THINK TANK

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What's a Geoprobe?

LUST Site Characterization With Vehicle Mounted Probe System

by David Lerner

You may notice at some sites that the UST Branch is performing site characterizations using a hydraulically-powered soil probing machine mounted on a pickup truck bed. The hydraulics are used to advance a small diameter sampling probe into the subsurface to collect soil core, soil gas, or groundwater samples. The UST Branch is using this tool to expedite site characterization and minimize costs to investigate petroleum contamination.

The Geoprobe, as it is called, is ideal when used in uniform soils consisting of sands and silts. The probe can be advanced twenty feet in less than twenty minutes, for most sites. Because of the speed and efficiency of the Geoprobe, UST Branch personnel are able to complete enough borings to define the area of soil contamination at a site in one day. The Geoprobe can also be used to collect groundwater samples to define the extent and severity of groundwater contamination. Use of the Geoprobe makes completion of subsurface investigations more efficient and less costly when compared to large drilling rigs.

For example, the Geoprobe is lighter, smaller and more mobile than most drill rigs, thus mobilization is completed quickly. Since it creates a one to two inch diameter hole, surface disturbance is minimal. Finally the vehicle mounted device does not use drilling fluids and only creates a minimal amount of cuttings; this reduces disposal costs for contaminated materials. The UST Branch is using the Geoprobe only in State funded investigations.■

Editor's Note:

Those of you who eagerly look forward to each issue of *Think Tank* may have noticed that there was no Fall 1995 issue. Branch priorities delayed publication, but articles scheduled to appear in the Fall issue are included in this one — making this the first eight-page issue.

The next issue will include the final of four articles in the MTBE series — cleanup options, more on cathodic protection and the '98 deadline, and tips on expediting your tank closure.

What's Inside...

MTBE – Part 3

Fuel Oxygenates: Groundwater Solubility and Movement

by Pat Ellis and Frank Gavas

This report is the third part of a four part series exploring fuel oxygenates, notably MTBE. Previously, fuel oxygenate health risk issues were discussed. In this part we will discuss the solubility, fate, and transport of fuel oxygenates in groundwater.

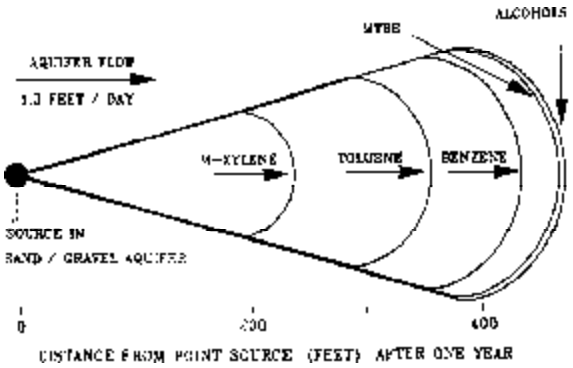
Studies of the behavior of benzene, toluene, ethylbenzene and xylenes (BTEX) in the subsurface have investigated the fate of these compounds in pure form or as derivatives of gasoline, with no additives. Most retail gasolines, however, now contain additives, typically oxygenates such as alcohols and ethers. These compounds, due to their high water solubility, pose special concerns with respect to groundwater quality. When released, they can be expected to occur in high concentrations in groundwater and may influence the fate and transport of other gasoline constituents such as BTEX.

MTBE is 4.3% soluble in water. When compared to the relative solubility of benzene (0.18%), tol-uene (0.05%), and xylene (0.02%), MTBE is substantially more soluble in water and consequently, when released, spreads both farther and faster than most gasoline components (Garrett and others, 1986). Another common oxygenate, methanol, is completely water soluble and moves at the same speed as groundwater.

It has been hypothesized that oxygenates in gasoline may act as co-solvents, increasing the water solubility of typically less soluble fuel constituents such as BTEX. In a recent laboratory study by Piel (1989), however, ethers such as MTBE did not exhibit a co-solvency effect for aromatic compounds such as BTEX. Alcohol additives, methanol and ethanol, however, may increase the water solubility of some aromatics.

Alcohols and ethers are octane enhancement alternatives to aromatics. The addition of up to 15% MTBE in gasoline results in a reduction in gasoline aromatic content, and consequently a reduction in the BTEX groundwater threat.

