Leak Prevention

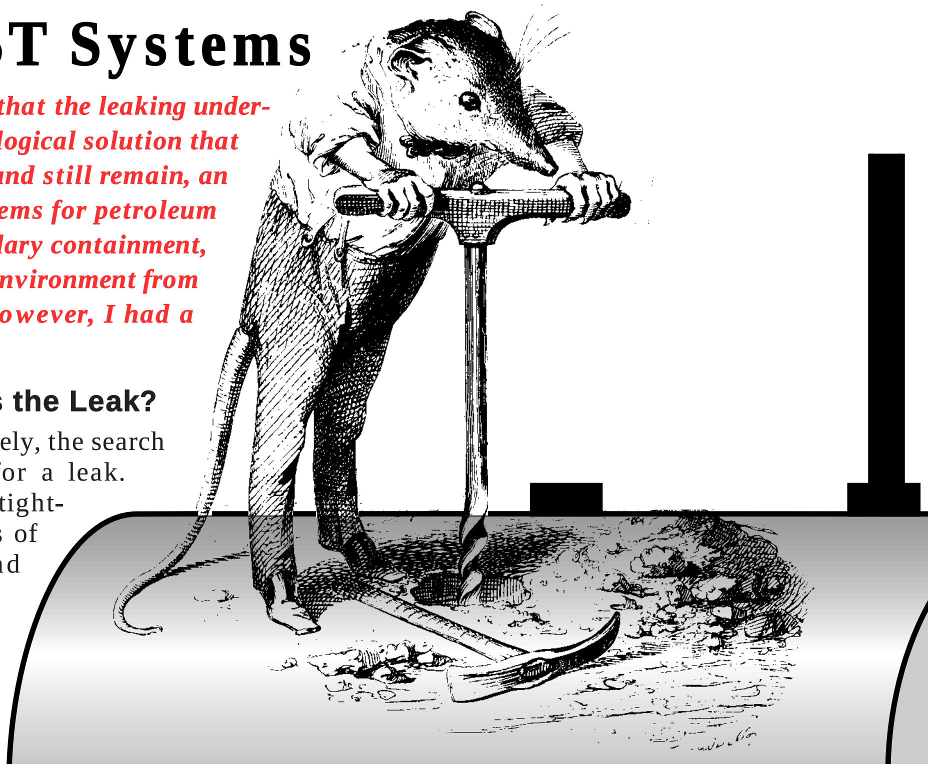
Tank–nically Speaking

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.*

The Holes in Our UST Systems

I used to sleep soundly at night. I used to believe that the leaking underground storage tank (LUST) problem had a technological solution that could overcome human frailty. I have long been, and still remain, an ardent proponent of secondary containment systems for petroleum storage. I have for a long time thought that secondary containment, though not perfect, would adequately protect our environment from petroleum contamination. A few months ago, however, I had a rude awakening.



A Troubling Case

The newspaper headlines announced bluntly that MTBE (methyl tertiary-butyl ether) had been found in a monitoring well located between a gas station and a public water supply well that serves several thousand people. The news reports indicated that a new convenience store/gas station facility, barely 10 months old, had reported that MTBE had been found in an observation well in the tank backfill.

The site had no previous history of gasoline storage. The storage facility was state-of-the-art, with double-walled fiberglass tanks and flexible piping, dispenser sumps, tank top piping sumps, and spill containment and overfill prevention. Only the Stage I vapor recovery riser and Stage II vapor return piping were single-walled. Sensors continuously monitored the piping sumps and tank interstitial spaces for evidence of releases.

As part of a due diligence investigation associated with a property transfer, samples that had been taken from the facility's observation wells tested positive for MTBE. Because of this, a monitoring well some 1,000 feet away that was halfway between the convenience store and the public wells was also sampled. This well also tested positive for MTBE. Soon low levels of MTBE appeared in the nearby public water supply well. As a result, that well was closed, and an alternate well a few hundred feet farther away was put into operation.

Where's the Leak?

Immediately, the search was on for a leak. Multiple tightness tests of tanks and piping showed nothing. Interstitial spaces of tanks and piping were dry. Was it a vapor leak? (See "The Great Escape..." on page 18.) A helium test, where the storage system is filled with helium and then a helium detector is used to check for leakage, was conducted and, at first, indicated a positive result. Helium levels in the area over the tank, as measured through holes in the concrete cover pad, were higher than expected.

To pinpoint the leak, the concrete mat over the tanks was sawed into large blocks and then carefully lifted off and removed. The gravel backfill over the tanks was vacuumed away so as to leave the piping as undisturbed as possible.

With the tank top and piping exposed, the helium test was repeated. This time, the helium detector was placed right up against the joints and the piping so that the exact location of the leak could be identified.

Quite a few interested parties were watching, including the state environmental agency, the tank installer, and several representatives of the tank owner. But no leak was found. A dead end again.

