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

A Tale of Two Gas Stations

How Petroleum Contamination at the Canob Park Neighborhood Sparked the Regulation of Tank Sites in Rhode Island

by Sofia M. Kaczor

Photos of the Mobil and Exxon stations taken from the CBS 60 Minutes *story "Check the Water" which aired in 1983.*

In the spring of 1993 I visited my first LUST sites located in the Village of Wyoming in Richmond, Rhode Island. My then mentor and fellow geologist Dave Sheldon of the Rhode Island Department of Environmental Management's (RIDEM's) LUST Program suggested we inspect the condition of monitoring wells at a Mobil station and an Exxon station located across the street from each other near Interstate 95. We were preparing for very contentious meetings with responsible parties and their lawyers in order to assess present subsurface conditions and expected future work. Unbeknownst to me, this area, known as "Canob Park," had been suffering from petroleum releases during the 1960s and 1970s, prior to the inception of any federal or state UST regulations. At the time I knew next to nothing about that site's grueling saga!

The Canob Park neighborhood was developed in the 1960s and consisted of 43 homes whose only potable drinking water came from private wells. At the same time, just south of this neighborhood, Richmond's commercial district on Route 138 and I-95 was expanding and included four gasoline stations as well as a laundromat facility at the Chariho Shopping Center, all served by private wells and individual sewage septic systems. For some of the residents of Canob Park, water quality problems started as soon as the water tap was turned on. What follows is the story of groundwater contamination in Canob Park caused by petroleum releases from two nearby gasoline stations and actions taken that finally led to RIDEM issuing a "No Further Action" letter to the Exxon station in December 2015.

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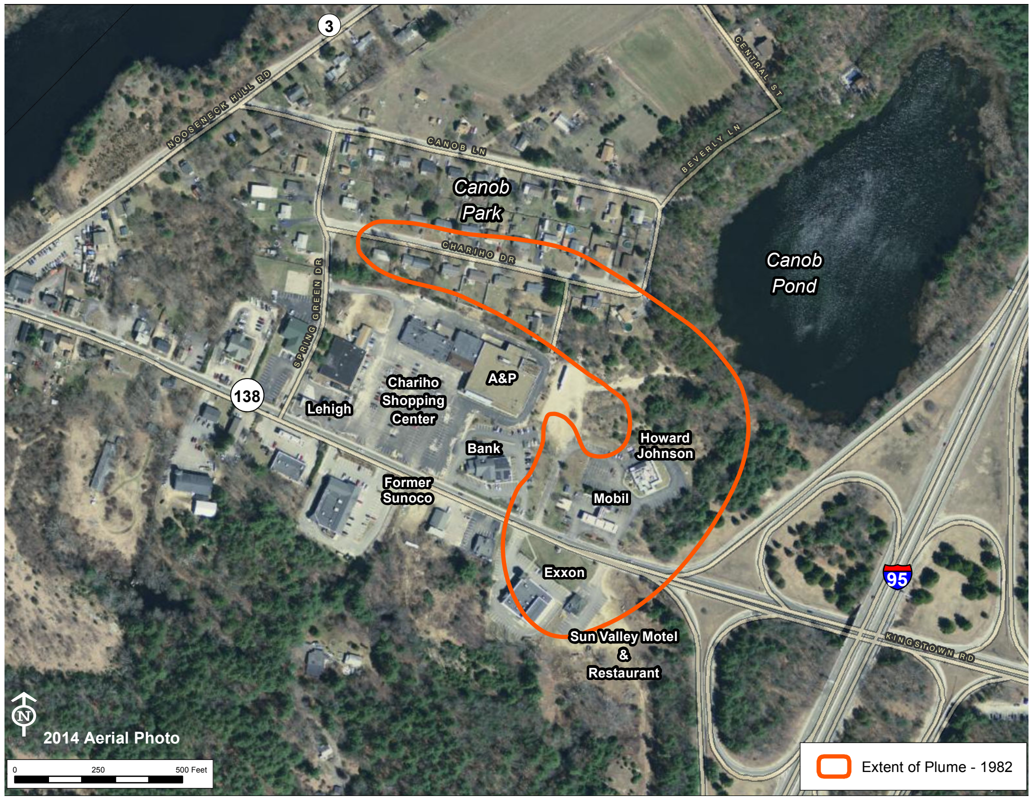

Figure prepared by Paul Jordan, Supervising GIS Specialist, RI DEM

Figure 1. *Extent of the gasoline plume based on USEPA's hydrogeologic investigation "1982 Draft Report."*

Arduous Times for the Residents of Canob Park

Our earliest records on the Canob Park site date to the 1950s and 1960s, and include scant correspondence and inspection reports between the Rhode Island Department of Health (RIDOH) and the Richmond Town Council. In late 1964, the RIDOH inspected the Chariho Shopping Center's public supply wells and found them to be possibly compromised due to their proximity to a failing septic system connected to the shopping center's laundromat.

The Chariho Shopping Center was located on Route 138, just south of the Canob Park neighborhood. At the time, the RIDOH advised the Richmond Town Council against permitting public water supply wells in areas that were not served by public sewers. However, the area was undergoing rapid housing development and the town was in need of a laundromat.

The first complaint of foul tasting water in a private well at Canob Park was documented in a letter to the Town of Richmond in 1968. At that time, all issues related to groundwater contamination were dealt with at the local level and by the RIDOH. Suspicion of possible sources of this contamination immediately fell on the gasoline stations and the laundromat operation.

The Town of Richmond had received advice from the RIDOH in the early 1960s to install a community water supply when the septic system for Valley Laundry Center appeared to be failing and could affect wells in the strip mall where the laundromat was located. In the meantime several homeowners in the newly established Canob Park neighborhood were forced to buy bottled water for drinking and cooking. The number of complaints of contaminated private well water increased to three in 1972. All fingers were pointing to the newly installed Mobil Station, due to its proximity to the neighborhood. The Town of Richmond contacted Mobil, and requested the installation of three new deep bedrock wells to "alleviate the problem of gas in the water at three home sites."

Mobil agreed to drill the three new bedrock wells at the affected homes, not as an admission of guilt but as a "good will" effort on their part. The Town Council also requested that Mobil provide "some quantity of water" to the affected homes. The Town Council, stated to Mobil: "Other than those listed, we cannot visualize any further complaints of this type within this area."

Nothing could have been further from the truth!

In 1979, complaints of private well contamination in the Canob Park neighborhood reached USEPA Region I in Boston. The agency commissioned a hydrogeologic study of the area to determine the source of contamination (draft report by Region I Field Investigation Team, Ecology and Environment, Inc.; April 1982). Between 1980 and 1982, a total of 11 out of 43 private wells in this community were now confirmed to be contaminated with gasoline compounds.

In a report prepared by Lombardo & Associates, Inc. (1982) to

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evaluate water supply alternatives for Canob Park, the following statement should have alarmed any small community in America:

> *"In the recently released Report to Congress on the state of the State's Waters, Canob Park was singled out as experiencing significant contamination. The problem has been classified as* ***'Major: Hazardous waste requiring removal for health or safety reasons, or causing significant impact on present public or private groundwater supplies.'*** *Based on the earlier evidence of contamination, the Region I office of the USEPA has been conducting a study of the area with the specific intent of establishing cause. Due to the legal implications of this investigation, the results are likely not to be available in the near future."*

Notoriety

The Canob Park neighborhood was now the subject of many newspaper stories in Rhode Island. The residents were concerned with their neighborhood being considered a "Hazardous Waste Site." As a result, in 1983 a group called Concerned Citizens of Canob Park (CCCP) filed a $100 million class action suit against the Mobil and Exxon Corporations, after the USEPA study cited the companies as contributors to the aquifer pollution at Canob Park.

In 1984, the CBS program *60 Minutes* brought to national attention the Canob Park situation in their story *Check the Water* (produced by Patti Hassler). The piece detailed the harrowing situation in the Canob Park neighborhood, where residents had been forced to buy their own water for more than 14 years, due to the presence of gasoline and other pollutants in their private wells. Two gasoline stations, belonging to Mobil and Exxon Corporations, were suspected of having leaked gasoline into the ground.