A hidden advantage to MTBE in gasoline lies both in its high solubility and, like other ethers, its low odor and taste thresholds for human beings. MTBE will form the leading edge of a release and should be immediately detected by odor or taste in impacted potable water, an early warning indicator, which may limit the consumption of and exposure to contaminated water.



Piel, William J., 1989, Fuel Oxygenate Affects (sic) on Aromatic Solubility in

Roy F. Weston, Inc. conducted a modeling study to determine the expected migration profiles of oxygenates and aromatics in a ground water aquifer (Dominguez, 1987). This dispersion model uses attenuation by adsorption for each constituent to predict a plume profile. Correlations with the octanol/water partition coefficients (K_{ow}) are used to predict the distribution coefficients (K_d), and retardation factors (R_d) for each contaminant. In the model, a continuous release of 500 ppb from a point source at the water table surface is assumed. In reality, the level of oxygenates entering the water table would be expected to be higher than the aromatics in a typical situation because of their higher water solubility. There is very little retardation with the oxygenates, so the profile of the oxygenates is nearly that of the water itself. The MTBE is not far behind the alcohols even though the water solubilities are relatively different. The aromatics lag farther behind because of their higher retardation.

In 1994 the Institute for Groundwater Research at the University of Waterloo under contract to the American Petroleum Institute (Hubbard, and others, 1994) presented the results of a field study of the fate and transport of two gasoline additives, methanol and MTBE, in ground-water. The study also attempted to determine the influence of these compounds on the groundwater fate and transport of benzene, toluene, ethylbenzene, and xylene. The study compared the behavior of three simulated releases: 100% gasoline, 10% MTBE and 90% gas-oline, and 85% methanol and 15% gasoline. The objective was to cre-ate three dissolved contaminant plumes of similar size that would travel side by side in the same flow system and geochemical environment. Sodium chloride was added to each plume to act as a conservative, unreactive tracer. Concentrations

of dissolved components were monitored over a 16 month period in three dimensions using a dense network of multilevel sampling probes.

The comparative assessment of the fate and transport of both BTEX and the oxygenates was accomplished by an evaluation of the relative mobility and persistence of these compounds. Mobility refers to the ease of transport (i.e. lack of retardation) of the compound in groundwater, using the groundwater velocity as the standard of comparison. Persistence addresses the rate of mass loss due to microbial transformation processes. BTEX and methanol are known to be biodegradable, while MTBE appears to be slightly degradable to nonbiodegradable.

The study shows that the methanol and MTBE mobility is similar to that of the chloride and groundwater, while the BTEX constituents are less mobile. Benzene moves at about 90% of the groundwater velocity, toluene at about 75%, and ethylbenzene and xylene move at about 67% of the groundwater velocity. Neither MTBE nor methanol causes a measurable difference in the mobility of the BTEX constituents relative to the control case. MTBE is recalcitrant to biodegradation in the aquifer. Methanol is rapidly degraded after an initial lag period of about 100 days. BTEX constituents degrade in all plumes, with toluene and m-xylene being the most easily degraded, followed in order by o-xylene and p-xylene, and benzene. The presence of MTBE does not appear to inhibit degradation of the BTEX compounds, while methanol inhibits BTEX degradation.

Donbaldson and others (1993) conducted laboratory experiments to investigate the subsurface fate and transport of a methanol/gasoline blend (M85). M85 was found to enhance BTEX solubility. In a recent paper (Rixey, 1994) presented at the NGWA hydrocarbon conference in Houston, a previously developed mathematical framework was used to determine expected BTEX source concentrations for oxygenated fuels of both low and high concentrations (M15 and M85). Both methanol concentrations produced significant BTEX concentrations at the source of the dissolved oxygenated plume.

From a fate and transport standpoint, there are trade-offs associated with the introduction of oxygenates. The addition of oxygenates has resulted in a reduction in the use of aromatics, BTEX. However, co-solvency effects, primarily observed in alcohol blend fuels, appear to increase the mobility of certain gasoline constituents in the subsurface.■

Changes to Stage II Testing Notification Procedures

by Carl F. Riegel

In the early years of the Stage II Vapor Recovery program, when all we had to concern ourselves with was inspecting new facilities, and observing post construction tests, handling requests for Stage II testing on the basis of a two day verbal notice did not create a problem. However, with the addition, of several hundred facilities in Kent and New Castle Counties requiring annual tests, the situation is rapidly becoming unmanageable. The solution, we believe, is to begin using a tool we already have, but until now, have not used.

