed.

The SDWA mandates that EPA make regulatory determinations based on three factors:

- Risk that a contaminant may pose to human health,
- The frequency with which a contaminant of concern occurs in drinking water supplies, and
- The "meaningful" opportunity for health risk reduction achieved through regulation of the contaminant.

If a regulatory determination is made, EPA will need approximately three and a half years for rule development. Thus, the earliest EPA would have a regulation for MTBE is 2010.

Once the contaminants have been selected and categorized on the CCL, the SDWA requires EPA to select five or more contaminants from the regulatory determination priorities category and, by 2001, determine whether to regulate them. If EPA determines that a regulation is necessary, the agency has three and a half years to issue a final regulation. The first CCL was published in February 1998, meaning that the first regulations to result from that list will be published in February 2005. The CCL and the decision to regulate operate on a five-year cycle; any contaminant that is not chosen in this round will not be regulated until 2010.

If EPA feels it does not have the information to make a regulatory determination for a contaminant on the CCL, then it is listed under the occurrence and research priority lists. The research priority list is designed to address additional information needed on health, treatment technologies, and analytical methods for the contaminant. The occurrence priority list addresses occurrence data gaps for that contaminant.

The MTBE Timeline

So how does this MCL process relate to MTBE? MTBE was placed on the February 1998 CCL with the indication that further health effects, occurrence, and treatment technique information was needed before a regulatory determination could be made. Since then, EPA has determined that suitable treatment technologies exist; however, more health effects and occurrence information is still needed.

EPA will gather occurrence information through the Unregulated Contaminant Monitoring Rule (UCMR), a vehicle for assisting the agency in obtaining national occurrence information for MTBE, beginning in 2001. EPA is also awaiting the completion of ongoing health effects studies.

Inasmuch as EPA does not expect to have this information for MTBE by 2001, when the agency makes its first round of regulatory determinations on contaminants on the CCL, a regulatory determination for MTBE could not be made until 2006. Keep in mind, however, this determination depends on whether EPA decides there is enough information for MTBE to move into the regulatory determinations category. If a regulatory determination is made, EPA will need approximately three and a half years for rule development. Thus, the earliest EPA would have a regulation for MTBE is 2010. ■

Rachel Sakata is an Environmental Protection Specialist with the U.S. Environmental Protection Agency Office of Ground Water and Drinking Water.

Leak Prevention

Are Upgraded UST Systems Leaking? The Santa Clara Valley Water District's Study

by Ron Kern

As part of a multipronged effort to protect Santa Clara County's water supplies, California's Santa Clara Valley Water District (SCVWD) conducted a study to determine whether methyl tertiary butyl ether (MTBE) is leaking from UST systems that comply with 1998 federal- and state-mandated upgrade requirements. The results, although inconclusive for the main objective, are nonetheless significant in other areas. The three-volume Groundwater Vulnerability Pilot Study, *Investigation of MTBE Occurrence Associated with Operating UST Systems,* was finalized on July 22, 1999.

The study was driven by the SCVWD's growing awareness that, as shown by anecdotal information of undetected releases at 1998 upgrade-compliant UST facilities, UST releases and MTBE are still very much with us. The Water District also recognized that there were more detections of MTBE at active site LUSTs (83%) than at inactive site LUSTs (59%) in the county.

Selection criteria for this study were threefold: candidate USTs had to be storing or distributing gasoline; have no known release of fuel containing MTBE based upon review of regulatory files and databases; and be in compliance with 1998 upgrade requirements. Using a database of more than 2,000 sites reporting petroleum storage or use in the county, the USTs that fit the first three criteria were further winnowed by a ranking process that included proximity of the UST site to a known LUST site, proximity to a potable-use well, and prior land use. In addition, facilities selected provided a good cross section of UST systems with single- and double-walled tank construction, single- and double-walled piping, and fiberglass and steel UST material.

The study population ultimately consisted of 28 facilities with 65 USTs. The SCVWD was able to gain on-site access at 17 of the 28 facilities but was able to conduct off-site investigations only for the remaining 11 facilities.

The Investigation

Investigation methods were comprehensive and included a preliminary site inspection and coordination with the UST facility owner/operator. At on-site locations, soil-gas surveys and cone penetrometer testing (to determine soil types and depth to groundwater) were conducted. Continuous core sampling was used to obtain lithologic and depth-to-water information at off-site localities. Soil and groundwater samples were collected at both on-site and off-site locations. Sampling targeted the tank(s), dispenser island(s), and any surface and other features that might collect or localize fuel releases containing MTBE.

> *The study was driven by the SCVWD's growing awareness that, as shown by anecdotal information of undetected releases at 1998 upgrade-compliant UST facilities, UST releases and MTBE are still very much with us.*

The data were compiled and summarized in 28 detailed site reports, which make up the majority of the more than 600-page report. Finally, statistical determinations were conducted to determine the relationship between MTBE in groundwater and various UST system components or features at a site.

The Findings, the Questions

MTBE was detected in soil gas at 9 of the 17 on-site localities and in soil samples at 15 of the 28 total facilities (5.1 to 15,000 $\mu g/kg$). Groundwater was encountered at 27 of the 28 facilities, ranging from depths of 8 feet to 97 feet. MTBE was detected in groundwater at 13 of the 27 facilities (0.55 to 200,000 $\mu g/L$), with 5 of the facilities having concentrations exceeding 1,000 $\mu g/L$. One or more other oxygenates (DIPE, ETBE, TAME, or TBA) were also detected in groundwater at these same 5 facilities. Benzene was detected in groundwater, but only at 7 of the 27 facilities and at concentrations less than 100 $\mu g/L$.

With the possible exception of one site, the SCVWD study was ultimately unable to determine whether releases of MTBE had occurred from upgraded UST systems. The data do indicate, however, that MTBE may be contaminating groundwater at about 50 percent of UST facilities meeting the 1998 upgrade requirements in Santa Clara County.

Furthermore, because there were no known releases of MTBE from these UST systems prior to the study, these facilities have experienced *undetected releases* of MTBE that have had an impact on soils and potentially groundwater. The question is, Why? Are these leaks related to a particular component of the storage or distribution system? Are releases occurring from places that are beyond the capacity of the leak detection method to detect? Are most or all of the leaks occurring as vapor-phase releases? Or, are the leak detection methods inadequate or not properly conducted?

Statistical correlations were conducted to determine whether the probability of an MTBE release could be related to any particular system component. The only statistically significant correlation found in this study was the likelihood of an MTBE occurrence associated with a "vacuum-assisted" versus a "balanced" Stage II vapor recovery

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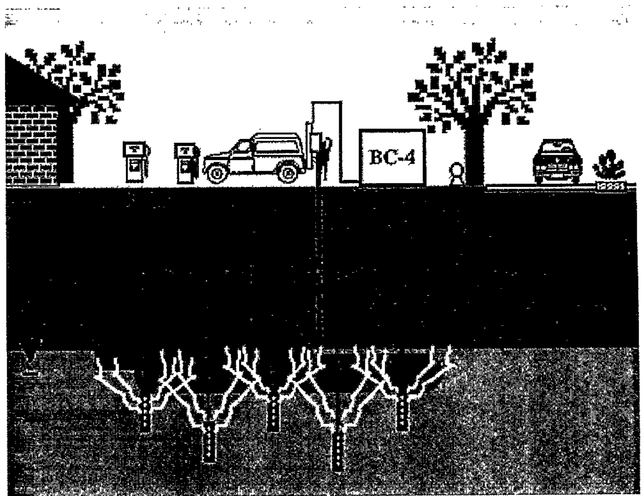
Investigation and Remediation

Using In Situ Biobarriers to Rapidly Degrade MTBE in Subsoils and Groundwater

By Joseph Salanitro and Paul Johnson



The Clean Air Act of 1990 mandated the use of oxygenated chemicals (i.e., MTBE and/or ethanol) in reformulated motor vehicle gasoline (RFG) to reduce tailpipe emissions of carbon monoxide. MTBE (methyl tertiary butyl ether), however, is the most widely used oxygenate. Although MTBE has been used as an octane enhancer since 1979, its current use in gasoline varies from 11 to 15 percent on a volume/ volume basis (where used) depending on the sale of fuel during the summer/winter seasons. It is now widely recognized that the presence of varying concentrations of MTBE in groundwater is the result of the accidental release of MTBE from storage tanks and delivery systems at retail and nonretail fuel stations.

Studies conducted by the Lawrence Livermore National Laboratory, the U.S. Geological Survey, the University of Texas, the American Petroleum Institute, and the petroleum industry have shown that, in many cases, the migration of MTBE in aquifers behaves differently than those of aromatic hydrocarbons (e.g., BTEX). Analysis of the physical, chemical, and biodegradability properties of MTBE indicate that this ether is more water-soluble (28-280 times), has a lower octanol/water partition coefficient (6-60 times), has a lower soil sorption coefficient (2-10 times), and is much less biodegradable (5-10 times) than BTEX compounds.

These inherent features of MTBE indicate that groundwater plumes of MTBE may be longer and more persistent than those of BTEX alone. In this respect, some MTBE plumes have varied from a few hundred to several thousand feet from the original spill source. The extent of soluble MTBE migration and its vertical and horizontal distribution in groundwater, however, are influenced by the local hydrogeology (i.e., soil type, hydraulic conductivity, water table gradient, and fluctuation), presence of a confined or unconfined aquifer, groundwater velocities, and advective dispersion and dilution along the aquifer flow path. Source areas containing free or residual-phase gasoline also affect the extent and persistence of MTBE plumes because of "water washing" and seasonal water table fluctuations in these zones.