CBS reporter Harry Reasoner interviewed Hope Valley Fire Chief Frederick Stanley, among others. Chief Stanley told Reasoner that a petroleum release had been reported as soon as the Mobil Station opened. He sampled the onsite drinking water well and found it to be "almost ignitable." He told the attendant to contact Mobil and to have the underground storage system tested. An engineer from Mobil was immediately sent to address the problem.

Chief Stanley referred the problem to the Town Council. Herbert Arnold, a former president of the Town Council, told *60 Minutes* that the town could not take any action against Mobil: "It was brought to our attention, loud and clear, that a company the size of Mobil had resources to successfully counteract anything that we might put up!" In the meantime, Mobil Corporation denied any responsibility for the aquifer contamination at Canob Park. Exxon Corporation, on the other hand, had found that two percent of their tanks and pipes were leaking gasoline nationwide, and that they had been upgrading and replacing their tanks since 1979 at a cost of $100 million.

At the end of the piece, Reasoner stated that the State of Rhode Island set a deadline of January 1984 for the two oil companies to reach an agreement with the residents to install a water system in Canob Park. Also, in January 1984, USEPA was expected to announce new national regulations for underground storage tanks.

A Memorandum of Understanding was signed in November 1983 between Mobil Oil Corporation, Exxon Company, USA, and the State of Rhode Island to construct the Canob Park Community Water System at a total cost not to exceed $1.0 million and to be paid in equal one-third shares. The Richmond Water Department, a community water system, was created in the early 1980s by the State Resources Board in response to groundwater contamination from gasoline stations in the Wyoming area (Town of Richmond, RI—Comprehensive Community Plan; adopted 2013 and amended 2014).

The Birth of Rhode Island's UST Program: 1985

The RI Department of Environmental Management (RIDEM) and the RIDOH faced their own lack of regulatory power during the Canob Park crisis. Before 1980, hazardous waste management was handled by the Division of Land Resources at RIDEM, which also included the Fresh Water Wetland Program, the Individual Subsurface Disposal System Program, and the Dam Safety Program.

Exxon Tank Tests Show Leaks

This photo from an article in The Westerly Sun, *December 9, 1982, shows workmen performing tests on three USTs at the Exxon station on Route 38. Two of the tanks were leaking.*

Potable Water Provided Canob Park Residents

In 1983, 15 Canob Park families plagued with water problems for more than a decade finally receive bottled water provided by the the Exxon and Mobil Corporations. The companies asserted this was in no way an admission of guilt. (The Westerly Sun, *June 28, 1983.)*

On March 20, 1980, "Executive Order No. 80-8 Management of Hazardous Waste" was signed by then Governor J. Joseph Garrahy to create and place within the RIDEM a Division of Air and Hazardous Materials. "*The Division of Water Supply, DOH, shall in cooperation with the Division*

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of Air and Hazardous Materials, DEM, develop an Emergency Well-Testing Program. The Program shall be capable of providing quick response requests for well testing in areas of the State where contamination of groundwater has been detected. The Program will outline specific conditions under which wells shall be tested and shall further establish a schedule for continued monitoring of test wells w here necessary."

This executive order provided more resources to RIDEM's newly formed Division of Air and Hazardous Materials. However, while it enabled RIDEM to protect the health of the citizens of Rhode Island, it did not go far enough with regard to dealing with releases from USTs. As of late 1983, only the local Fire Department could order testing or removal of USTs at gasoline stations with suspected releases.

USEPA became involved in 1979, when it was made aware of the contamination at Canob Park, but it had no legislation to enforce cleanups of petroleum releases or to order oil corporations to install water lines in areas affected by petroleum releases.

In 1984, after Congress passed a series of laws to address the nationwide problem of leaking USTs (Subtitle I of the Solid Waste Disposal Act), the State of Rhode Island promulgated its own regulations:

1. "Emergency Regulations for Underground Storage Facilities used for Petroleum Products and Hazardous Materials" (DEM; 9 October 1984), and
2. "Regulations for Underground Storage Facilities used for Petroleum Products and Hazardous Materials" (DEM; 18 April 1985).

The passage of these regulations allowed RIDEM to finally institute regulations for UST facility registrations, requirements for tank installations and removals, and the reporting and response to petroleum or hazardous material releases.

Although the Mobil and Exxon Corporations negotiated remediation with state and federal authorities prior to the passage of the UST regulations, now these corporations and any other responsible party had to abide by them!

Post-UST Fund Regulations: Early 1990s

My involvement in these cases began in 1993. Over the years, both sites had multiple petroleum releases in an area of high transmissivity (sand and gravel aquifer) and in the presence of a shallow bedrock surface. These two facilities were also located in a sensitive groundwater area, due to the presence of a public well serving the Sun Valley Motel and Restaurant next to the Exxon Station and a private well at the Exxon Station.

USEPA became involved in 1979, when it was made aware of the contamination at Canob Park, but it had no legislation to enforce cleanups of petroleum releases or to order oil corporations to install water lines in areas affected by petroleum releases.

At this point, Notices of Violations from the early 1990s had to be resolved, Consent Agreements had to be drafted, remediation alternatives were being discussed, and Orders of Approval for remediation systems were being issued. Our meetings with responsible parties (RPs) and their consultants were difficult and in some instances contentious.

Many site visits were required and analytical samples were typically split between the RPs and the state to check for irregularities. I reviewed many proposed remediation systems and many groundwater monitoring reports. I also witnessed releases of petroleum from product lines (at Exxon in 1993) and from tanks (at Mobil in 1994), as well as tank removals. It seemed like this area was doomed and cleanups were going to take a long, long time.

To make matters worse, the public well servicing Sun Valley Motel and Restaurant was decommissioned in 1998, when a tractor-trailer overturned on the I-95 ramp in August 1997 and spilled gasoline in close vicinity to this well. The Sun Valley Motel and Restaurant was then connected to an existing water main on Route 138.

Post-UST Fund Regulations: 1997 to Present

In 1996, the RI UST Review Board and Fund were created as a financial mechanism for UST facility owners/operators to meet USEPA's Financial Responsibility requirements to clean up releases from their UST systems. In 1997, both Mobil and Exxon Corporations filed compliance applications respectively, for the petroleum releases that took place at their facilities in the early 1990s. Because both facilities were in compliance with the UST regulations, they received approval from RIDEM for reimbursement.

The creation of this reimbursement fund through a gas tax eliminated the difficulties of enforcing the UST regulations. Now the cleanup process became more routine and in many ways more successful. Consultants for Exxon, for example, were able to propose more aggressive cleanup solutions. Bedrock and overburden remediation was achieved at the Exxon station via high vacuum pumping and in-situ Chemical Oxidation.

The Exxon station received a "No Further Action" letter this past December 2015. The Mobil Station is still on semi-annual monitoring due to residual contamination in bedrock near the tank pad location.

From Confusion to Process

In looking back at the Richmond quandries, I realize how many great strides have been made in more than four decades to protect Rhode Island's and the nation's valuable groundwater resources. Early on, the environmental puzzles that presented themselves when a tank system had a release had many well-meaning players, but none were talking to each other. Over the years and after many painful and confrontational encounters, government and industry found a way to communicate through regulations.

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What Are You Really Measuring Using an Extractable TPH Analysis at LUST Sites?

By Catalina Espino Devine, Dawn A. Zemo, Kirk T. O'Reilly, Rachel E. Mohler, Renae I. Magaw, and Asheesh K. Tiwary

Total Petroleum Hydrocarbon (TPH) analysis is widely used at LUST sites. Extractable TPH methods that are often used actually provide a measure of the total extractable organic chemicals in a given sample, and are not limited to the petroleum hydrocarbon compounds present. This results in a poor understanding of actual site conditions. Here is a way to resolve the issue.

Natural Attenuation at LUST Sites

Petroleum products released at LUST sites are complex mixtures that contain hundreds to thousands of individual petroleum hydrocarbon compounds (PHCs). In the subsurface, during the early stages of the release, the chemical composition of the PHC mixture is similar to the type of fuel originally released (e.g., gasoline, diesel, and bunker C fuel); but as soon as physical and chemical natural attenuation processes take hold (e.g., volatilization, biodegradation, dispersion), the complex mixture begins to change. Metabolites from biodegradation of PHCs (i.e., polar oxygenated compounds such as organic acids) start to form and they become part of the *complex organic mixture* in soil and groundwater.