Regulation 24, Section 36, subsection g.1 of Delaware's *Regulations Governing the Control of Air Pollution* states "The Department shall receive written notification 10 working days prior to any test operation, unless permission is granted to the contrary." The clause, "unless permission is granted to the contrary" is intended to address the need for emergency testing which the Department may verbally approve, waiving the ten day notice requirement. In order to more efficiently schedule these tests, and better serve the regulated community, the Underground Storage Tank Branch will start requiring the ten day notification beginning January 15, 1996.

This ten day notification does *NOT* replace or supersede the two day notice. The two day verbal notice is intended to adjust and/or confirm the ten day. This two day notice is required by Delaware's *Regulations Governing the Control of Air Pollution*, Regulation 24, Appendix J2, Section b.1 and Appendix J3, Section b.1. Please note that the Department may or may not witness the test, and that failure to provide notice may result in the test being declared invalid and a retest being required.

Testing notification forms are available from the UST Branch and will be attached to Stage II Construction and Operating permits in the future. You may mail it or fax it to us. And you may copy it as needed.

We thank you for your cooperation. Please feel to contact us if you have any questions or comments.■

Delaware's 1998 Compliance Deadlines

by Matt Higgins

This article is the first in a series of four describing the last set of compliance deadlines for Delaware's underground storage tank (UST) system owners. These compliance deadlines "piggyback" on the Environmental Protection Agency's (EPA) December 22, 1998, deadline for the addition of spill and overfill protection, cathodic protection, and tank testing requirements.

Delaware's 1998 compliance deadlines differ from the EPA's by requiring owners and operators of existing non-heating fuel UST systems to install spill and overfill protection on their UST system by the end of 1990. All other Federal and State 1998 compliance deadlines are the same for non-heating fuel UST systems.

Topic's to be covered in this, and upcoming installments of *Think Tank* will include:

1. Tank Testing Requirements
2. Cathodic Protection — Impressed Current Systems
3. Cathodic Protection — Sacrificial Anode Systems
4. Corrosion Protection — Internal Lining of USTs

Please note that Delaware also has separate regulations for heating fuel UST systems; this topic will be discussed in a later article.

Part 1

Tank Testing Requirements

Delaware requires that leak detection be performed on all UST systems. This must consist of inventory control procedures and some "other" method of monitoring the UST for releases. One of the "other" methods of leak detection is a tank tightness or precision test. This method of leak detection must be performed at least once a year. Delaware's regulations require that if you presently use the annual tank tightness test option you must choose a monthly monitoring method of leak detection after December 22, 1998, or ten years after the tank was installed, whichever is later.

The monthly methods of leak detection include the following:

Interstitial Monitoring

This is an option for double walled USTs or for UST systems installed with a liner. The interstitial space between the inner and outer wall of the tank or the tank and the liner is monitored continually or on a monthly basis for a release.

Automatic Tank Gauging

This method utilizes equipment installed in the UST to test for loss of product and may (if programmed) conduct inventory control. This system must conduct a leak test of the UST at least once a month.

Monitoring Wells

This is used for groundwater monitoring. It must consist of a minimum of four (4) monitoring wells that must be monitored continuously or on a monthly basis. This method must be able to detect at least one-eighth of an inch (1/8") of free product. Soils in which the monitoring wells are installed should consist of gravel, coarse to medium sand, or other permeable material.

Monitoring wells must be clearly marked to avoid unauthorized access and tampering and must be installed by a Delaware licensed well driller. This method is only effective at sites where groundwater is within twenty (20) feet of the surface.

Vadose Zone Vapor Detection Tubes

This method is used for monitoring vapors in the vadose zone (the area between the top of the water table and the surface of the ground). It must consist of a minimum of four (4) vapor tubes that must be monitored continuously or on a monthly basis.