Microbial Cultures That Degrade MTBE

Research for determining the potential for biodegradation of MTBE began in 1989 at the Shell Westhollow Technology Center, now part of the Shell-Texaco alliance, as part of an effort to develop cost-effective technologies for soil and groundwater remediation and water treatment of MTBE. Our current understanding of the metabolism of MTBE indicates that the ether is cleaved to t-butyl alcohol (TBA), a primary but transient metabolite. TBA is then oxidized via the sequence TBA→ isopropyl alcohol → acetone → pyruvate → acetate → CO_2.

Mixed cultures [e.g., biological culture (BC) consortia] developed in our laboratory can metabolize MTBE and all of its downstream metabolites at high rates. BC bacterial cultures can also oxidize several other ethers, including ethyl-t-butyl ether (ETBE), t-amyl methyl ether (TAME), diisopropyl ether (DIPE), n-butyl methyl ether, and n-butyl ethyl ether.

Three types of naturally occurring mixed or single bacterial cultures have been isolated that can degrade MTBE partially or completely:

- Cometabolic systems, such as those requiring another substrate (e.g., propane, pentane, isoalkanes, or cyclohexane) to induce an existing oxygenase enzyme system, have been shown to partially degrade (only to TBA) or completely degrade MTBE. When using cometabolic substrates, however, it may be more difficult to maintain and sustain activity. There are also mixing and delivery problems with gaseous substrates in inducing aquifer soil populations.
- Mixed microbe culture enrichments derived from refinery or chemical biotreaters can degrade MTBE to CO_2.
- Aerobic single cultures (SC) such as *Rhodococcus* sp. (SC-100) derived from our BC mixed culture or a *Rubrivivax* sp. derived from a municipal biofilter enrichment are possible. These single cultures also degrade MTBE similarly to mixed consortia. Anaerobic transformation of MTBE appears to be uncommon; in one case it has been shown that MTBE is metabolized to TBA only by a methanogenic river sediment culture.

Our studies on the ability of BC or SC cultures to grow on MTBE and TBA as sole carbon sources indicate that low cell yields are obtained. The growth rate and low yields are 5 to 10 times lower than comparable growth on sugars, aromatic hydrocarbons (e.g., BTEX), or alkanes.

The Case for Aquifer Bioaugmentation

Several of the gasoline releases from USTs indicate that MTBE plumes have extended beyond BTEX plumes. Laboratory soil/groundwater microcosm experiments with aquifer material from these sites indicate that low numbers of MTBE-degraders or weak ether-degrading activity is usually observed and is much less than that for BTEX compounds.

It is well known that BTEX plumes are largely attenuated in aerobic aquifers because of the rapid growth and metabolism of indigenous soil microbes on these hydrocarbons. By contrast, the natural decay of MTBE occurs slowly or not at all because of the low numbers of degraders and the inability of bacteria to grow on the ether. In MTBE plumes, "microbial enrichment" does not occur to any significant degree and the plume "grows" primarily by advection with dispersion and dilution. In other words, the microbial growth rate on MTBE in the aquifer is much slower than the groundwater velocity.

We have investigated the effect of adding specialized, high-activity, MTBE-degrading bacterial cultures to soils and groundwater. Microcosms prepared from site aquifer material amended with BTEX and MTBE (5-80 mg/L) and inoculated with mixed (BC) or single (SC-100) cultures of MTBE-degraders that we have identified rapidly degrade MTBE at rates comparable to the natural decay of BTEX compounds. These results suggest that significant in situ bioremediation of MTBE in aquifers is possible with the implantation of high-activity cultures.

The concept of a biobarrier is to "seed" (inject) microbes into the aquifer at an appropriate point. The inoculant is distributed vertically throughout the zone of contamination. An intermittent air or oxygen injection manifold system installed throughout the biobarrier ensures that sufficient dissolved oxygen is present in the seeded treatment zone to sustain MTBE biodegradation. Bioaugmenting source zones containing residual-phase gasoline with high-activity cultures has also been shown to reduce the "growth" of MTBE plumes and lower the "bounce back" effect when remaining non-aqueous-phase liquid (NAPL) "feeds" the plume.

In the O_2 and biobarrier plot, MTBE declined in the seeded zone soon after implantation of the BC-4 culture and was nondetectable (<1 µg/L) in shallow wells after 260 days. TBA levels also declined below detectable levels (<10 µg/L) in the bioaugmented plot.

The Port Hueneme Experiment

The first field demonstration of a biobarrier seeded with a high-activity culture occurred in June 1999 at the U.S. Naval Construction Battalion Center in Port Hueneme, California. Analysis of monitoring wells at the base indicates that the MTBE plume has traveled over 4,500 feet and is 400 feet wide. Although 75 percent of the soluble plume is only MTBE, much of the BTEX constituents have been bioattenuated.

The surficial aquifer is approximately 10 to 20 feet below the ground surface, and the apparent the groundwater velocities vary from 0.1 to 0.3 foot per day. Our test was located midway down the advancing MTBE plume and contained ether concentrations from 2,000 to 8,000 µg/L and dissolved oxygen (DO) levels of less than or equal to 1 mg/L.

We designed three test plots consisting of: (1) O_2 only, (2) O_2 + BC-4 (MTBE-degrading culture) seeded biobarrier, and (3) a control, with no treatment. Plot dimensions were 20 feet wide by 40 feet long, and monitoring wells were installed at different depths throughout each test cell. The oxygen delivery system in the O_2 only and O_2 + BC-4 plots were similar and consisted of an O_2-generating system and injection wells that sparged O_2 intermittently. DO levels increased in the sparged zones up to 5 to 20 mg/L. Groundwater samples were taken before and during the 11-month experiment for MTBE and TBA levels and bioactivity.

In shallow wells in the control plot, DO was less than or equal to 1 mg/L and MTBE concentrations varied from 800 to 8,000 µg/L throughout the 330-day experimental period. In the O_2 only plot, MTBE levels varied from 500 to 7,000 µg/L and DO was 5 to 20 mg/L for 185 days. After 260 days, the MTBE declined in this plot to 10 µg/L.

Initial bioactivity determinations on samples of groundwater before the start of the experimental plots indicated that low numbers of MTBE-degraders were present at the site. The decline in MTBE in the O_2 only cell, therefore, suggests that the degraders that are present require O_2 and a long adaptation period to initiate metabolism of the ether. Also, TBA, which was present in the groundwater (50-250 µg/L), was not degraded in the O_2 only plot. In the O_2 and biobarrier plot, MTBE declined in the seeded zone soon after implantation of the BC-4 culture and was nondetectable (< 1 µg/L) in shallow wells after 260 days. TBA levels also declined below detectable levels (< 10 µg/L) in the bioaugmented plot.

The Good News Is...

Our results when implementing an in situ oxygenated biobarrier in an aquifer to control migration of an advancing MTBE plume demonstrate that MTBE can be degraded to below drinking water standards (e.g., 5 µg/L in California) and without the accumulation of TBA. The seeded biobarrier at Port Hueneme has been stable and active for at least a year of operation. The bioaugmentation of aquifer sediments with these highly specialized cultures appears to be a more cost-effective method than traditional "pump and treat" engineered systems for controlling the migration of MTBE plumes. Our seeded biobarrier technology is currently being implemented at several retail UST sites in the United States. Because of our high initial success, we intend to assist other companies and governmental agencies in remediating MTBE and other oxygenates early in 2000. ■

Joseph Salanitro is a Senior Staff Research Microbiologist at Equilon Enterprises and Paul Johnson is an Associate Professor in the Civil and Environmental Engineering Dept. at Arizona St. University. For more information, contact Joe at jpsalanitro@equilon.com or (281) 544-7552.

Explosion Ruptures Two Tanks During Video Inspection at St. Louis Service Station

by Mark Lenox

It was just before lunch. The service technician was sitting in his truck completing a video inspection of an underground storage tank when the tank exploded. The camera was blown out of the tank and one end of the tank being inspected blew off. The impact of the explosion caused the adjacent tank that had not been emptied of product to rupture, releasing around 3,000 gallons of gasoline. The good news is that no one was hurt.

This event happened at a St. Louis Shell station earlier this summer. The owner was preparing his fiberglass tanks for a switch to reformulated gasoline (RFG). Because he was switching to an alcohol blend, the tanks needed to be upgraded, inasmuch as they were purchased and installed years before there was an approved alcohol-compatible listing. The process required the tanks to be cleaned. After cleaning, the tanks were to be inspected visually by lowering a video camera down the fill pipe.

The tank was one of three that was being inspected by Tanknology, Inc. It had been emptied of product and then pressure-washed by lowering a special nozzle down through several tank risers, such as the fill port. After a preliminary inspection with the video camera, the technician determined that more cleaning was necessary. The tank was further washed and cleaned. Once the cleaning material was pumped out, the camera was lowered back into the tank; shortly thereafter the explosion occurred.

Because gasoline was released to the subsurface as a result of the tank rupture, emergency response was initiated. Due to the company's quick response, most of the gasoline was pumped out of the tank backfill area before it had a chance to spread any further.

Why the Video Inspection?

The video inspection was conducted to ensure that the tank was in condition to contain a new reformulated gasoline containing ethanol. Reformulated gasoline (RFG) is a formulation of gas used to reduce volatile organic compounds (VOCs). RFG requires the use of oxygenates such as ethanol or MTBE, and it has a lower benzene content than non-RFG gasoline. As of June 1, 1999, the alcohol blend of RFG has been required in the St. Louis area.

When switching to an alcohol blend for the first time, all water and precipitated material must be removed from the tank because of alcohol's propensity to soak up any water in the tank. If enough water is present in the water bottom of a tank, the alcohol will separate from the gas, mix with the water, and settle to the bottom of the tank, where it could get pumped into somebody's car. Cars run well on gasohol, but they choke on this alcohol/water cocktail.

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Why the Explosion?