Gas Chromatography-Based TPH Analysis at LUST Sites

Gas chromatography (GC) analytical methods were developed for state LUST programs in the late 1980s and early 1990s, and have proven to be very useful for analyzing PHCs in soil and groundwater. Detection and quantification of individual organic compounds, such as benzene, that commonly drive risk at LUST sites can be achieved by using a wide variety of detectors connected to the GC instrument. The data for individual compounds (e.g., benzene, naphthalene, methyl tertiary butyl ether [MtBE]) from the GC-based analyses, are usually reasonably accurate and allow us to develop Conceptual Site Models (CSMs) that are then used to prioritize resources and focus remediation efforts on the environmental impacts that pose the highest potential risk.

Since the advent of state UST programs, states have taken a variety of approaches to the analysis of the bulk PHC concentration, referred to as Total Petroleum Hydrocarbons. Most of the TPH analytical methods are based on EPA Method 8015B, a GC method using a Flame Ionization Detector (GCFID). The intent of GC-based TPH methods is to provide an aggregate concentration of organic compounds in a mixture that falls within a particular GC retention time period or boiling point range.

The boiling point range is defined by the particular TPH analytical method and is related to the carbon number of the molecules being targeted for detection (see boxed section below). As a result, the extractable TPH method (referred to as "TPH as diesel" [TPHd, DRO], or "TPH as motor oil" [TPHmo, ORO]) provides a *concentration of total organics* that falls within a certain boiling point range. Originally, these TPH analytical methods were intended to be screening tools because they offer a simple way of measuring the bulk organic mixture within a selected boiling point range. However, many regulatory agencies now routinely use these methods and the TPH concentrations they provide to set cleanup goals at fuel release sites, and ultimately to evaluate sites for regulatory closure.

Method 8015 for extractable TPH is used to measure organics that can be extracted from a sample with an organic solvent (usually methylene chloride or hexane). The extract is injected into the GC instrument and the response is measured using an FID. The compounds measured with the extractable TPH method are relatively less volatile and this method is often referred to as a "method for semi volatiles."

The Issue with Extractable TPH

A significant problem with extractable TPH methods is that, unlike the name implies, neither the extraction nor the GC-FID analytical methods are specific for PHCs. Studies from the 1990s (Zemo and Foote, 2003) show that the extractable TPH method (EPA Method 8015 B/C) measures not only PHC compounds but also any other extractable organic compound present in a sample that falls within the target boiling point range. At LUST sites, metabolites that form as a fuel release biodegrades in the environment can be detected by the extractable TPH

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Commonly Used GC-FID Methods for TPH at LUST Sites

The two most commonly used GC-FID methods for TPH at LUST sites are:

1. TPH as gasoline (TPHg) or gasoline-range organics (GRO) by EPA Method 8015B/C (boiling point range: 60 to 170 °C)
2. Extractable TPH referred to as TPH as diesel (TPHd) or diesel-range organics (DRO) by EPA Method 8015B/C (boiling point range: 170 to 430 °C)

Method 8015 for TPHg is used to measure organic compounds that are purged from a sample with a carrier gas (or collected from the headspace of a sample extract) into the GC and detected using an FID. The compounds that are measured by the TPHg method are relatively more volatile than other PHCs present in the sample, which is why this method is often referred to as a "method for volatiles."

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method and, at some sites, can constitute 100 percent of the extractable TPH in groundwater (Lundegard and Sweeney, 2004; and Lang et al., 2009). Furthermore, other non-petroleum-related compounds can also be detected by the extractable TPH method, including natural organics (e.g., humic acids), laboratory or sample equipment artifacts (e.g., phthalates), or nonpetroleum chemicals (e.g., creosote and chlorinated solvents) (Zemo et al., 1995; Uhler et al., 1998) .

In addition to LUST site regulatory oversight decisions, extractable TPH concentrations are regularly used to evaluate whether natural attenuation of petroleum hydrocarbons is occurring. If the extractable TPH method that is being used measures PHCs and its metabolites; and the PHC portion is not quantified separately, the extent of petroleum attenuation can be underestimated. This is why extractable TPH concentrations can appear stable for many years and why they frequently preclude site closure, even if all other factors can be considered low-risk. LUST sites can then languish for years causing resources to be expended for monitoring, additional investigation, or remediation because it is wrongly believed that either there must be an active "source" feeding the stable extractable TPH plume or that biodegradation has stalled out.

Therefore, the use of an extractable TPH method to measure PHCs in a plume that contains PHCs and metabolites does not provide a realistic measure of the "petroleum hydrocarbon" content of the mixture. For this reason, the extractable TPH result should not be compared to "TPH" cleanup goals developed based solely on petroleum hydrocarbons in that it is likely to result in an apples to oranges comparison. The accurate measurement of PHCs as TPH is important, considering that thousands of LUST sites with biodegraded fuel impacts are regulated based on extractable TPH cleanup goals or screening levels.

Earlier this year, the Interstate Technical and Regulatory Council (ITRC) recognized the issues with TPH data interpretation and formed the Team "TPH Risk Evaluation at Petroleum Contaminated Sites" to work on TPH analytical guidance as well as other TPH topics.

The Solution for Extractable TPH: Silica Gel Cleanup

Fortunately, there is a way of separating PHCs from metabolites in these mixtures: by applying a Silica Gel Cleanup (SGC, based on EPA Method 3630C) to the sample extract before it is analyzed for TPH. The SGC pre-step removes the polar compounds from the sample extract while leaving the PHCs. A SGC to isolate the PHCs from other organics was included in the old infrared Method 418.1 ("Total Recoverable Petroleum Hydrocarbons"), and is currently included in the replacement gravimetric Method 1664A (Silica Gel Treated [SGT] Hexane Extractable Material), but SGC was not officially included in the GC-FID extractable TPH method 8015B/C.

If SGC were incorporated into the extractable TPH method to separate the PHCs from the polar metabolites, the extractable TPH result would provide a more accurate representation of the concentration of the PHCs and eliminate the apples to oranges comparison to hydrocarbon-based "TPH" cleanup goals. This solution was recommended several years ago (Zemo and Foote, 2003), and SGC EPA Method 3630C is used by many commercial analytical laboratories.

Several state regulatory programs have already incorporated SGC in their extractable TPH analysis. For example:

- The Massachusetts Department of Environmental Protection, Washington Department of Ecology, and Texas Commission of Environmental Quality have fractionated TPH methods that include a SGC step to isolate and fractionate the PHCs (MADEP, 2004; WA Ecology, 1997; TCEQ, 1997).
- The California LUFT Manual recommends the use of SGC for samples when TPH results are to be compared to PHC-based regulatory criteria (CA SWRCB, 2012).
- The Hawaii State Department of Health guidance recommends the use of SGC to distinguish between the PHC and polar portions of the total dissolved organics plume to focus remedial efforts or to support closure decisions (HDOH, 2013).

To illustrate the importance of using SGC in extractable TPH testing, a review of data for approximately 5,000 monitoring wells in the California State Water Board's Geotracker public database indicates that in over 30 percent of the wells, TPHd was the only analyte that exceeded California's taste and odor threshold of 100 ug/L for TPHd. However, when SGC was used on those 5,000 monitoring wells, only 10 percent exceeded the regulatory threshold (Espino Devine et al., 2015).

Why Haven't More State UST Regulatory Programs Adopted This Practice?

The science behind the need for SGC to separate PHCs and metabolites is in wide agreement. However, adoption of SGC has been inconsistent, mainly because some regulators have questions regarding the composition of the metabolite mixtures and their potential toxicity to human and/or aquatic receptors. Furthermore, perhaps there is a misconception that USEPA requires strict compliance with published analytical methods for a particular analyte(s).

However, while USEPA's SW-846 methods provide technical guidance they do not establish legal requirements unless specified in individual regulations (USEPA, 2014). USEPA recognizes a performance-based approach, rather than a prescriptive approach, as an important factor in selecting an analytical approach that is appropriate for the purpose (Federal Register, 2005).