The regulated substance stored in the UST system must be sufficiently volatile to be detected, such as gasoline, kerosene and aviation fuels. Soils in which the vapor tubes are installed should consist of gravel, coarse to medium sand, or other permeable material. Vapor tubes must be clearly marked to avoid unauthorized access and tampering.

Alternative Release Detection Method

This is approved by the Department on a site by site basis. The method must be able to detect a leak rate of 0.2 gallons per hour or a release of 150 gallons within one (1) month. An example of an alternative release detection method is Statistical Inventory Reconciliation (SIR).

Remember, there are some instances when tank testing can be used after the December 22, 1998, deadline. The following set of situations will explain when tank testing can and cannot be used:

Case 1

A single walled sti-P_3 UST installed in 1983 that uses tank

tightness testing must switch to a monthly monitoring method by December 22, 1998.

Case 2

A single walled sti-P_3 UST that is installed in 1997 may use tank tightness testing until the year 2007; the tank must then switch to a monthly monitoring method.

Case 3

A single walled bare steel UST installed in 1980 that is upgraded with internal lining, cathodic protection, or a combination of both methods in 1996 may use tank tightness testing until the year 2006; the tank must then be switched to a monthly monitoring method.

Please note that this requirement applies only to tanks, not the associated product lines. An annual line tightness test and leak detector functional test must be performed on piping with pressurized delivery systems. Suction systems with the check valve at the tank must have a line tightness test every three (3) years; suction systems with the check valve at the dispenser are exempt from this requirement.

Keep in mind that not every monthly monitoring method may be applicable for your facility. Check Part B or D of the Regulations if you are not clear about tank tightness testing requirements. You may also call the UST Branch and we will be happy to review the options with you.■

~~Air-to-Liquid~~ Ratio Tests

by Carl Riegel

When the State of Delaware's *Regulations Governing Underground Storage Tank Systems* were written, the California Air Resource Board, better known as CARB, had not yet developed a protocol for the Air-to-Liquid ratio (A-to-L) test. In the past years CARB has promulgated Draft Test Procedure TP 201.5, and revised it at least once. All owners of vacuum assist Stage II Vapor Recovery systems, using the A-to-L test for compliance, will shortly be receiving notice from the Department of changes in the A-to-L test procedure. This notice is to be attached to your Operating Permit, and on file at the facility. You may begin using the new protocol upon receipt of the notice. The following will explain these changes.

Draft Test Procedure 201.5 defines the A-to-L test as it applies to both new equipment certification and to annual compliance testing. First, of course, you must look at the CARB Executive Order which gives approval for the particular system being tested. This will establish the required A-to-L ratios for approval.

For new equipment certification testing, the three consecutive test average A-to-L ratio must be within the limits set by the Executive Order. This is how the State of Delaware has been requiring all A-to-L tests to be performed.

The most recent version of Draft Test Procedure TP 201.5 defines an A-to-L test for compliance. Each nozzle is tested once. If it meets the levels set in the CARB Executive Order, it passes. If it fails the first time, then the three consecutive test average must meet the limits in the Executive Order. If it fails this as well the nozzle is defective and must be removed from service.

This only changes the number of times the test must be performed on each nozzle. You still have the option of using a Roots meter, or an approved vacuum test meter.

The benefit here should be quite obvious. The average test will now be considerably shorter. This translates to less down time for the facility which could mean less loss of revenue. Since the test will be shorter, there could be a reduction in costs for these annual tests charged by testing contractors.

For ease of reference, the table below summarizes the A-to-L limits for the various systems in use in the State of Delaware. Do not forget that many systems have pumping rate limits as well as A-to-L limits. Questions on the above should be addressed to Carl Riegel at the UST Branch.■

	Flow Rate		A to L	
	Minimum	Maximum	Minimum	Maximum
Amoco V-1	7	-	1.11	-
	8	-	1.08	-
	9	-	1.06	-
	10	-	1.04	-
Gilbarco Vapor Vac	8	-	1.00	1.25
Hasstech	6	-	1.40	2.40
	8	-	1.40	2.30
	10	-	1.40	2.15
	12	-	1.40	2.00
OPW Vapor EZ	7	10	0.90	1.1
Tokheim MaxVac	7	10	0.90	1.10
Wayne Vac	7	10	0.90	1.10

Land... And the Environment

by Emil Onuschak, Jr.