The precise ignition source of the explosion is as yet unknown. When using a camera to inspect a tank, a few important safety steps are typically taken. First, after the tank is pumped out and, if necessary, cleaned, the tank, camera, and truck are grounded to discharge any static electricity that has built up. The inside of the tank is then inerted to displace oxygen with carbon dioxide.

To ensure that the atmosphere is inert, or noncombustible, the oxygen level is checked using a meter that is not affected by the high levels of carbon dioxide that are present. Readings should be taken at the bottom, middle, and top of the tank at both ends and the middle of the tank. This safety check is done several times during the inspection. The grounding connection should be in place during

■ continued on page 11

Field Notes

from Robert N. Renkes, Executive Vice President, Petroleum Equipment Institute

Why Many of Today's UST Systems Are Not Leak-Proof

The plan of action recommended to EPA and Congress by the Blue Ribbon Panel on Oxygenates (see cover article) regarding the use of MTBE in gasoline involves a four-part strategy. One part of the strategy is to develop a comprehensive set of programs to enhance water protection. One specific recommendation in this regard is to "evaluate the field performance of current system design requirements and technology and, based on that evaluation, improve system requirements to minimize leaks/releases, particularly in vulnerable areas."

Some say that the industry has done everything possible to minimize leaks. But the truth is that leaks and releases still happen—even to systems upgraded to 1998 standards. How are those upgraded UST systems performing, and what can be done in the future to improve the systems that contain regulated substances?

These issues were some of the subjects discussed at a recent focus group meeting convened by EPA and attended by members of the Petroleum Equipment Institute. The group was in complete agreement that UST systems in the ground today represent a vast improvement over the UST systems in use in the 1980s. Nevertheless, the group was in substantial accord in the belief that many of the systems in operation today are not leak-proof.

The group pinpointed four major causes of releases and identified steps that can be taken to prevent such releases in the future:

- Pressurized piping systems are probably the biggest contributor (in terms of the number of gallons lost) to the problems we have today.

  Recommendation: Secondarily contain and periodically test tanks and piping.

- Meter seals fail, impact valves wear out, unions leak, and product spills when filters are changed and meters are replaced.

  Recommendation: Provide containment under product dispensers.

- Releases occur at the turbine during servicing and, over time, as a result of normal wear and tear. Leaks from submerged turbines are often not discovered until it's too late, because they are buried and not subject to routine inspection.

  Recommendation: Provide containment at the submerged turbine.

- Proper operation and maintenance of the UST system are essential. Unfortunately, many tank owners lapse into an "out of sight, out of mind" tank management pattern, because they believe that the hardware installed over the last decade will take care of all their problems.

  Recommendation: Inspect the UST system periodically for compliance.

These conclusions and recommendations should not come as a surprise to tank owners or UST regulators. In fact, my sense is that at least the first three of the recommendations listed are already incorporated into the lion's share of UST systems installed today.

■ **Explosion** *from page 10*

the inerting procedure (and throughout the entire inspection) in the event of a static charge buildup. Once everything checks out, the visual inspection can begin.

A number of factors may have been at work at this site to cause the explosion. The visual inspection had been interrupted for additional cleaning, and the tank's oxygen levels may not have been checked again before the second inspection. In this case, gasoline vapors and oxygen levels could have reaccumulated inside the tank, creating an explosive environment. The vapor recovery system could also have been a source of vapors or oxygen. In either case, the introduction of the camera and its lighting system could have provided the ignition source needed to set off the explosion.

According to Pudgie Fewox, DOT Safety Fleet Manager for Tanknology, the company has taken additional steps to tighten up its safety procedures. A camera is now installed at the inspection site to record the preliminary phase of the inspection. This way, both the company and the client have a record of the technician grounding all equipment, inerting the tank, and taking oxygen concentration readings. Furthermore, the tank environment is now monitored continuously through electronic controls so that any time the internal environment exceeds predetermined safety levels, the entire camera system automatically shuts off. The inspection cannot proceed until the tank environment is again below safe limits.

Even with the best safety procedures in place, accidents can happen. Ensuring that proper procedures are followed consistently, however, can greatly reduce the likelihood of such accidents. ■

Mark Lenox is an Environmental Engineer with the Tanks Section of the Missouri Department of Natural Resources' Hazardous Waste Program.

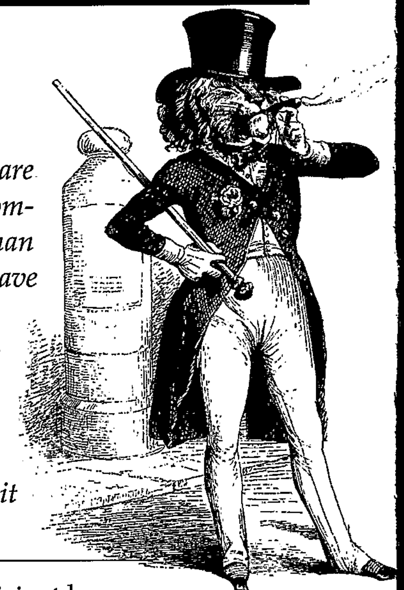
Leak Prevention

Tank-nically Speaking

by Marcel Moreau

*Marcel Moreau is a nationally recognized petroleum storage specialist whose column, **Tank-nically Speaking**, is a regular feature of* LUSTLine. *As always, we welcome your comments and questions. If there are technical issues that you would like to have Marcel discuss, let us know.*

Enough with the Walking Softly, It's Time to Get Out the Stick!



The Federal UST program is now a full decade old—a number of state UST programs are even older. Yet an almost universal complaint from tank inspectors seems to be that compliance with UST operational requirements, specifically leak detection, is far less than satisfactory. Historically, most, if not all, states (let me know if you're the exceptional state) have focused on educating their UST owners and operators rather than hammering them. Some, I know, are restricted to an educational role by the local political climate. In most states, an outnumbered regulatory staff tries to educate and reeducate an ever-changing and generally complacent tank-owning population. So the leaks go on, and while statistics are sparse, the few data available indicate that the success rate in detecting releases is abysmal. As any teacher or parent knows, gentle persuasion will take you only so far. There comes a time when it is necessary to lay down the law.

Many Are Law Abiding, But Few Are Saints

I consider myself to be a law-abiding citizen. I also know that I am not a candidate for sainthood. Consider this true story. Until I moved into a home office last December, I had a small office in downtown Portland, Maine. I usually rode my bike to get to the office, but there were days when it was raining or snowing or when I was carting equipment when I would take my car. My options for parking the car downtown were either a parking garage that was a short hike from the office ($1/hour) or a curbside parking meter that was typically a stone's throw away from the office (50 cents/hour, two hour limit). The parking meters were my first choice when they were available.

Initially, I put money in the meter religiously. However, I often got engrossed in my work and forgot to add money after the meter ran out. I also routinely exceeded the two hour limit. But guess what? No parking tickets appeared on my windshield. Over time, I became more bold in my transgression of the rules. Before too long, I quit putting any money in the meter. I found that on most days I could park conveniently the whole day for free. Once in a great while, I would get a ticket, but it was a mere five bucks. I didn't need to do much calculating to figure out that paying the occasional parking ticket was more convenient and much cheaper than any other alternative.

What would you have done? I rationalized my behavior by saying that I was still following the rules: I paid the fine when it was levied.

I was clearly not the only person who had figured this point out. Portland merchants had long-standing complaints about office workers who parked all day in front of their stores and prevented customers from finding convenient parking. The city finally listened and decided to enforce the parking regulations. They hired some meter attendants and raised the cost of the parking ticket to $10.

I learned about this change the hard way. Under the new system, I got a ticket every single time I parked without paying. I started putting money in the meter, but whenever I was even a few minutes late—Darn!—another ticket. I then noticed that nearly every time I looked out my office window, there was a meter attendant writing a ticket. I marveled at how efficient he was. He could put a ticket on a car in about 15 seconds.

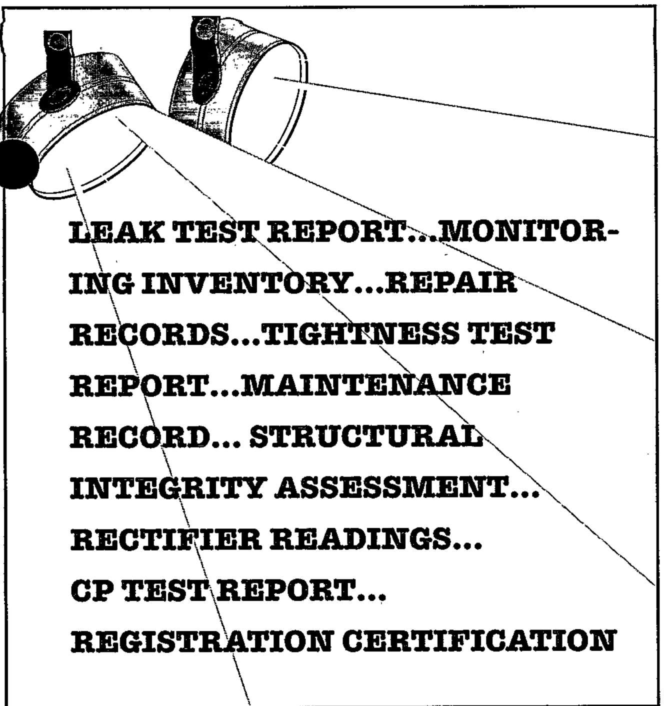
I knew right then that my days of hassle-free parking were over. Pretty soon, the light dawned that the economics had changed. The parking garage was starting to look pretty good. The thought of ignoring the tickets crossed my mind, until one day I looked down Congress Street and saw a long string of bright yellow boots on cars' front wheels. I didn't know how much it cost to get the boot off, but I knew it wasn't cheap, and I knew I'd have to pay my back tickets and late payment fees as well.

So my behavior changed. If I was going to be at the office only a short while, I'd park at a meter (they were much easier to find now!). If I was going to be more than two hours, I'd park in the garage (it was much fuller now!) and trek to the office.