It is obviously challenging to understand such a complex mixture in which thousands of chemicals are continually changing over time as part of the natural attenuation process. Based on many natural attenuation studies from the 1990s, it was understood that the metabolites mixture would consist of organic acids, alcohols, ketones, aldehydes, and phenols, but analytical methods were not available to identify the proportions of the various groups in

Polar Chemical Family	Specific Chemical Class	Expected Chronic Oral Toxicity to Humans	Average % for class identified using GCxGC in downgradient samples
Alcohols (and diols)	Alkyl alcohols	Low	8
	Cycloalkyl alcohols	Low	4
	Bicyclic alkyl alcohols	Low	3
	Aromatic alcohols	Low	1
	Polycyclic aromatic alcohols	Low to moderate	0
Acids (and esters)	Alkyl acids	Low	63
	Cycloalkyl acids	Low	4
	Bicyclic alkyl acids	Low	0
	Aromatic acids	Low	8
	Polycyclic aromatic acids	Low to moderate	0
Ketones	Alkyl ketones	Low to moderate	3
	Cycloalkyl ketones	Low	1
	Bicyclic alkyl ketones	Low	1
	Aromatic ketones	Low to moderate	1
	Polycyclic aromatic ketones	Low to moderate	0
Aldehydes	Alkyl aldehydes	Low to moderate	1
	Cycloalkyl aldehydes	Low to moderate	0
	Bicyclic alkyl aldehydes	Low to moderate	0
	Aromatic aldehydes	Low to moderate	0
	Polycyclic aromatic aldehydes	Low to moderate	0
Phenols	Alkyl phenols	Moderate	1*
	Phenol	Low	1

NOTES
Toxicity ranking system and criteria are explained in Zemo et al., 2013. RfD= reference dose in mg/kg/day.
Low: RfD >= 0.1; Low to Moderate: 0.1> Rfd >= 0.01; Moderate: 0.01> Rfd >= 0.001.
* Alkylphenol DTBP was assigned a low toxicity ranking based on USEPA toxicity summary for di-substituted alkylphenols US EPA (2009).

Table 1. *The 22 structural classes of the potential metabolites from biodegradation of petroleum, the expected chronic oral toxicity to humans for each class, and the per-sample average percentage of the metabolites in each structural class identified using GCxGC for 30 groundwater samples downgradient of biodegrading fuel sources (after Zemo et al., 2013 and Zemo et al., 2016, in review).*

these mixtures (e.g., Cozzarelli et al., 1994; Langbehn and Steinhart, 1994; Barcelona et al., 1995).

However, a recent study conducted using groundwater samples from several different biodegrading fuel-release sites has used research-level GC technology (two-dimensional GC) to identify the families and structural classes of metabolites present in the complex mixture, and to evaluate their toxicity (Mohler et al., 2013; Zemo et al., 2013; Zemo et al., 2016 in review). This research has validated the earlier findings by USEPA and others: the metabolites identified in the mixtures are primarily organic acids/esters, with variable proportions of alcohols and ketones, and very few aldehydes and phenols.

Taking into consideration the different structural classes of the mixture components, the research also showed that the metabolites pose low risk to human health. Toxicity testing with whole groundwater samples similarly demonstrated that the mixtures present low risk to human health and aquatic receptors. Finally, the metabolites mixtures were seen to naturally attenuate with an overall trend to a lower toxicity profile, higher proportions of organic acids/esters, and simpler molecular structures.

If our goal as environmental practitioners is to prioritize resources and focus our efforts on the environmental impacts that pose the highest potential risk at LUST sites, then SGC needs to be incorporated into the extractable TPH analysis. If extractable TPH is used as a closure criterion for a site and TPH results are to be compared to hydrocarbon-based closure criteria, then analysis of *extractable TPH with SGC* is needed. Measurement of PHCs in groundwater and soil samples using extractable TPH with SGC can improve our CSMs, help us properly evaluate natural attenuation, and help us use our remediation resources in an effective and efficient way. ■

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Additional technical details on TPH can be found in the following publications:

Barcelona, M. J.; Lu, J.; Tomczak, D. M. 1995. Organic acid derivatization techniques applied to petroleum hydrocarbon transformations in subsurface environments. *Ground Water Monitoring and Remediation Journal* 15, 114–124.

California State Water Resources Control Board. 2012. *Leaking Underground Fuel Tank (LUFT)* Guidance Manual. *http://www.swrcb.ca.gov/ust/luft_manual.shtml.*

Cozzarelli, I. M.; Baedecker, M. J.; Eganhouse, R. P.; Goerlitz, D. F. 1994. The geochemical evolution of low-molecular-weight organic acids derived from

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Wander LUST

a walkabout with Jeff Kuhn...

Jeff Kuhn is with the Montana Department of Environmental Quality (MDEQ) and a venerable veteran of petroleum remediation at the state and national levels. Through this column he takes us on "walkabouts" across the fascinating world of underground storage tanks. Jeff welcomes your comments and suggestions and can be reached at jkuhn@mt.gov.

The Enigma of TPH

What to Do with Total Petroleum Hydrocarbons?

As a class of compounds total petroleum hydrocarbons (TPH) are somewhat enigmatic. They represent a huge range of compounds, many of which biodegrade. A significant portion of the TPH fraction may consist of compounds that are naturally occurring in the subsurface and are not derived from petroleum or its distilled products (e.g., gasoline, diesel). The consequence of using TPH results is that a cleanup may be initiated to clean up something that has nothing to do with a leaking UST. Misinterpretation of TPH results can therefore cost a significant amount of time and money.

Recognizing this, we still actually know little about the toxicity of these compounds or the toxicity of their biodegradation "break-down products"—the metabolites, specific compounds created from bacterial degradation of the parent compounds. However, as regulators, we have a habit of generally ignoring potential health hazards associated with TPH in favor of addressing the better-known and defined carcinogenic compounds.

In fact, most regulatory groups seem more willing to move forward on closure at sites that contain only TPH compounds, with poorly defined toxicity or cleanup goals, than sites with specific compounds (e.g., benzene) with very low but well-known toxicity and pre-defined cleanup standards in soil and water. Most state TPH standards are based on direct exposure, and do not consider other exposure pathways, such as vapor intrusion.

USEPA's recent guidance document, *Technical Guide for Addressing Petroleum Vapor Intrusion at LUST Sites*, states that: "Petroleum Hydrocarbons (PHCs) generally biodegrade rapidly under aerobic conditions and if biodegradation is complete, produce only water and carbon dioxide. If biodegradation is incomplete a variety of intermediate degradation products may be formed, but these are usually less toxic than the parent PHCs."[1] While the statement provides some level of comfort for regulators in the decision-making mode, it does not answer many other questions about TPH that most states have struggled with since the beginning of their remediation programs.

This conundrum made me reflect on the body of work completed by the TPH Criteria Working Group, a group that made tremendous progress on the issue of TPH. In their March 1998 publication they articulated a clear statement of fact that stands today: "The use of TPH concentrations to establish target cleanup levels for soil and water is a common approach implemented by regulatory agencies in the United States. Approximately 75 percent of the states use TPH-based cleanup criteria. Because these values have become such remediation criteria, it is essential that everyone using TPH data—environmental coordinators, field personnel, regulators—be knowledgeable about the various analytical methods."[2] So what has been accomplished in the TPH discussion since the work of the TPH Criteria Working Group, and why is this a recurring issue?

The ITRC TPH Risk Evaluation Team

The Interstate Technical and Regulatory Council (ITRC) recognized this and other problems associated with evaluating TPH and recently approved the establishment of a TPH Risk Evaluation Team.[3] The team's proposal identifies the following common problems associated with TPH:

- Concerns of workers over potential health effects from exposure to contaminated soil, water, and vapor
- Fouling of heavy equipment with oil
- Sudden need to store and dispose of large volumes of contaminated soil and/or water
- Need to redesign a dewatering system due to high levels of dissolved TPH (or TPH-related

degradation products) in groundwater

- Need to redesign engineering plans to address concerns over potential vapor migration into utility corridors or new buildings
- Discoloration of soils
- Odors that may alarm workers and nearby residents.