Many persons believe that "the environment" is something that always costs money — an added expense from which they derive no benefit. Nothing could be farther from the truth, especially in the case of underground storage tanks and especially in Delaware.

These same persons often are responsible for the operation, maintenance and putting to productive use a huge capital investment in facilities, machinery... and land. They would not tolerate failure to follow standard operating procedures at their facilities anymore than they would neglect regular maintenance of their expensive machinery. But the land? Land is often considered something to be owned, to be occupied, to be used. But to be *maintained*? That may be okay for farmers, but...

Will Rogers once said, "If I was an investing man, I'd invest in land 'cause they ain't makin' anymore of it."

Like so many insightful Americans, "ole Will" liked to pass himself off as a country bumpkin and to disguise his insights as humor. But his observations are no less true.

Many people spare no expense when it comes to maintaining a new automobile. They wash it, they wax it, they vacuum the interior and they change the oil regularly because they recognize their purchase as the sizeable investment it is and accept the responsibility for maintaining that investment as well as they can.

All too often, these same people consider maintenance of land that they own in a different light. If they think of land "maintenance" at all, they think in terms of grass cutting, snow shoveling, and perhaps landscaping.

From a legal perspective, "land" is a complex subject. Land is considered to comprise a "bundle" of properties and characteristics. Thus, we may talk of water rights, grazing rights, access rights, rights-of-way and many other characteristics that make up real property. More and more it is becoming widely recognized that environmental properties are another of the "bundle" of site characteristics that comprise a particular piece of real estate.

In recognition of this fact, mortgage bankers, realtors, insurance companies and others commonly now require audits to establish the environmental characteristics of a piece of land when it is involved in a property transfer, refinancing or redevelopment. UST Branch files include sites from pre-audit times where heirs found themselves with a potentially unmarketable property and a large cleanup bill, sites where conventional mortgages were not available at any price and sites where unsuspecting buyers were faced with bankruptcy because of unscrupulous sellers.

A sample of 268 identified LUST sites in Delaware shows that 15 percent are known to be involved in a property transfer (Figure 1). Of these, one-third are residential and potential residential sites and two-thirds are commercial sites (Figure 2). If we assign an arbitrary value of $80,000 to each residential and potential residential property transfer and a value $150,000 to each commercial transfer, then this sample of identified LUST sites involved in property transfers represents a little over $5 million added to the economic activity of Delaware (Table 1).

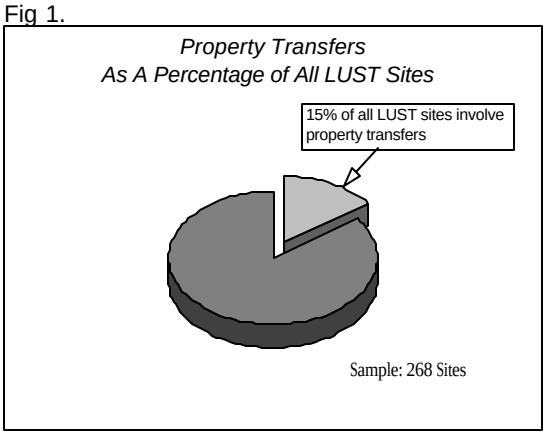
If we extrapolate this sample to the entire population of identified LUST sites in Delaware, we find that a minimum of $32.5 million has been added to the economic activity of the State through the Underground Storage Tank program.

To whom would the principal parties involved in these transfers have turned if not to the Underground Storage Tank Branch? A moment's reflection shows that the UST Branch is the *only* party

Table 1.

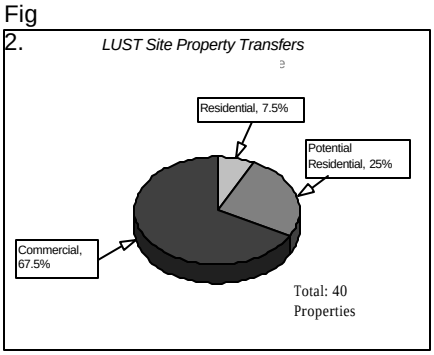
Value of residential property transfers: 3 @ $80K	240,000
Value of potential residential property transfers: 10 @ $80K	800,000
Value of commercial property transfers: 27 @ $150K	4,050,000
TOTAL	$5,090,000

Fig 1.



without a personal financial interest in such real estate transfers and the *only* source of nonpartisan decisions and evaluations. Who would restore these real properties to productive, *taxable* use if not for the UST Branch?