The moral of the story is that it is very hard to be a saint. Law-abiding citizens abide by laws that have consequences for noncompliance.

Never Judge Another Until You Have Walked a Mile in His Moccasins

Now put yourself behind the desk of a tank owner. When was the last time



you received anything but a friendly notice with lots of information that you don't have time to read from your UST regulator? When was the last time any regulator looked at your records or your equipment? When was the last time you paid a fine for noncompliance with tank rules?

Chances are that your state has a tank fund that will pay a large chunk of your cleanup costs, and you've heard through the grapevine that you don't even have to be very much in compliance to be eligible for the cleanup money. The leak alarm on the wall is flashing, but the last 10 times it's gone off it was because there was water in the sump, and you're tired of paying big bucks to have a contractor deal with it. You just paid over $100,000 for new storage systems, so they can't be leaking.

Meanwhile you've just fired another employee for stealing and now you're short-handed; your competition is building new stores across the street from several of your best locations; your freezer just quit, and you've got 50 gallons of ice cream sitting in there melting; your new integrated data management system is crashing every other day, so you can't keep track of anything; and a customer is suing you for everything you've got, because a nozzle failed to shut off while she was topping off her tank and she got gas on her foot and she claims the MTBE in the gas has caused a severe reaction that prevents her from working, which has precipitated a nasty divorce and may lead to surgery to remove an obscene growth on her middle toe.

Is it really any wonder that leak detection is so often ignored?

The Status Quo

Convenience store loss prevention specialists say that the primary deterrent to employee theft is knowing that you are going to get caught and pay the consequences. I suspect that the same holds true for UST compliance. Most UST owners and operators today simply do not believe that they will be "caught," and for the most part, they are right. So how do we convince UST operators that they are going to get "caught"?

Most UST owners and operators today simply do not believe that they will be "caught," and for the most part, they are right. So how do we convince UST operators that they are going to get "caught"?

First, let's look at the status quo. How do we catch UST rule violators? In most cases, it involves a personal visit from an UST inspector. The inspection requires some driving time, a chunk of time inspecting hardware, a chunk of time trying to find records, and a big chunk of time trying to explain to some presumably responsible person exactly what he or she is supposed to be doing.

Unless there is a field citation program in place, the odds of any kind of a financial penalty being levied are pretty remote. The process is time-consuming and inefficient, and it has little long-term effect on the behavior of the tank owner or operator.

For this process to work, you need a tremendous long-term financial investment in the regulatory program. The State of Florida has made such a commitment. Its inspection program began in earnest in 1987, and by 1990, had reached the point where every UST facility in the state was visited every year. Compliance levels, which were initially about 3 percent, have climbed slowly but steadily. Today the "complete" compliance level (every "i" dotted and "t" crossed) is around 85 percent, with "substantial" compliance (minor omissions, generally involving paperwork) levels running at 93 percent.

This achievement requires an inspection force of about 150 contracted county inspectors and 30 state Department of Environmental Protection inspectors (who inspect county-owned facilities), who are currently dealing with a tank population of 35,000 active USTs. Eighty-five thousand USTs have been closed and not replaced since the program began. Aboveground tanks are also inspected annually.

Since the inception of the program, nearly 300,000 inspections have been completed. This effort requires an annual financial investment of about $8 million. Marshall Mott-Smith, director of the Florida Tank Program, says he hopes to *increase* funding in the future to improve the quality and consistency of the inspections.

Mott-Smith notes that about 50 percent of all tanks in the state currently have secondary containment, so many of these inspections are less time-consuming. With secondary containment, inventory records don't have to be checked and release detection is much simpler.

Based on Florida's experience, then, if you're planning to achieve compliance with the traditional physical inspection route, plan on a 10-year effort at a cost of about $225 per tank per year.

So how does your program compare? Let's do a survey. Send me an e-mail with the following information:

- The number of active USTs in your state
- The number of dollars you have to spend on UST compliance
- The number of inspectors you have

■ *continued on page 14*

■ **Tank-nically Speaking** *from page 13*

- At your current level of inspection activity, how often you expect to visit each UST facility (annually, three years, five years, etc.)

Send the information to marcel.moreau@juno.com. Results of the survey will appear in the next issue of *LUSTLine*. I'm thinking your figures could help make the case for how woefully underfunded the UST program is on a national scale.

Beyond Status Quo

What are some alternatives? A few states (e.g., Pennsylvania and Alaska) have gone the route of third-party inspectors. In this approach, private-sector individuals are authorized to conduct regulatory inspections and report back to the regulatory agency. This tactic shifts the cost of the inspection to the private sector, because the tank owner now pays for the inspection. Enforcement remains the domain of the regulator, so following up on violations is still the responsibility of the regulatory agency. I believe this approach is viable, but there needs to be careful monitoring of inspector activities (these people are not saints either) and significant effort expended to ensure consistency among inspectors.

A New Inspection Paradigm

Another approach that I believe holds some promise, though I don't know that it has ever been tried, is to change the inspection paradigm. In my experience, UST violations today stem primarily from recordkeeping. ATGs on the wall and line leak detectors on the submersible pumps are commonplace. Although many inspectors get in a dither wondering whether the ATG is working on the day of the inspection or whether the operator knows how to run the ATG, these issues are really of little relevance to bottom-line compliance, because these things are not regulatory requirements.

The regulatory requirement is that leak detection results for each month must be on hand for the last 12 months. If the ATG is lying in pieces on the floor on the day of the inspection, but there are 12 months worth of passing test results, the facility is in compliance. If the ATG is working perfectly, and the operator knows everything about it, but 12 months worth of test results cannot be produced, the facility is *not* in compliance.

It is not the inspector's job to teach people about ATGs or any other piece of UST hardware—it is the equipment vendor's job. Because, in most cases, the leak detection records are not kept at the UST facility, chasing down missing records is an activity that is typically triggered by an inspection; the records are mailed or faxed to the inspector a few days later.

Here is my question: Is the on-site visit really necessary? Why can't an inspection consist simply of a certified mail request to produce paperwork records of leak detection and maintenance? Failure to produce the records within a specified time frame becomes an automatic violation. If inspection of the records reveals other irregularities, such as missing test results for a particular month or failure to reconcile inventory, then these violations could be listed in a notice of violation or an assessment of a small fine (using something like a consent agreement rather than full-blown enforcement procedures), and, of course, educational materials would be sent out out to the violator.

> ***The advantage of the strictly paper inspection is that I could probably conduct 10 times as many of these inspections in a month than I could physical inspections, particularly once I have developed some semiautomated process for sending out mailings and cataloging and reviewing the incoming paperwork.***

I'll bet that more attention will be paid to the educational materials when they arrive by certified mail and are accompanied by a notice of violation and a monetary penalty than when they are handed over, in person, by a smiling inspector, who takes her leave saying that she hopes to see improvement the next time she comes.

The Blessings of the Paper Inspection

The advantage of the strictly paper inspection is that I could probably conduct 10 times as many of these inspections in a month than I could physical inspections, particularly once I have developed some semiautomated process for sending out mailings and cataloging and reviewing the incoming paperwork.

Sure, I might miss a few things (do you really think you catch everything during an on-site inspection?), but overall I could make my presence felt more widely using this approach than by driving my body all over the state and talking to people who have a thousand things they'd rather be doing than listening to me. More importantly, the regulated community would come to learn that someone is watching what they do and there are penalties (small ones, to be sure) to pay for ignoring UST requirements.

Consider this point. As the owner of a small business, I must file an inordinate amount of paper (and money) by very definite dates to an abundance of state and federal agencies. Over the years, I may have occasionally missed a date by a few days or a week. I have been impressed by the fact that I inevitably receive a little notice from whatever agency that was supposed to receive something and that sometimes I must pay a late fee. Now my violations are small, as are the penalties. But as I am writing the check, I think, "Boy, I'd better not try to pull anything over on these guys because they are keeping pretty close tabs on what I do."

A variation on this paper inspection paradigm could be used for those multiple-facility tank owners who maintain centralized records. Rather than traveling to facilities, simply travel to the central office and go through all the records without bothering to visit the facilities themselves. Cite the owner for all missing records. I'll bet you could inspect dozens of facilities a day in this way.

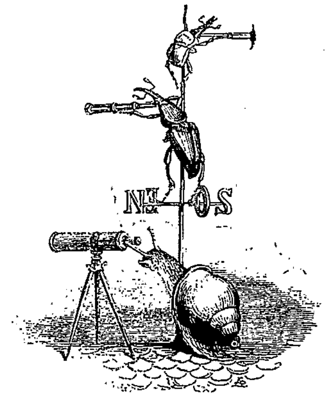
Scofflaws who submit no records or very poor records could be targeted for a repeat request for documents in a few months. Lists of names of facilities whose owners have failed to submit adequate

■ *continued on page 16*

Leak Prevention

Anyone for Reevaluating Our Leak Detection Method Protocols?

Results of a Third-Party Evaluation Test Protocol Survey



by Shahla Dargahi Farahnak

For many years, I have been reviewing leak detection equipment third-party certification reports for the State of California and also as a member of the National Work Group on Leak Detection Evaluations. These reviews involve comparing third-party certification reports with procedures described in the applicable standard U.S. EPA test protocol or the new and/or modified ones. Over the years, new or modified test protocols have been developed in response to advances in leak detection technology and broader applications of some leak detection methods and equipment.

Through the experience gained by reviewing these evaluations and the technical principles on which these methods are developed, I and the members of the work group occasionally come across issues that have not been adequately addressed in the original (more than nine years old) EPA protocols. At times, we also wonder about the adequacy and the level of peer review for some of the new and modified protocols. For these reasons, we decided to reach out and find out what the other state regulators think about these test protocols.