In addressing these problems the team also recognized the recent development of "a variety of methods, which lead to a wide range of cleanup values" used by states. The team proposal reiterates the need for better guidance "to help states develop consistent methodology for establishing risk-based cleanup levels and for establishing and approving methods for risk-based corrective actions."

The ITRC team will also address the following technical areas and regulatory barriers:

- Overview of petroleum fuel and vapor chemistry
- Review of published, TPH carbon range toxicity factors including those that are part of ongoing API review
- Review of methods to develop risk-based, TPH carbon-range screening levels for soil, water, and air/vapor (e.g., standard EPA RSL models)
- Review of lab methods for testing of carbon ranges and TPH in soil, water, and air
- Example use of risk-based TPH screening levels for the remediation and long-term management of petroleum-contaminated sites
- Possible review and consideration of approaches to develop weighted toxicity factors and screening levels for specific petroleum fuels and mixtures.

Evaluating TPH Carbon-Range Toxicity

An evaluation of TPH carbon–range toxicity factors and the presence/absence of biodegradation metabolites (polar compounds) will most certainly lead to an evaluation of the role of silica-gel cleanup (SGC) used in the extractable TPH method. The use of SGC in TPH methodology is not new. Without using the SGC method it is not possible to distinguish polar compounds from petroleum hydrocarbon fractions. The standard TPH methodology (EPA Method 8015B/C) provides a "bulk TPH" sample containing both petroleum hydrocarbons and polar metabolites, representing primary biodegradation compounds.

However, a concern expressed by some regulators is that we know very little about the toxicity of TPH metabolites that may also be removed via the SGC method. In other words, using SGC means that TPH biodegradation or "breakdown" products will not appear in the fraction of compounds reported as TPH. This raises questions about what these compounds are and whether we should be concerned about their toxicity.

This concern leads to obvious questions that regulators and other practitioners may ask:

- If we are only concerned about the toxicity of specific petroleum hydrocarbons for which we have a standard, but utilize a method that removes other compounds for which we have no standard, can we know what we are being exposed to in drinking water that meets a TPH standard?
- Are there synergistic effects caused by the wide range of hydrocarbons and associated metabolites that could pose health concerns?
- If older sites have a larger percentage of metabolites present, should we evaluate those sites differently?

A companion article on page 5 of this issue of *LUSTLine* describes the potential importance of SGC in current TPH methodology. The article summarizes emerging work on the toxicity of extractable TPH mixtures, most recently updated in a 2013 paper by Zemo et al.[4] That study concluded that TPH results from five sites with biodegrading fuel sources contained a large percentage of polar metabolites representing biodegradation products. The composition of these metabolites was primarily "organic acids/esters, with variable alcohols and ketones, and very few phenols and aldehydes."

The spatial trend and relative proportions of measured metabolites downgradient from source areas, and their ultimate decrease in concentration with distance, supports the conclusion that the metabolites continue to biodegrade with an endpoint as carbon dioxide and water. The study used a Reference Dose (RfD)-based toxicity ranking system to assign toxicity hazard rankings to each class of polar metabolites.

The paper concluded that these metabolites were "unlikely to present a significant human health risk, assuming that the affected groundwater were to be consumed as drinking water." The authors also accurately point out that the use of SGC in the extractable TPH method (EPA Method 8015B/C) is important in removing other non-petroleum compounds such as humic acids, artifacts of laboratory and sample equipment (e.g., phthalates), and chemicals such as creosote and chlorinated solvents that interfere with an accurate assessment of the actual petroleum hydrocarbon fraction.

In concluding their 2013 paper, the authors make a strong case for the use of SGC to obtain accurate TPH results leading to better regulatory decision making. This is an important conclusion that states should pay attention to if they intend to more accurately interpret TPH results that may represent a significant portion of assessment costs at thousands of sites across the country.

Bulk TPH vs. TPH with SGC

It seems to me, if these conclusions are valid then states may want to consider evaluating "bulk TPH" as well as TPH using the SGC method to better understand the presence and composition of TPH metabolites. Some states, including my own, currently use a modified Massachusetts Method for Extractable Hydrocarbons (EPH) that utilizes the SGC method as a second step if sample results exceed a screening level. The sample is fractionated and SGC is employed to achieve a final petroleum hydrocarbon result free of polar metabolites and compounds representing laboratory artifacts.

Although some states may be reluctant to incur the additional cost

■ *continued on page 22*

A Message from Carolyn Hoskinson

Director, USEPA's Office of Underground Storage Tanks

The 2015 UST Regulation
Is That All There Is?

Did you think USEPA's underground storage tank (UST) program would rest on our accomplishments or have a bit of a letdown after issuing the 2015 UST regulation in July? Well, that is not the case. We have been working as diligently as ever to develop new resources designed to help both those who must meet requirements in the regulation and those who will implement them.

So let's briefly review compliance deadlines, look at implementation resources currently available, and preview resources we are still developing.

Compliance Deadlines

As you know, USEPA published the 2015 UST regulation in the July 15, 2015 *Federal Register*, which established October 13, 2015 as the effective date of the regulation. The regulation includes compliance deadlines ranging from immediate to three years. Key compliance dates with the federal requirements are October 13, 2015; April 11, 2016; and October 13, 2018—the requirements associated with each of those dates vary. You can find details about the requirements and their dates in our brochure *Implementation Time Frames for 2015 Underground Storage Tank Requirements* at *www.epa.gov/ust/implementation-time-frames-2015-underground-storage-tank-requirements* and our plain language booklet about the federal UST regulation *Musts For USTs* at *www.epa.gov/ust/musts-usts* (see table on page 3).

As always, if an owner's UST system is located in a state with state program approval, the owner must follow state requirements, which means timeframes may be different from those in the federal UST regulation. If an owner's UST system is located in a state without state program approval, both the federal and state requirements apply. And, if an owner's UST system is located in Indian country, the federal requirements and applicable tribal requirements apply. You can access state and territorial UST program websites at *www.epa.gov/ust/underground-storage-tank-ust-contacts#states*.

That said, there are a couple of deadlines I particularly want to call to your attention:

- **April 2016 Deadline for Secondary Containment and Interstitial Monitoring.** April 11, 2016 marked when owners and operators must begin meeting secondary containment and interstitial monitoring requirements. April 11 is also when owners and operators must meet requirements for under-dispenser containment for new dispenser systems. *Musts For USTs* at *www.epa.gov/ust/musts-usts* and our web pages at *www.epa.gov/ust/release-detection-underground-storage-tanks-usts#interstitial* and *www.epa.gov/ust/secondary-containment-and-under-dispenser-containment-2015-requirements* provide more information.
- **October 2018 Deadline for State Program Approval Applications.** The 2015 UST regulation changed portions of the 1988 UST technical regulation in 40 CFR part 280. The 2015 state program approval (SPA) regulation updates requirements in 40 CFR part 281 and incorporates the changes in the 2015 UST (technical) regulation. Under the 2015 SPA regulation, the 38 states plus the District of Columbia and Puerto Rico, which currently have SPA, must reapply by October 13, 2018 in order to retain their SPA status. The remaining non-SPA states and territories may apply for SPA at any time.
- USEPA's regional UST programs will coordinate the SPA process for states and territories under their jurisdiction. The regions will work closely with state officials while states are developing their UST programs. After state legislatures enact statutes and state UST agencies develop regulations in line with USEPA requirements and put other necessary components of a program in place, states may apply for formal approval. USEPA must respond to those applications within 180 days.

2015 UST Regulation Implementation Resources Currently Available

In keeping with its long tradition of USEPA's UST program providing our stakeholders with plain language documents about the UST requirements, since finalizing the 2015 UST regulation the USEPA UST program issued the implementation documents listed below. All documents are available online.

General Implementation Assistance

- ***Comparison of 2015 Revised UST Regulations and 1988 UST Regulations*** describes the significant differences between the 1988 UST and SPA regulations and the 2015 revised UST requirements; it also provides additional information about the revisions (*www.epa.gov/sites/production/files/2015-07/documents/regs2015-crosswalk.pdf*, September 2015).
- ***Implementation Time Frames for 2015 Underground Storage Tank Requirements*** is a two-page bro-

A Message from Carolyn Hoskinson... *continued from page 10*

chure that highlights the implementation time frames to meet the 2015 UST requirements (*www.epa.gov/ust/implementation-time-frames-2015-underground-storage-tank-requirements*; September 2015).