Fig 2.



So what does this have to do with Will Rogers and the State of Delaware? Simply this: Given Delaware's small size, we have less margin for error in — and less opportunity to walk away from — maintaining land and in rehabilitating those parcels that become contaminated from leaking underground storage tanks. If we arbitrarily assign a one-acre size to each known LUST site, the total area is 0.14 percent of the State's total area, a larger proportion than if the same contamination occurred in almost any other state. And this does not include third-party im-pacts that result when contamination migrates off-site and affects larger areas.

"Ole Will" was right — they're *not* making land anymore. So we'd better wisely use that which we have! And that includes managing our underground storage tanks and taking *prompt action* whenever a question or a problem arises.■

Kathy Calloway Ensures UST Branch Stays on Track

By Jill Hall

Kathy Calloway has been with the DNREC since 1987 where she started in the Division of Water Resources as a Resource Planner. In July of 1989 she joined the UST team as the manager of the UST group, comprised of Environmental Scientists who are responsible for tank compliance issues. In the spring of 1993 she took on the task of managing the entire UST Branch encompassing everything from tank compliance to cleaning up leaks. As the Program Manager II Kathy is responsible for keeping the Branch focused on its goals.

Kathy is particularly proud of the UST Branch as 1995's accomplishments include implementation of the Small Retail Gasoline Station Assistance Program, adoption of new contractor certification regulations and amendments to the UST Regulations, presentation of a trade show, and implementation of final Financial Responsibility requirements for tanks. Also, the Branch has conducted the first UST Branch soil vapor extraction/ bio-filtration demonstration project, closed 306 LUST sites and identified 303 new LUST sites, completed 93 new tank inspections and implemented a Stage II vapor recovery program in addition to a host of others!

Kathy's duties as the Branch Manager include the A-Z's of management including budgeting, resource management, development of regulations and legislation, staff hiring, and chairing committees such as LUST and ECDI that bring together the Department and the community.

Kathy is a native of Delaware having grown-up in the North Wilmington area. She holds a B.S. in Marine Sciences from the University of South Carolina and a Masters in Marine Policy from the University of Delaware. Kathy's biggest accomplishment was the addition of baby Victoria in March of 1994. She shares her New Castle County residence with husband Chris, dog Max, and daughter Vicki.■

Contractor Certification Update

Since September 12, 1995, all contractors performing work on regulated USTs including; installation of new tanks, upgrade of existing tanks, removal or abandonment, or internal lining, have been required to be certified. The Department's certification program has now certified 51 companies to perform UST work, and has applications from 14 more who are requesting certification.

As a tank owner, or potential tank owner, you are required to use a certified contractor to perform UST work on regulated tanks. To assist you in obtaining a certified contractor, the UST Branch maintains an up-to-date list that is available upon request. Please call the UST Branch if you need a copy — we will be happy to mail or fax the current list to you.

THINK TANK

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Announcements:

Ravi Rangan — Promoted

Those of you who have dealt with Ravi Rangan for tank installations, leak reporting, and Stage II issues, will be pleased to know that he has accepted a promotion within the Department and will be working with the Air Quality Management Section. His new responsibilities will include compliance with Air Regulations at Star Refinery in Delaware City.

His responsibilities within the UST Branch will be divided among the staff for the present time. We will miss "the Prankster" and wish him well in his new position.

Jill Hall — Management Fellow

Jill Hall is one of only eleven State Employees accepted into the Governor's Management Fellows program. Her fellowship will include three months working on a project with Nikki Castle in the Delaware Economic Development Office. This is a program which allows those with extraordinary management potential to work on a project of special interest to them and to gain experience working with other government agencies.

Jill will be out of the office February, March & April. Anyone requiring assistance with the ECDI program should talk to David Brixen. Matt Higgins will be the contact if you need assistance with the Small Retail Gasoline Station Assistance Program.

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Doc. #40-09/96/02/01

Corrosion Protection Required