My area of emphasis in the UST program has been leak detection. I have worked on a few research projects involving the use of leak detection and its effectiveness in detecting leaks once installed or implemented in the field. To me, it seemed apropos to expand the horizon and take a look at the leak detection evaluation protocols by conducting a survey. My goal was to present the results of the survey to the work group members so that we use this information to identify some of the areas we need to focus on for future activities and to help EPA identify future project priorities.

At the March 1999 UST/LUST conference and subsequent to that via broadcast Internet mail, I distributed a survey form to all states. A total of 23 responded to the survey. Considering that many of the states may not have staff who are very familiar with the leak detection evaluation protocols, this is a good response rate, and I thank the states that took the time to participate in this survey.

In the survey, the respondents were asked to list acceptable leak detection methods in their state for both single-walled and double-walled tank and piping and to identify the three most common leak detection methods for tank and piping systems. Most of the states responding to the survey stated that they follow federal regulations for acceptable methods of tank and piping leak detection. That means, in these states, single-walled system leak detection methods, such as automatic tank gauges and statistical inventory reconciliation, are allowed for double-walled tanks. Only a few states require continuous interstitial monitoring for double-walled systems. The following two tables summarize the frequency with which the most common leak detection methods for tanks and piping were listed by the respondents:

Monitoring Methods for Tanks in Order of Frequency

Method	States
Automatic Tank Gauge	16
SIR (monthly)	15
Tightness Testing	12
Inventory Control	9
Interstitial	7
SIR (annual)	1
External	1

Monitoring Methods for Piping in Order of Frequency

Method	States
Tightness Testing	14
Sump Monitoring	12
Electronic Line Leak Detector	11
SIR (monthly)	9
Mechanical Line Leak Detector	9
Safe Suction	3
Automatic Tank Gauge	2
External	1
Inventory Control	1
SIR (annual)	1

The respondents were also asked to list and rank the evaluation protocols of concern and, for each one, to list the items of concern. Three of the respondents stated that they were not familiar with the protocols, and three others stated that they had no concerns. For the remaining 14 responses, the protocols listed and the number of times they were mentioned are summarized as follows:

Test Protocols	# of Times Listed
Statistical Inventory Reconciliation	12
Liquid-Phase Out-of-Tank	5
Continuous In-Tank Leak Detection	4
Volumetric Tank Tightness Test	3
Nonvolumetric Tank Tightness Test	3
Automatic Tank Gauge	3
Vapor-Phase Out-of-Tank	2
Pipeline Leak Detection	2

The following is the list of respondent concerns (not edited) for each evaluation protocol. As you will notice, some are related to field application and limitations and not directly to the evaluation the test protocol.

■ *continued on page 16*

■ Protocol Survey *from page 15*

Comments and Concerns by Protocol

Automatic Tank Gauging Systems
- Range for threshold varies too greatly between vendors
- Effect of the level of groundwater on the test performed
- ATGs rarely test the full capacity of the tank, having to show only one passing test per month without requiring a level of 90% full or better

Continuous In-Tank Leak Detection Systems
- Field verification
- Quantification
- Throughput limitation as a function of tank size
- Embedded SIR
- Using created quiet-time data
- Modifications to existing systems—need standardized method of updating certification

Liquid-Phase Out-of-Tank and Interstitial Product Detectors
- When groundwater is not in contact with the tank, the amount of time between the initial release and this method's ability to detect it is too great
- No protection
- Capability not stringent
- Should be eliminated as a leak detection method

Nonvolumetric Tank Tightness Testing Methods
- Most do not specify the level of the product in the tank
- Do not specify how they check for groundwater and pressure on the tank from the outside
- Water ingress measurement
- Evaluation of acoustic systems

Pipeline Leak Detection Systems
- Number of tests and test facilities
- Scaling
- Averaging
- Reuse of data

Statistical Inventory Reconciliation Methods
- High throughput
- Manifolded tanks
- Stand-alone and hybrid SIR
- Pipeline LD. Does SIR 0.2 gph equal 0.2 gph pipeline test? Test times differ.
- Bogus leak threshold
- Numbers provided by the vendor for third-party evaluation do not test the system adequately
- Improvement needed in all areas
- Movable threshold
- Set threshold value
- Clarify substitution of data (e.g., using last two months of data to fill out this month's)
- Clarify use of ATG to gather data
- Nonvolumetric (qualitative?) is not stringent
- Reporting is not adequate on 0.2 gph test
- Error ID needed
- Vendor's data manipulated
- Standards for qualifying report-outs
- Groundwater effects
- Automated improvements
- Vendors seem reluctant to fail data
- Adjustment for "outliers"
- Real-world leak data vs. simulated
- Better defined data sets with "real data and operational noise"
- Systems can pass current protocol, but may not perform in the field
- Size limits and number of tanks determined by evaluator
- Control over the reuse of data
- Reliability of data
- Amount of data needed
- Statistical method for the calculation of pass/fail

Vapor-Phase Out-of-Tank Detectors
- Should be eliminated as a leak detection method
- Sensitivity

Volumetric Tank Tightness Testing
- Does or doesn't it test suction lines?
- Application to system test

It's Time to Review the Situation

With the present concerns about the release of oxygenated fuels to the environment, now is a good time for EPA to initiate efforts to have protocol documents reviewed and revised. We also need a formal process for the extensive review of new and modified protocols. The extent to which each leak detection method is used and the significance and relevance of the listed concerns about its performance could be used to help set priorities.

In my mind, at least, one question still remains unanswered. Would this effort help improve performance of leak detection? Maybe yes, maybe not! One thing that is evident, however, is that more realistic and stringent evaluation protocols may help weed out some poorly designed systems. But definitely, there is more to making leak detection work than just enhancing the evaluation protocols. ■

Shahla Dargahi Farahnak, P.E., is Senior Engineer with the California State Water Resources Control Board. For more information about this survey, contact Shahla at farahnas@gwgate.swrcb.ca.gov.

■ Tank-nically Speaking *from page 14*

records could be published in local newspapers. Recalcitrant individuals could be targeted for EPA inspections where field citation authority could be used to get their attention. Eventually, UST owners would get the idea that someone is indeed watching what they do and they had better not try to get away with too much.

Perhaps some UST owners would see the wisdom of farming out their compliance activities to knowledgeable firms whose primary business is keeping customers in compliance with UST requirements. Because of problems with employee turnover, trying to manage multiple facilities, and the multitude of other activities typically associated with running today's fueling facilities, I believe that third-party monitoring of USTs is the long-term future of UST management. For third-party management to become cost-effective to the UST owner, however, noncompliance must become more costly than it currently is.

Better, Faster, Cheaper Enforcement

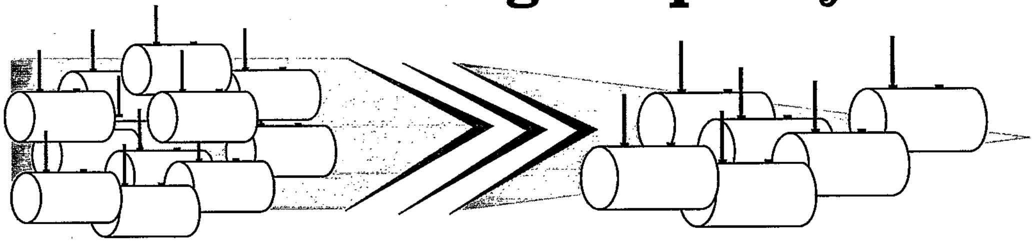
The LUST people long ago learned the mantra of "better, faster, cheaper" cleanups. While the LUST challenge remains formidable, remarkable progress has been made. Now it's time for the UST side of the program to learn the same mantra and apply it to enforcement.

We have made great strides in reducing the environmental threats from USTs in the last decade. But to achieve the full environmental protection potential of the program, operational compliance levels must be improved dramatically. Walking softly with an armful of educational materials is not going to do it. It's time to get out the stick and figure out how to slap as many wrists as possible as efficiently as possible. It's either that, or figure out how to convert tank owners and operators into saints. ■

As always, your thoughts on this issue are welcome.

Where Has Our Petroleum Storage Capacity Gone?

by Wayne Geyer



Tracking the success or failure of the federal underground storage tank program is a difficult task. One of the most telling statistics publicly available is the number of storage tanks in the federally regulated tank universe that remain in service. When the U.S. Environmental Protection Agency (EPA) began its program, an estimated 2 million federally regulated tanks existed. According to a recent survey sponsored by the Petroleum Equipment Institute, only about 750,000 tanks remain—a 62.5 percent decrease in the number of tank units. These figures suggest that five of every eight tanks in existence in 1988 are no longer in service.

Environmentalists might say that the program is an overwhelming success—over half of the potential leaking tank systems have been erased. An equipment manufacturer, installer, or petroleum storage system user might have other thoughts. After all, fewer tanks means less business for manufacturers and installers and less product availability for consumers. Or does it? Are we as a society inconvenienced because of this drastic reduction in regulated underground storage tank units?

As I travel down the federal highway system, my first impression is that the downsizing of our tank universe has had very little impact. I continue to see a tremendous number of motor vehicles on the road. For example, *NPN* reported that in the United States, motor vehicles were driven a total of 2.48 trillion miles in 1996, an increase of 2.2 percent over the 1995 figures. According to *NPN Market Facts*, an annual statistical guide of the petroleum industry, gasoline consumption has increased from 114.7 trillion gallons in 1988 to 128.9 trillion gallons in 1998, a 12.7 percent increase over the past 10 years.

According to *NPN*, however, the number of retail service stations in the United States dropped from 210,120 in 1991 to 182,596 in 1998, a 13 percent decrease over the past seven years. Despite this decrease, little media commentary has emerged regarding public inconveniences, except perhaps in a few remote areas left without a nearby service station. In fact, as older facilities take their leave, new service stations continue to be built with better conveniences and in more desirable locations. Many fabricators tell me that a large percentage of their constructed tanks are being installed at new facilities.