■ ***Questions and Answers About the 2015 Underground Storage Tank Regulation*** is a multi-page table that provides information in a question and answer format. The document covers applicability, implementation, state program approval, spill prevention and containment sumps, secondary containment and interstitial monitoring, overfill protection, internal lining, walkthrough inspections, release detection, compatibility, release reporting, temporarily out of use facilities, and partially excluded USTs (*www.epa.gov/ust/questions-and-answers-about-2015-underground-storage-tank-regulation*; December 2015).

Plain Language Publications

■ ***Musts for USTs*** is a plain language booklet that summarizes the federal UST requirements for installation, reporting, spill and overfill prevention, corrosion protection, release detection, walkthrough inspections, compatibility, operating training, repairs, financial responsibility, release response, and closure (*www.epa.gov/ust/musts-usts*; November 2015).

■ ***UST System Compatibility with Petroleum-Biofuel Blends: A Brief Guide to the 2015 Federal UST Regulations for Owners and Operators of USTs Located on Tribal Lands*** is a tri-fold brochure that provides UST owners and operators on tribal lands with the compatibility requirements in the 2015 UST regulation for storing gasoline blends containing greater than 10 percent ethanol or diesel blends containing greater than 20 percent biodiesel (*www.epa.gov/ust/ust-system-compatibility-petroleum-biofuel-blends-brief-guide-2015-federal-ust-regulations*; September 2015).

■ ***UST System Compatibility with Biofuels*** is a 16-page booklet that discusses the 2015 UST compatibility requirements for tank systems storing biofuels and petroleum-biofuel blends; the booklet also presents actions for minimizing the risk of a release from UST systems due to incompatibility (*www.epa.gov/ust/ust-system-compatibility-biofuels*; November 2015).

■ ***Operating and Maintaining Underground Storage Tank Systems*** is a booklet that contains brief summaries of the federal UST requirements for operation and maintenance, as well as practical help that goes beyond the requirements. The booklet contains recordkeeping forms that help UST owners and operators keep equipment operating properly. It also contains checklists and information that will help owners properly operate and maintain their USTs. State and USEPA UST inspectors can use the booklet and checklists to help educate UST owners and operators, as well as encourage compliance with UST requirements (*www.epa.gov/ust/operating-and-maintaining-underground-storage-tank-systems-practical-help-and-checklists*; February 2016).

■ ***Requirements for Field-Constructed Tanks and Airport Hydrant Systems*** summarizes the 2015 federal UST requirements specific to UST systems with field-constructed tanks and airport hydrant fuel distribution systems. The document covers installation, reporting, spill and overfill prevention, corrosion protection, release detection, walkthrough inspections, compatibility, operator training, repairs, financial responsibility, release response, and closure (*www.epa.gov/ust/requirements-field-constructed-tanks-and-airport-hydrant-systems*; April 2016).

■ ***Release Detection for Underground Storage Tanks and Piping: Straight Talk on Tanks*** discusses several release detection methods for tanks and piping, as well as explanations of the release detection requirements in the 2015 UST regulation. Release detection methods include: secondary containment with interstitial monitoring, automatic tank gauging, continuous in-tank leak detection, statistical inventory reconciliation, tank tightness testing with inventory control, manual tank gauging, groundwater monitoring, vapor monitoring, and release detection for underground piping (*www.epa.gov/ust/release-detection-underground-storage-tanks-and-piping-straight-talk-tanks*; May 2016).

State Program Approval Online Assistance

■ ***Applying or Re-applying for State Program Approval*** is an online resource to help states and territories develop their SPA applications (see *www.epa.gov/ust/state-underground-storage-tank-ust-programs#apply*). There you will find: a flowchart and table that present the process states can use to apply and re-apply for SPA under the 2015 UST regulations; governor's letter; attorney general's certification and statement; demonstration of adequate enforcement procedures; memorandum of agreement template; program description; and state statutes and regulations that allow states and regions to compare state regulations to the federal UST regulation.

And More Implementation Resources Are in the Works

The three additional efforts, described below, are already underway. We will share them with our stakeholders as soon as they are final.

We are updating our 2005 sumps and spill bucket manual, which provides owners and operators with practical help and checklists for inspecting and maintaining that equipment. The revised version of the manual will include inspection and testing requirements contained in the 2015 UST regulation.

Also, we are revising our internet-based UST inspector training to incorporate the requirements in the

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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 him know at* **marcel.moreau@juno.com.**

Whack-a-Leak

The Holes in Our Leak Detection

As I look back at the history of UST leaks and leak detection, I am reminded of the "Whack-a-Mole" game where as soon as you beat one plastic mole back into its hole, another appears. Corrosion holes in bare steel tanks were the first focus of the tank program, but delivery spills and pressurized piping leaks soon gained notoriety as well. Then came dispenser and submersible pump leaks, followed by vapor releases made particularly significant by the presence of MtBE in the gasoline.

Leak detection technology has adapted as well. We moved out of the inventory control world into line-leak detectors and ATGs, double-walled tanks and piping, STP sumps and under-dispenser containment. If properly installed and maintained, secondary containment will hopefully put our leaks and leak detection concerns to rest. But on a national level we are a long way from having all of our USTs secondarily contained.

The reality of today's UST world is that leak detection is still very important in protecting human health and the environment. And those moles just keep popping up. There are still some weak spots in our USTs and in the mechanisms that we have in place to detect those weak spots. So in this article I want to focus on three troublesome little (or maybe not so little) holes in the fabric of our leak detection systems:

- *The inappropriate use of periodic ATG leak detection on continuously operating USTs.*[1]
- *The ability of large leaks to fool continuous ATG leak detection.*[2]
- *The blind spots in line-leak detectors.*

The Inappropriate Use of Periodic ATG Leak Detection on Continuously Operating USTs

It used to be that gas stations were either open 24 hours a day or closed at night. It has now become quite common for smaller convenience stores that sell fuel to operate in a hybrid fashion where vehicle fueling can be conducted on a 24-hour basis, but the store itself closes each night. In this case store personnel are present during the day, but none are present at night.

A leak detection problem arises at these 24/7 fueling facilities when the method of tank leak detection is periodic tightness tests conducted by an ATG . These facilities often implemented periodic ATG leak detection at a time when the facility was closed each night. However, when the facility shifted to 24/7 fuel sales, the method of leak detection was not changed.

When "Fail" Becomes the Norm...

The problem is that when fuel is dispensed while the ATG is conducting a periodic test, the test result is usually "Fail." The operator is not concerned about this failing result because, of course, his tank can't be leaking and he only has to produce one passing test a month for the inspector. He figures that if he runs a test every night, there's likely to be at least one passing test in a 30-day period.

So a pattern develops where on many mornings the operator just tosses a failing ATG test printout into the wastebasket—with nary a thought as to whether the failed test was due to fuel pumping activity during the test or a leak. When passing tests become increasingly scarce the operator just figures that nighttime fuel sales must be increasing and he pats himself on the back for going to a 24/7 operation.

...Failure to "Pass" Is Not Noticed

If the increasing scarcity of passing tests is due to a leak in the tank rather than increasing fuel sales, it can be a long time before the leak is discovered. The operator is not paying attention and is unlikely to suspect that anything is wrong. During a compliance inspection the only clue to the leak will be the absence of passing test results for some months. If the operator is filing the test results in a compliance book, he may claim that test results for those months were merely "misplaced." If the inspector checks the alarm history, there will be no record in the alarm history of the failed tests if the leak alarm is in its default position of "off."

1. I'm defining a periodic ATG leak detection as a test for leaks in a tank where no pumping is allowed for the duration of the test, which lasts for several hours. This type of test is also known as a static test.
2. I'm defining continuous ATG leak detection as a test for leaks in a tank where the ATG automatically monitors the tank for periods of inactivity during which tightness test data can be gathered. Pumping of fuel does not need to be interrupted in order to conduct a test.