Spillage Perhaps?

A review of inventory records provided a clue. There were four instances where the records provided strong indications that the regular tank had been overfilled. This was evidenced by a shortage of several hundred gallons in the regular product inventory, while the premium product showed an overage of similar magnitude. The most likely scenario was that more regular product had been ordered than could fit into the tank, so the excess was delivered into the premium tank. This is known in the trade as "cross-dropping."

The reason excess product had been ordered was perhaps because the fuel manager failed to recognize that the "10,000-gallon tank" had an actual maximum capacity of 9,728 gallons. This volume was further reduced by a float vent valve that had been set conservatively at 18 inches below tank top, yielding an actual tank capacity of only 8,459 gallons.

Given the operational characteristics of float vent valves (see *LUSTLine* #21), it seems likely that the delivery person would have to have dealt with a hose full of product and that some spillage could have resulted.

By What Route?

The spill containment manholes at this site were below-grade models, which is good in terms of keeping surface water out, but leaves some gravel exposed around the rim of the spill container. Product could have infiltrated this backfill area. But then why was there no significant presence of any other gasoline constituents in the groundwater in the tank excavation and no evidence of contamination in the gravel backfill around the fill pipe?

For this scenario to be credible, we must assume that the other gasoline constituents volatilized and biodegraded, while the MTBE was carried by precipitation down to the groundwater. Because the backfill was clean and well aerated, and the investigation of the site occurred about five months after the last clear indication of an overfill incident in the inventory records, this scenario seems somewhat plausible.

Another possible route for MTBE contamination is being explored by Dr. Gary Robbins at the University of Connecticut. Robbins is finding that MTBE is appearing in groundwater beneath dispensing areas, apparently originating with spillage during vehicle fueling. Because of its solubility, MTBE can be transported by rainwater to groundwater while other gasoline constituents are attenuated or volatilized. It is possible that surface spillage at the dispensers could have contributed MTBE contamination to our mystery spill as well.

A Bit of History

Until the publication of the EPA's tank testing study in 1988, a leak rate of 0.05 gallon per hour had been the longstanding industry standard for leak detection accuracy. This number apparently originated with a study that concluded that leaks of 0.05 gallon or less assimilated naturally and did not pose a significant contamination threat.

While the actual magnitude of a "no-adverse-effect leak rate" could be debated at great length, I think the presence of MTBE in today's motor fuels would add a new dimension to the equation. The incident cited above, as well as several others that I am aware of involving significant MTBE contamination resulting from automobile accidents, where limited amounts of fuel were spilled, casts a new light on the significance of gasoline spillage. Volumes of spilled gasoline that previously would have had no adverse effects can cause significant damage when MTBE is present.

While the official EPA position is that there is no "allowable" leak rate, the evaluation protocols for the various leak detection methods determine threshold leak rates below which a storage system is assumed to be tight. The nagging question is whether a leak detection standard of 0.2 or 0.1 gallon per hour is adequate to protect human health and the environment when MTBE is present.

What Does the Future Hold?

While we are no doubt better off from a leaking storage system perspective today than we were 10 years ago, we are not out of the woods yet, and probably never will be. In the next decade we will likely still be paying for some sins of the past decade, will still be dealing with the foibles of human nature, and will be facing an ever more prevalent chemical specter with the initials MTBE.

So what possible routes of escape might gasoline and its constituents (MTBE in particular) find in our future fueling systems? Here are some working hypotheses that I think are worth keeping in mind:

■ There are holes in our UST systems, but they are below the detection threshold for leak detection technology.

One of my favorite stories involves a double-walled fiberglass tank. During a routine regulatory inspection, the regulator discovered that the interstitial sensor had been disconnected. A subsequent investigation revealed that the interstitial space was half full of product, which explained why the sensor had been disabled. The owner insisted that there was no problem, suggesting that a delivery had mistakenly been made into the interstitial space and pointing to several tightness tests with "tight" results.

The product was pumped out of the interstitial space, yet a small amount of product, about a gallon every couple of days, kept reappearing. This was initially explained as residual product draining from inside the ribs of the tank, but the product continued to mysteriously accumulate.

The owner insisted that everything was fine, but the environmental agency was suspicious. Finally a dye was introduced into the product in the tank, and a few days later, the dye appeared in the product that was being removed from the interstitial space. Subsequent internal inspection uncovered a pry bar lying in the bottom of the tank at the fill opening, and a small impact fracture just beyond the edge of the striker plate in the bottom of the tank.

A likely scenario is that a delivery driver, in the process of chopping ice out of the spill container (after removing the fill cap), had slipped and dropped the bar down the fill pipe. The point is that this leak would never have been detected had it not been for secondary containment (the leak rate was less than 0.1 gph), but clearly could have resulted in the release of a significant amount of product over time.