Can Less Be More?

So, if vehicle miles traveled are way up, the tank universe is way down, and the public has not been terribly inconvenienced, what has happened to all of the previous storage tank capacity? A number of theories have been put forth to explain this curiosity.

Some say that much of the 1988 regulated tank population was either not in use or little used. Others hypothesize that oil companies and petroleum marketers today exercise greater control over the amount of product stored—a large inventory of product on hand is bad for the bottom line. Keep product moving, because if less product sits idle in a tank, fewer tanks are necessary.

In December 1927, an industry report noted that 317,000 gas stations dispensed fuels. The report made the assumption that it took 15 minutes to dispense 5 gallons of gasoline, half the actual dispensing rate of that time period. Furthermore, with the 604,000 dispensers in existence then, the report calculated that the nation could dispense five times its needs in an eight-hour day. The report concluded that a glut of tanks and service stations existed then.

If we use that type of analysis, we can obtain a further comparison between 1988 and 1998. Let's assume that the average tank is operating 10 hours per day, 300 days per year, dispensing fuel at a rate of 8 gallons per minute (gpm), and storing gasoline. Also, let's assume that 60 percent of the regulated USTs in existence during the past decade stored gasoline.

With some sophisticated sixth-grade mathematics, we can calculate that the average tank dispensed gasoline 4.25 minutes out of every hour in 1988 and 12.75 minutes out of every hour in 1998. That rate is nearly a 300 percent increase in tank usage. On the other hand, the usage rate of 12.75 minutes dispensed out of every hour today could also tell us that the tanks are not yet fully utilized.

Remember, not every UST is located at a retail service station, nor does it store gasoline. So don't go to Las Vegas with the assumptions and calculations made above. Some gas stations pump 2 to 5 million gallons of gasoline per year. As a matter of fact, new stations are built today on the premise that 1.2 million gallons of gasoline will be dispensed annually—at a minimum.

For comparison purposes, 1.2 million gallons dispensed annually equates to a tank usage rate of 14.6 minutes out of every hour, assuming 3 gasoline tanks per service station, 365 days of operation for 10 hours per day, and a fuel dispensed rate of 8 gpm. My main point here is that many of the unused or underutilized tanks in place in 1988 are gone and that the utilization rate of tanks has increased.

Blending fuel grades on-site, the use of compartmented tanks, and the shift to aboveground tanks are additional reasons why there are fewer tanks installed and used underground today.

But I have another fact to throw into the mix. I checked out the Steel

■ continued on page 18

■ **Storage Capacity** *from page 17*

Tank Institute's (STI's) registration database and engaged in some undercover detective work. STI keeps detailed computer records on every new steel underground and aboveground storage tank that bears the STI label.

STI records indicate that over 1,000,000,000 gallons of new STI-labeled underground steel storage tank capacity was installed between 1988 and 1998. That's right, 1 billion gallons! This time period corresponds with EPA's UST regulatory compliance time frame.

On further examination of the most recent 10 years of data, we find some startling trends. The average STI-labeled UST tank capacity has increased by over one-third, to nearly 8,000 gallons of capacity today. For example, STI statistics for ACT-100 and Permatank tank technologies show that the average tank capacity is approximately 10,000 gallons, more than a 20 percent increase during a seven- to eight-year time frame.

In the mid- to late 1980s, the typical sti-P3 tank capacity was around 5,500 gallons. The sti-P3 tank was the only nationally standardized, corrosion-resistant steel tank available back then. It provides preengineered cathodic protection via galvanic anodes of zinc or magnesium metal attached to the tank. In 1987 and 1988, more than 30,000 of these P3 tanks were built and installed each year. Today, fewer than 25 percent of that number of tank units are being built with the P3 label. Other underground steel storage tank technologies that do not use cathodic protection, such as composite tanks and jacketed tanks, have displaced some of the P3 tank installations.

Yes, It Can!

For hypothetical purposes, then, let's say that the average tank capacity in the ground prior to 1989 was 4,000 gallons (20 percent less than the average reflected by STI statistics to accommodate the probability that older tanks were smaller). Two million tanks multiplied by a 4,000-gallon average tank capacity yields a total of 8 billion gallons of regulated capacity at the start of the EPA program. Let's also say that the average tank size in the ground today is 8,000 gallons. So, 750,000 tanks multiplied by 8,000 gallons average tank capacity yields 6 billion gallons of regulated tank capacity, a 25 percent drop in tank capacity over the past 10 years.

Thus, the decline in storage capacity is much smaller than the decline in tank numbers. This point correlates well with our calculation of average tank throughput—we are selling more fuel from fewer tanks.

While retail petroleum marketing is still predominantly conducted using USTs, the same is not true for nonretail storage. Many smaller fleet fueling operations and emergency generator tank owners have turned to ASTs. Much of the 25 percent decline in UST storage capacity could be accounted for aboveground if we looked hard enough.

Thus, the decline in storage capacity is much smaller than the decline in tank numbers. This correlates well with our calculation of average tank throughput—we are selling more fuel from fewer tanks.

Statistics on shop-fabricated ASTs are difficult to collect because of the far greater varieties of storage tank types. So it is more difficult for me to be absolute in reaching conclusions on total storage capacity. Nonetheless, some trends are apparent. For example, in 1998, STI's statistics for double-walled F921 ASTs and secondary-contained, protected Fireguard tanks indicated a 45 percent growth in tank units built.

Not surprisingly, an increase in tank capacity is clearly evident here as well. The Fireguard tank experienced an 80 percent increase in average tank capacity over the past five years—the average capacity today is more than 4,000 gallons. STI members are building ASTs to USTs at a 2:1 ratio, quite different from 10 years ago, when USTs far outnumbered ASTs.

The trends associated with secondary containment of aboveground storage tanks are indicative of those associated with secondary containment of all regulated shop-built tanks. In 1988, STI was registering fewer than 18 percent of its tanks as secondary-contained P3s. As a matter of fact, 1984 was the first year in which significant numbers of double-walled tanks were being built. Their numbers have easily doubled in recent years. When accounting for other types of steel-jacketed tanks that do not bear the STI label, it appears that over 50 percent of the steel USTs built today are secondary contained.

So the bottom line is that, without a doubt, the number of USTs has declined since the UST regulations were promulgated. However, more product than ever is flowing through the remaining storage tank systems—through larger tanks and in tanks located both under and above the ground. ■

Wayne Geyer is Executive Director of the Steel Tank Institute.

■ **Santa Clara Study** *from page 7*

system. Depth to water and lithology were apparently not significant factors in contamination of groundwater by MTBE at the study sites.

The SCVWD conducted a good, well-documented study, but, as such, it leaves us with a number of unanswered questions: Where are the MTBE releases coming from at these sites? Why weren't the releases detected prior to the study? Is current release detection technology adequate for protecting groundwater from MTBE leaks? Are MTBE vapor releases a significant source of contamination in groundwater? For the SCVWD to adequately assess the vulnerability of its groundwater resources to releases of MTBE (and for all of us to better understand the nature of the beast), additional research is definitely needed to address these questions.

The complete study can be accessed on Santa Clara Valley Water District's Website: http:www.scvwd.dst.ca.us/wtrqual/fact mtbe.htm. ■

Ron Kern is Manager of the UST & Program Support Section at the Arizona Department of Environmental Quality.

Coast to Coast
from the ASTSWMO Tanks Subcommittee

Coast to Coast is provided as a regular feature of **LUSTLine** *to update state and federal UST, LUST, and cleanup fund personnel about the activities of the Association of State and Territorial Solid Waste Management Officials (ASTSWMO) Tanks Subcommittee. To find out more about the Tanks Subcommittee, contact Chairperson Scott Winters (CO) at (303) 620-4008 or Stephen Crimaudo (ASTSWMO) at (202) 624-7883*

State Symposium on MTBE Remediation Held

The ASTSWMO MTBE work group sponsored a two-day symposium on MTBE remediation in Washington, D.C., on July 26-27. The symposium was attended by representatives from 35 states, five EPA regions, four EPA HQ offices, and the U.S. Geological Survey, and by several industry and state association representatives and consultants. There were presentations on research findings in the areas of remediation, toxicology, and drinking water treatment. Other specific topics addressed were natural attenuation, impacts to water supplies, the Blue Ribbon Panel findings and recommendations, and state remediation experiences.

Toward the end of the symposium, the group was divided into four subgroups. Each subgroup was asked to develop four critical issues related to MTBE and to suggest ways that state and federal agencies could address these issues. The MTBE work group plans to prepare a synopsis of critical issues identified at the symposium and detail those concerns in the next issue of *LUSTLine.* Notes from the meeting will be produced by ASTSWMO.

8th Annual State Fund Administrators Conference

The Kentucky Petroleum Storage Tank Environmental Assurance Fund, the Association of State Underground Storage Tank Cleanup Funds (supported ASTSWMO), the New England Interstate Water Pollution Control Commission, and OUST co-hosted the 8th Annual State Fund Administrators Conference on June 6-9 in Lexington, Kentucky. The conference was attended by approximately 150 people representing state fund managers and staff, EPA regions, state commissions, tank owners and operators, cleanup consultants, and insurance underwriters, plus one state trooper who investigates cleanup crime and fraud.

State Fund Success Awards were given to three states in recognition of their accomplishments in three award categories: Washington for Financial Success, Kansas for Corrective Action, and Vermont for Legal/Management. Alabama won the award for "Best Fund for Getting the Job Done," the most successful fund, overall, based on its submissions in all three award categories. Congratulations to these states and to all of the states that submitted award applications this year.