The only definitive indication of a problem is that the ATG's internal list of passing tank tests for the previous twelve months will indicate that the most recent test occurred some time ago. The list will also include some test results that occurred more than twelve months ago, indicating that no passing tests occurred during those months (see Figure 1). It takes a sharp inspector to notice these older than normal test dates and understand what they are telling her. More often, it is not until fuel shows up in an adjacent basement, sewer, or stream that the leak is revealed.

This scenario is not entirely a figment of my imagination. A substantial leak with which I am familiar went unnoticed for several months because the operator assumed that the lack of passing test results was due to increased fuel sales. It was not until gasoline vapors showed up in an adjacent building that the problem was discovered. No one knows when the leak began nor the volume of fuel lost because the operator kept no inventory records.

```
TANK LEAK TEST HISTORY
T 2: REGULAR
LAST TEST PASSED:
OCT 20, 2015  3:49 AM
STARTING VOLUME: 5732
PERCENT VOLUME: 57.2

FULLEST TEST PASSED
EACH MONTH:
JAN 30, 2015 4:39 AM
STARTING VOLUME: 6318
PERCENT VOLUME: 63.0

FEB 23, 2015 3:34 AM
STARTING VOLUME: 7308
PERCENT VOLUME: 72.9

MAR 1, 2015 10:44 PM
STARTING VOLUME: 7183
PERCENT VOLUME: 71.6

APR 4, 2015 11:42 PM
STARTING VOLUME: 6941
PERCENT VOLUME: 69.2

MAY 29, 2015 5:30 AM
STARTING VOLUME: 7841
PERCENT VOLUME: 78.2

JUN 2, 2015 5:31 AM
STARTING VOLUME: 7895
PERCENT VOLUME: 78.7

JUL 6, 2015  11:27 PM
STARTING VOLUME: 7305
PERCENT VOLUME: 72.9

AUG 1, 2015 3:49 AM
STARTING VOLUME: 6960
PERCENT VOLUME: 69.4

SEP 8, 2015 11:48 PM
STARTING VOLUME: 6679
PERCENT VOLUME: 66.6

OCT 14, 2015 12:26 AM
STARTING VOLUME: 6726
PERCENT VOLUME: 67.1

NOV 10, 2014 10:28 PM
STARTING VOLUME: 6955
PERCENT VOLUME: 69.4

DEC 4, 2014 5:04 AM
STARTING VOLUME: 5999
PERCENT VOLUME: 59.8
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Figure 1. *The tank leak test history may provide the only clues that something is not right with a tank, but it must be carefully read. If this leak history were printed on October 20, 2015, then it would indicate everything was normal. The most recent tank test was completed this morning and tests were passed each of the previous 12 months. However, if this leak history were printed in January 2016, then it would indicate a problem. The last passing test is more than two months old and the November and December tests date from 2014, not 2015.*

Periodic ATGs Are Not Certified for This Application

It is clear to me that ATGs conducting periodic tests are not acceptable for leak detection for facilities that operate 24/7. Certifications for these methods, as summarized by the National Work Group on Leak Detection Evaluations, clearly state: "There must be no dispensing or delivery during test."

A clever UST operator might counter that this limitation merely provides justification for discarding a failed test result. I would counter this claim by noting that under 24/7 operating conditions the ATG will exceed the five percent false alarm limit set by the regulations. If the operator protests, all he needs to do is produce the ATG manufacturer's certification that the ATG will not exceed the five percent false alarm limit when pumping is allowed at random intervals during the test period. I doubt that any ATG manufacturer will produce such a certification.

If the facility owner is unwilling or unable to upgrade the ATG such that it can conduct continuous tests, then another regulatory option would be to require the facility to shut down fueling operations at least once a month for a period long enough for the ATG to conduct a test.

The Ability of Large Leaks to Fool Continuous ATG Leak Detection

ATGs that conduct continuous testing have their own leak detection issue: they need to be able to distinguish pumping activity from a leak. As far as I can determine, most ATGs that conduct continuous testing assume that when the fuel level in the tank is dropping in excess of a gallon a minute (or some similar rate) that fuel dispensing must be happening and the ATG must wait until the dispensing activity stops before test data can be gathered. If fuel is leaving the tank at a rate less than a gallon a minute, the fuel loss is assumed to be a leak. Well, maybe and maybe not.

Tank Failure Modes Have Changed

In the old days of bare steel tanks with pinholes produced by corrosion, tank leak rates were initially quite small and the assumption that loss rates in excess of a gallon a minute must be evidence of pumping activity was perhaps reasonable. But the days of the old bare steel tanks are largely over. We have new failure modes to deal with today.

Though not common, failure of fiberglass tanks involving substantial cracks, which happen suddenly, does

■ *continued on page 14*

■ Whack-A-Leak *from page 13*

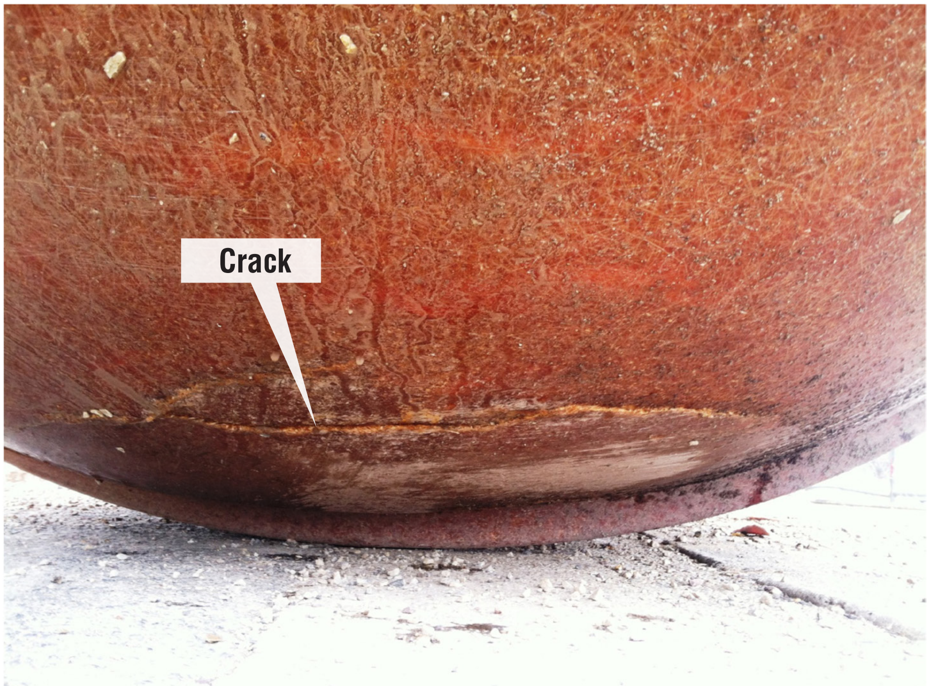

Figure 2. *Substantial cracks can appear in fiberglass tanks quite suddenly, producing large leak rates.*

occur (see Figure 2). Kathy Nagle of the Pennsylvania Department of Environmental Protection brought this issue to my attention. She has noted three cases of such failure in the last few years. In each of these incidents, the tank gauge conducting continuous testing failed to detect the leak because the ATG assumed that fuel was being dispensed rather than leaking out.

Because the ATG presumed that non-stop dispensing was going on, it eventually produced a warning that there was "no idle time," meaning that there was no time when the fuel level was stable enough for the ATG to gather data for a tightness test. No leak-related alarms sounded. There were two clues that something was amiss. The daily printout of the test results included a test date for the leaking tank that did not match the current date at the top of the printout (see Figure 3). The other clue that something was amiss was passing test results in the test result history that were more than twelve months old (see Figure 1).

Steel tanks are not immune from this large leak scenario either. Well-coated tanks protected from external corrosion can fail due to internal corrosion (see Figure 4). In these newer tanks the external epoxy and urethane coatings have a certain amount of structural integrity so the coating (supported by the tank backfill) is able to keep a single-walled tank from leaking even though the steel shell itself is perforated. As internal corrosion continues to enlarge the perforation, the coating may eventually be unable to contain the fuel. When the coating fails, a large leak is suddenly present.

In a case that I am familiar with, the tank had developed a large hole in the steel shell, but there was no detectable leakage because the coating was still intact. A delivery occurred that likely activated the ball float valve, causing a small pressure spike in the tank. This pressure spike apparently was enough to rupture the coating that covered the hole, resulting in a sudden and large leak rate.

Within a day of the delivery, the tank was empty. The owner figured the fuel he had ordered had not been delivered, so he ordered another load. It was only after the disappearance of the second load of fuel that the owner suspected there might be a problem. The tank gauge, set up for continuous testing, was silent throughout the entire incident. Because of the large leak rate, the leak was mistaken for pumping activity.

Leak Detection Equipment Must Detect Large as Well as Small Leaks

The failure modes of the tanks that constitute the bulk of our active UST population include those that produce large leak rates that occur suddenly. Distinguishing tank leaks from pumping activity purely by the rate at which the fuel is leaving the tank is not a good strategy. For continuous ATGs to accurately diagnose large leaks they need to be able to positively identify when fuel is being dispensed and when it is not. For at least some models of ATGs, additional hardware is available that can detect when the submersible pump is on; however, this hardware is not a required component of most continuous testing ATGs and so is often not installed.

I believe this hardware should be required whenever an ATG conducts continuous testing. In my view, ATGs that dismiss two gallon per minute leaks as pumping activity and produce an innocuous warning about "no idle time" do not meet the regulatory requirements for leak

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CONTINUOUS TEST RESULTS
JANUARY 25, 2016

T 1: DIESEL
0.2 GAL/HR TEST
PER: JAN 25, 2016 PASS

T 2: REGULAR
0.2 GAL/HR TEST
PER: NOV 15, 2015 PASS

T 3: REGULAR 2
0.2 GAL/HR TEST
PER: JAN 25, 2016 PASS

T 4: PREMIUM
0.2 GAL/HR TEST
PER: JAN 25, 2016 PASS
```