In another recent case, a tank gauge had apparently failed to detect a leak that had gotten into some underground utilities. Review of the automatic tank gauge (ATG) test records indicated a small, consistent loss—evidently not enough to exceed the leak threshold for the device and fail a leak test.

■ There are holes in our UST systems, but we are not looking in the right places for them.

Leaks of petroleum vapors from UST systems have not been a traditional target of leak detection efforts, and it may well be that historically the magnitude of these releases has been

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below the "no-adverse-effect leak rate." Although I do not yet know of any instance where a vapor release has been the source of an environmental problem, theoretical considerations indicate that it could be a possible origin for MTBE contamination. (See "The Great Escape..." on page 18.)

The potential magnitude of vapor releases has been increased by the widespread use of pressure/vacuum vents that maintain a small pressure on the vapor space of the tank, thus increasing the rate of vapor emissions from any holes near the top of the tank.

Of the leak detection tools at our disposal, only full system tightness testing and soil vapor monitoring are likely to detect vapor leakage from storage systems. Soil vapor monitoring is rarely used and tank tightness testing will be phased out with inventory control. Storage systems that are subject to Stage II vapor recovery regulations are subject to periodic tightness testing of the vapor space, but these are a relatively small percentage of the tank population at this time. So, for a great many storage systems, the tightness of the tank ullage space and the piping that handles only vapors is never determined.

Other storage system components that escape routine testing are the piping sumps on top of tanks and dispenser sumps. While sumps that contain some amount of water are a fairly common sight, I always wonder whether the sumps that don't contain water are dry because no water is getting in or because whatever water is getting in is also leaking out.

As sumps age and are subject to frost action, possible tank movement, and assorted maintenance activities, it would seem reasonable that, at some point, they could develop holes that would compromise their leak detection role. Yet sumps are not routinely evaluated for liquid tightness.

■ There are holes in our UST systems, but the technology to detect them is not being installed properly.

Recently, I heard of a case where secondary containment piping had been installed, but leaked product failed to make its way back to the piping sump where the sensor lay in wait to detect it. If leak detection technology is not properly installed, it may not operate properly. This problem, of course, can result in undetected leaks.

■ There are holes in our UST systems, and they are being detected, but no one is paying attention.

The routine disregard of alarm signals by facility personnel is a problem of epidemic proportion. I recently heard of a facility where the ATG recorded that an alarm indication had been turned off 47 times in 28 days. This problem is twofold in that false alarms that result from poor equipment design or installation occur too frequently, and facility personnel have not been made sufficiently conscious of the potential significance of an alarm going off.

■ There are no holes in our UST systems, but product is being spilled during deliveries.

As illustrated by the story at the beginning of this article, spill events associated with deliveries continue to occur and can result in significant environmental problems, especially when MTBE is involved. A number of factors contribute to this problem, including the owner's lack of awareness of actual storage tank capacity, the ineffectiveness of the overfill prevention technology we commonly use (see *LUSTLine* #21), and the delivery personnel's financial incentive to be quick rather than careful (especially those who are paid by the truckload, not by the hour).

■ There are no holes in our UST systems, but product is being spilled during dispensing.

The possibility that routine spillage of gasoline by the end user is a significant source of gasoline releases is very disconcerting. Since talking with Gary Robbins about his research, I have begun to notice that evidence of gasoline spillage is everywhere—concrete mats around dispensers, fast-food restaurant parking lots, and on-street parking areas all display ample evidence of how often end users spill gasoline. (Did you ever stop to think why the area around dispensers is paved with concrete and not asphalt? Because we learned long ago that asphalt is rapidly degraded by spillage during fueling.)

Historically, this spillage may have been of little consequence because of volatilization and biodegradation, but again, the introduction of MTBE has changed this picture.

The mathematics of consumer spillage look something like this: In 1997, we, as a nation, dispensed about 126 billion gallons of gasoline. If we assume that the consumer purchases an average of 10 gallons per fuel dispensing event and that one in 1,000 fueling operations results in the spillage of one cup of gasoline (that's an individual driver spilling one cup about every 19 years if you fill up once a week), then about 750,000 gallons of fuel are spilled every year at fueling facilities alone. Is this a number we can live with? Is this a number we can live with if MTBE is part of the picture?

The Watchwords

So here are some watchwords we should keep in mind for the next decade:

- **Out of sight must not be out of mind.**

  Tank management must be an active and ongoing process on the part of tank owners and operators.

- **Do it right!**

  Proper storage system installation and maintenance work is more important than ever.

- **Early retirement is not an option.**

  The tank regulator's job is far from over.

I'm also considering the possibility that the most intractable part of the underground petroleum storage problem may prove to be sociological rather than technological: Can we complete 15.75 million underground tank filling operations and 12.5 billion automotive fueling operations each year without spilling a drop? ■