Hot topics on this year's agenda included the effects of the December 22 compliance deadline on state funds, the impact of MTBE on fund reimbursement, aboveground storage tank cleanups (which more funds are now being mandated to pay for), and cost control (a never-ending issue). The conference also showcased its 1st Annual State Fund Fair, which was patterned after the state fair held during OUST's UST/LUST National Conference. Sixteen exhibits featured a range of topics, from database management systems to an MTBE detection (sniff test) survey. Next year's conference will be held June 4-7 in Scottsdale, Arizona.

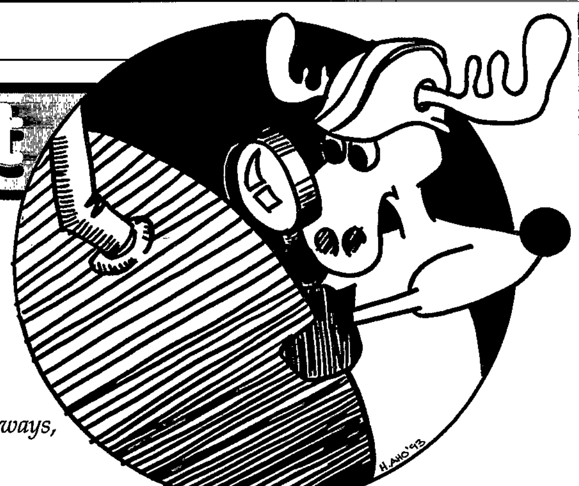
We're on the Case! — Are EPA's UST Rules and Standards Doing the Deed?

If you cup your ears, you will be hard pressed not to take in the increasingly audible hubbub surrounding UST systems performance and tank and pipe design standards. With the 1998 deadline 10 months behind us and the recommendations of the Blue Ribbon Panel on Oxygenates in Gasoline fairly fresh on the table, many state, federal, and local UST regulators find themselves drifting back to the future, asking questions about UST systems protectiveness that were asked during rule making in the mid 1980s.

Does EPA have answers to these questions? Anectodal? Yes. Real data? Not much. EPA and many of the states have told *LUSTLine* that they would love to have some real performance data for the various types of storage systems and leak detection systems. They would also like to learn more about the life expectancy of various tanks, piping systems, and other components.

Who, if anyone, will provide this vital information? That answer's on the murky side, right now. But folks, *LUSTLine* will do its best to stay focused on these issues and to keep you up-to-date and primed for optimal performance. So stay tuned, and, above all, let us know about anything that you might be able to add to the discussion. ■

Tanks Down East



by W. David McCaskill

David McCaskill is an Environmental Engineer with the Maine Department of Environmental Protection. Tanks Down East is a regular feature of LUSTLine. *In this edition, David, at long last, provides a second installment of his popular June 1994 article, "Those Tanks in America's Backyards and Basements." This update describes Maine's strategy for dealing with the problem of spills and leaks from aboveground home heating oil tanks. As always, we welcome our readers' comments.*

Those Tanks in America's Backyards and Basements—Part 2

A Report from Maine on the Trials and Tribulations of Leaking Aboveground Home Heating Oil Tanks

Oh, the idyllic life of spending the summer in a cottage on a coastal island in Maine. The picture of evergreens marching down to the rocky, wave-washed shores, accented with a touch of wispy fog, is so beautiful it just plain hurts. Many an out-of-stater has purchased his or her own little slice of the Maine coast. Many of these folks summer in small cottage communities year after year, and, more to the point, some of these cottages have outside heating oil tanks that fuel small furnaces that help inhabitants enjoy those chilly June and September evenings in comfort.

Such was the case on one island in Casco Bay in the fall of 1996, except the comfort level diminished when the contents of one particular tank at one particular cottage "mysteriously" escaped their confines. Whether this spill was the result of an overfill or a damaged oil filter, we'll never know. Nevertheless, by the time the Maine Department of Environmental Protection (MDEP) found out about the problem, the fractured bedrock arteries of this rocky island made sure that the tank had shared its contents with the entire cottage community.

Needless to say, some old summer friendships, like the bedrock, were now fractured—around $80, 000 would be spent on this site. This scenario was nothing new for those of us at MDEP, inasmuch as we'd spent the last five years responding to an ever-increasing number of these types of releases from aboveground home heating oil tanks.

Shortly after the spill was discovered, I was asked to take a gander at the then "fixed" offending tank. While at the site, one of my coworkers pointed out a neighboring cottage whose tank rested at a precarious slant on rickety, five-foot high wooden legs. We attempted to contact the out-of-state owner to provide counsel on the condition of this "tippy tank" (MDEP has no jurisdiction over these tanks), but not in time to avoid it falling over two weeks later during an autumn storm, adding its contents to the mess!

You betcha, we were more than frustrated about our lack of preventative powers. In fact, our boss demanded that we come up with some scheme to take a more proactive role in addressing our burgeoning problem of leaking aboveground home heating oil tanks.

The Grim Statistics

Since 1991, MDEP has seen an increasing number of aboveground home heating oil tank releases. Until the Casco Bay island affair, however, our efforts at addressing the problem had been limited to working with the state's oil industry to develop a series of public service announcements and informational pamphlets to alert the public of the need to pay attention to these tanks. After dealing with the situation on the island, we moved toward a more proactive approach—to replace these tanks, especially in sensitive areas, such as coastal islands and peninsulas, where shallow bedrock and limited alternative water supplies hinder cleanup of an invaluable resource.

But before our department was to undertake this new initiative, our industry "stakeholders" wanted to see some data. With the gauntlet thrown down, we looked over spill records from 1994 to 1997. We determined that we were responding, on average, to one home heating oil tank/piping leak or spill per day!

We also had some data from a case study performed by a staff member on home heating oil tank releases in the three southern Maine counties. Out of 498 incidents investigated during a period between 1994 and 1996, 17 percent of the spills resulted from internal corrosion, 11 percent from breakage of piping and filters, 10 percent from tank overfills, and 6 percent from corrosion of buried piping. The other remaining categories included vandalism (3%), poor/improper installation (8%), human error (10%), other piping/valve failures (12%), storm damage (5%), other (12%), and unknown (5%). We felt that this information was fairly typical of the rest of the state. The frequency and causes coupled with the long-term cleanup costs associated with these releases really got the industry's attention!

Spills associated with damage to the oil filter and lines (often caused by falling snow and ice) or a corroded tank bottom are one thing; they are usually noticed and cleaned up relatively quickly. Releases from corroding buried piping, however, are more insidious, because by the time they are discovered, the damage is done.

Here's a real-life example of a grim, corroded, buried-pipe statistic. Picture this. It's Super Bowl Sunday. A husband and wife sit glued to the television watching the game, when the wife notices the sweet smell of fuel oil. They investigate and find a pool of oil around the tank in the garage. They later find that it's been seeping up from a leak in the copper line buried in the concrete slab running from the tank to the furnace.

The MDEP investigates and finds that the soil and water under the home are contaminated. The MDEP Groundwater Cleanup Fund will pay for the remediation, but they still have the aggravation of having their yard dug up and a remediation system full of pumps and blowers housed on their property. To add to the confusion, the husband is to be transferred to another state in several months and the couple are afraid (rightly so!) that the house won't sell.

According to the MDEP and its consultant, the cleanup will take years, but some relative tells the wife that digging the contaminated soil from under the house will do the trick. The couple talks the MDEP into letting them manage this portion of the cleanup, which means gutting the bottom story of their house down to the studs so that a bobcat with a front end loader can come in and dig up the soil. It comes to pass, the soil is removed, the house is put back together, and months later it sells. What fun. All that hassle caused by something most people think about as often as they think about their hot water heater or the inner workings of their toilet!

Going with the Program

Back to MDEP's efforts to curtail heating oil releases. With the data in hand and the problem defined, it was up to us to devise a strategy to prevent tank and piping leaks. The first thing we did was to meet with the oil industry and the Oil and Solid Fuel Board (OSFB), the state agency that licenses oil technicians and sets the tank standards. Our goal was to upgrade the state code to address some of the problems that we were seeing.

As in most states where heating oil fuel is used, OSFB adopts the National Fire Protection Code 31, *Installation of Oil-Burning Equipment*, with some modifications. In February 1998, the state rules were amended to include requirements for a layer of well-drained, crushed rock or gravel under the tank pad to prevent the tippy tank scenario; overhead protection from ice and snow falling off the roof; and sleeving for underslab or buried copper lines.

Spills associated with damage to the oil filter and lines (often caused by falling snow and ice) or a corroded tank bottom are one thing; they are usually noticed and cleaned up relatively quickly. Releases from corroding buried piping, however, are more insidious, because by the time they are discovered, the damage is done.

The oil industry recommended that a two-year compliance schedule be set for upgrading buried copper lines and a five-year schedule for overhead protection and padding. These deadlines turned out to be a bit too aggressive, inasmuch as there are more than 250,000 oil heating customers in the state. So, after some public and political pressure, the piping deadline was extended from February 2000 to September 2000. Extending the deadline into a non-heating season makes sense and has given the OSFB, MDEP, and the oil industry more time to get the word out.

The other prong of our strategy is a two-year pilot project, negotiated with our Groundwater Cleanup Fund stakeholders, that will allow MDEP to spend $250,000 per year for two years to replace tanks in sensitive areas at no cost to the homeowner. This project is focused on coastal islands and peninsulas, where groundwater is especially valuable and vulnerable.

Another reason to focus on offshore islands is because some islands, such as Monhegan (one of our replacement sites), are several miles from the mainland, and the logistics of cleaning up a major release would cost many times more than an onshore cleanup. So far, MDEP has replaced 150 tanks on two coastal islands and one peninsula and plans to replace over 100 tanks on two more islands. We provide grant monies for these communities; they, in turn, contract out the work.

We have also contracted with the Community Action Program (CAP—a program set up to help low-income families) to use $750,000 per year for two years to replace tank systems at low-income homes. In Maine, there are around 30,000 CAP clients who use heating oil, so finding places to spend the money is not an issue. So far, CAP has replaced around 1,000 tanks, giving priority to homes that are on private wells. MDEP and OSFB audit/inspect a number of the installations to see whether they meet state requirements and specifications and to find out about any unforeseen problems with implementation of the project.

MDEP keeps a balance of about $25,000 that can be used for quick tank replacement when field staff run across a questionable tank that has the potential to contaminate multiple wells.

Contentious Specifications

For the purposes of our replacement program, MDEP developed a set of storage system specifications that include several items not included in the OSFB rules or NFPA 31. The most contentious requirements involve tank specifications. We specified that:

- Each heating oil tank be an Underwriters Laboratory (U.L.) listed tank (Standard for Steel Oil Furnace Tanks-U.L.-80) that has a bottom outlet so that water and sludge drain into the fuel filter

■ *continued on page 22*

■ **Tanks Down East** *from page 21*

and don't cause tank bottom corrosion.

- Tanks be painted a light color to reduce condensation and, thereby, help reduce tank bottom corrosion.
- The tank end be welded to the body of the tank using a lap joint rather than a crimp connection to prevent rupture caused by joint fatigue resulting from repeated fillings.

We knew that these features were not found on the standard tank in Maine, and we were willing to pay extra for them.

Sounds good, huh? But you'd think that we had asked for the sun and moon! Many oil burner technicians don't like the bottom outlet because they want the water and sludge to stay in the tank and not plug the lines, which results in midnight service calls. However, other

It's a groundwater and indoor air quality issue. Ideally, the combination of public outreach, retrofit deadlines, and industry support should help us succeed in reducing the environmental and health and safety effects of substandard home heating oil tanks.

service technicians assure us that with proper maintenance and filter replacement this issue should not be a problem. The tanks come with only a black primer so the technician would have to paint them, which we are willing to pay for. The stronger end weld is one of the approved welds found in U.L. 80 and offered by some tank manufacturers; still it is different, and technicians need to make the adjustment. By the way, in the next version of U.L. 80 (published July 30, 1999, and effective 18 months later), the "crimped," U.L. 80 weld number 25 will no longer be allowed.

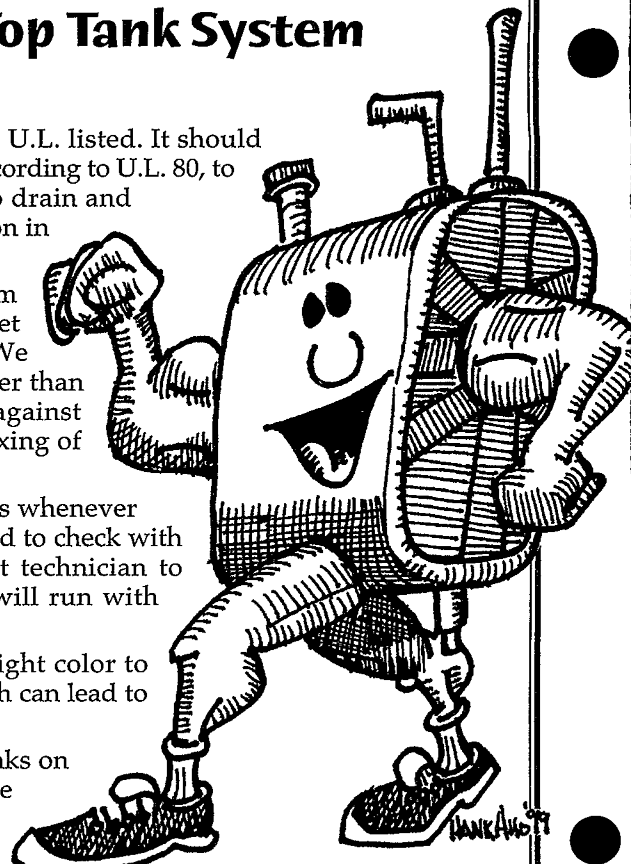
As Maine Goes...

We are now in the second year of our program and are quite pleased with

■ *continued on page 23*

Make Your Tank a Super Tank

Tips for a Tip-Top Tank System



The Tank

✔ Make sure that the tank is U.L. listed. It should include a bottom outlet, according to U.L. 80, to allow water and sludge to drain and to prevent bottom corrosion in the tank.

✔ Be sure that tank ends form a tight lap joint using a fillet weld with the tank shell. We recommend a capped rather than a crimped end to guard against joint fatigue caused by flexing of the tank end during filling.

✔ Use horizontal or flat tanks whenever possible. Homeowners need to check with their professional oil heat technician to find out if their furnace will run with this configuration.

✔ Paint all outside tanks a light color to reduce condensation, which can lead to bottom corrosion.

✔ Rest all outside vertical tanks on a 3-inch, reinforced concrete slab that is underlain with 6 inches of well-drained gravel or crushed rock. Four-inch solid concrete blocks placed under each leg are sufficient for horizontal or flat tanks, along with the 6-inch crushed stone or gravel.

✔ Be sure that the filter is protected from falling ice and snow. Ideally, tanks should be located at the gable end of the house. If this setup is not possible, filter protectors can be installed. (Check with Peter Moulton at MDEP for details.)

✔ Provide the tank with a gauge and a whistle so that the delivery person knows that the tank is full. This setup has always been a requirement, but it has often been overlooked.

The Piping

✔ Protect all piping. If copper lines are buried under or in a concrete or grout-filled trench, replace the lines aboveground and keep them out of the way of traffic. Most lines can be run overhead (again, homeowners need to ask their service technician if this option will work with their furnace pump) or along the wall. If the lines must go back under the basement or garage floor, sleeve them in plastic pipe or conduit. We also recommend that all aboveground piping be run in a protected sleeve.

✔ Run vent and fill lines to the outside of the basement or garage.

Care and Feeding

✔ Routinely check the tank for leaks and weeps.

✔ Have the oil dealer add a fuel additive to prevent sludge buildup and displace any water.

✔ Fill tanks in late spring to keep them full throughout the summer to reduce condensation.

■ **Tanks Down East** *from page 22*

the results. In fact, there is a good indication that our legislature will approve our proposal to continue the project until 2005 (when our Groundwater Fund will be severely cut back). Still, we are targeting only a small portion of the population and it is going to be up to the people of Maine to comply with the OSFB rules.

Meanwhile, our sister states here in northern New England and our Canadian Maritime cousins have had to deal with this problem as well. In a recent meeting of the NFPA 31 Technical Committee, the New Hampshire delegates proposed that NFPA adopt many of the requirements currently found in Maine's rules. This problem is a very regional issue, but it does affect a large number of people. It's a groundwater and indoor air quality issue. Ideally, the combination of public outreach, retrofit deadlines, and industry support should help us succeed in reducing the environmental and health and safety effects of substandard home heating oil tanks.

For a detailed copy of MDEP's specification, e-mail Peter Moulton at peter.t.moulton@state.me.us. ■

Mitigating Third-Party Damage Claims with Pay for Performance

by Bill Foskett

Pay-for-performance (PFP) UST cleanups might prove to be a tool for mitigating third-party damage claims associated with UST releases and related litigation. If a plume can be quickly and successfully remediated, the case for third-party damage may be nipped in the bud or mitigated if already filed.

Many time and materials (T&M) cleanups go on for years, run up high costs, and give no guarantee of a clean site. PFP cleanups offer a fixed price and a fixed time for reducing contamination below levels at which third-party damage claims are likely to be sustained.

The uncertain time and cost associated with T&M cleanups can invite larger third-party damage claims. Furthermore, the slowness of T&M cleanups can nurture third-party damages litigation. As the T&M cleanup grinds on and on with no apparent end in sight, a neighbor might begin to believe that the seemingly endless cleanup has stigmatized his or her own property, even if it has not been contaminated by an off-site plume. These parties assert that the endless neighboring cleanup diminishes their ability to sell or refinance their property.

At least one state is anticipating such claims and is using PFP as a means to reduce contamination at various sites expeditiously so that levels will be low enough within a short time frame to deter claims, if made. More detail on third-party damage claims and the use of PFP to mitigate them will be provided in the next issue of *LUSTLine*.

Bill Foskett is with EPA's Office of Underground Storage Tanks and is the PFP Staff Lead.

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We welcome your comments and suggestions on any of our articles.

EPA HQ UPDATE

OUST Releases Basic Compliance Checklist

After incorporating comments received from state and regional reviewers, the EPA Office of Underground Storage Tanks (OUST) has released its final version of *A Basic Checklist for USTs.* Copies of the checklist have been to regulatory partners in states and regions. The checklist is also posted on OUST's Web site under the "Compliance Assistance" icon (at http://www.epa.gov/swerust1/cmplastc/index.htm). OUST hopes that the checklist will prove to be a very useful compliance assistance tool for UST owners and operators as they self-evaluate their compliance status. The checklist is not presented as an enforcement tool and is clearly caveated on each page to alert the user that filling out the checklist is not a guarantee of compliance status. For more information, contact Jay Evans at 703-603-7149 or evans.jay@epamail.epa.gov.

List of Known Insurance Providers for USTs Published

UST owners and operators seeking a way to comply with federal financial responsibility requirements for USTs can check out OUST's *List of Known Insurance Providers for Underground Storage Tanks* (EPA 510-B-99-003), published in July 1999. The booklet provides a list of insurance providers that may be able to help UST owners and operators comply with their financial responsibility requirements by providing a suitable insurance mechanism. OUST will update the list periodically on its Web site and less frequently as updated printed material.

Copies are available free of charge from NSCEP at (800) 490-9198 or EPA's RCRA Hotline at (800) 424-9346. If you need more than 30 copies, contact Jay Evans at (703) 603-7149.

The document is also available on OUST's Web site at http://www.epa.gov/swerust1/pubs/index.htm#inslist.

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