Figure 3. *Some ATGs that do continuous testing report test results on a daily basis. The test date for each tank should be the same as the date of the printout. The test result for Tank 2 in this printout is over two months old, indicating that there have been no passing tests since November 15, 2015. This could be due to an equipment issue, but it could also indicate a leak.*

Figure 4. *Internal corrosion in single-wall corrosion-protected steel tanks can produce large holes in the tank that do not leak initially because the external coating seals the hole. When the coating fails, the leak appears suddenly and the leak rate can be quite large.*

detection. A 10 gallon per hour (0.17 gallon per minute) leak rate is the largest leak rate that the Continuous In-Tank Leak Detection Systems (CITLDS) protocol uses to evaluate continuous ATGs, so the ability of these ATGs to detect really large leaks is not evaluated. I strongly suspect that if the certification protocol for these ATGs included the ability to detect leaks substantially greater than a gallon a minute, they would not have passed the protocol.

The Blind Spots in Line-Leak Detectors

Line-leak detectors also have their blind spots when it comes to leak detection. Mechanical line-leak detectors (MLLD) will not detect a leak upstream of the MLLD location.[3] This means they will not see a leak in the threaded connection where the MLLD screws into the submersible pump manifold, nor will they detect a leak in the check valve of the submersible pump.

Electronic line-leak detectors (ELLD) have fewer blind spots because they will generally see leaks at the joint where the ELLD screws into the pump manifold and leaks in the pump check valve. However, this is not true in all cases. When installed on certain types of submersible pumps, some ELLDs require the replacement of the original check valve on the submersible pump with a different check valve. The replacement check valve is screwed into the submersible pump leak detector port and the ELLD is then installed into the top of the replacement check valve (see Figure 5).

Replacement Check Valves and ELLD Performance

When a replacement check valve is installed, the ELLD will only detect leaks between the check valve mechanism and the solenoid valve in the dispenser. Leaks at the joint where the replacement check valve screws into the submersible pump manifold will not be detected. Likewise, leaks at the submersible pump check valve fitting will not be detectable by the ELLD when a replacement check valve is installed.

I recently became aware of this issue while investigating a release of several thousand gallons of gasoline that resulted from a replacement check valve that was not properly tightened when it was installed. The ELLD did not detect this leak and the ELLD leak alarm never sounded. An investigation of large inventory losses eventually found the problem. Neither the service technician familiar with the site nor a technician who answered the ELLD manufacturer's help line was able to identify why the ELLD had not detected the leak. It was not until an upper level engineer employed by the ELLD manufacturer was consulted that the reason why the leak was not detected was identified.

What's to Be Done?

We've made a lot of progress in our UST leak detection technology

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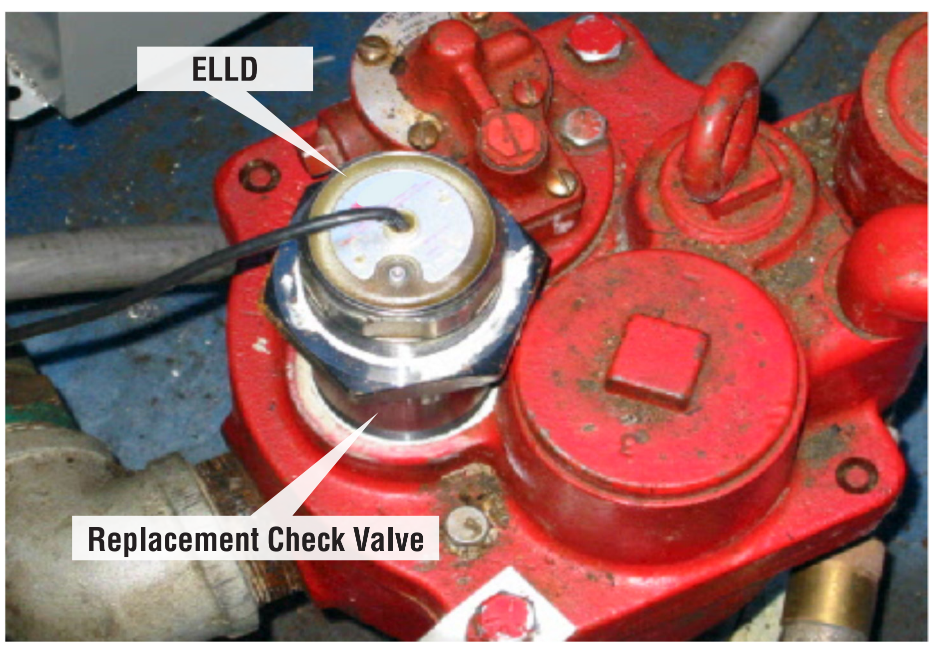
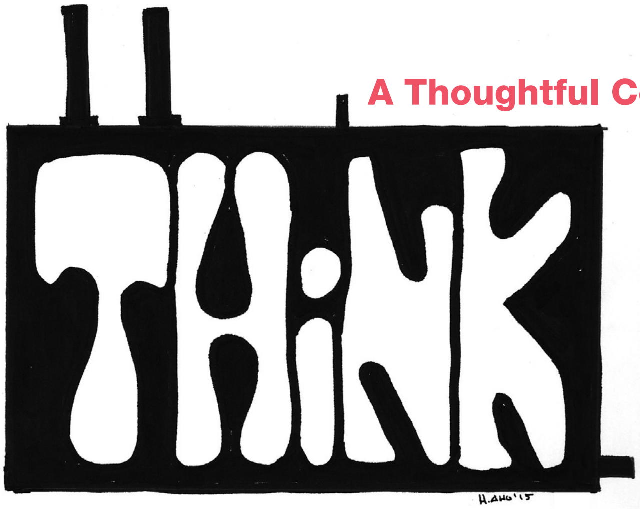


Figure 5. *In some installations, a replacement check valve must be used when an ELLD is installed.*

3. Fuel flows from the tank to the dispenser, so components along the piping run have an "upstream" side that leads toward the tank, and a "downstream" side that leads toward the dispenser.



A Thoughtful Column Engineered by Mahesh Albuquerque

Mahesh Albuquerque, Director of the Colorado Division of Oil and Public Safety, is on the lookout for articles from creative thinkers and experts willing to share ideas, insights, and stories on a wide variety of issues related to underground storage tanks. Topics include policy, strategy, successes, failures, and lessons learned. "Now that we have been regulating USTs for 30 years," says Mahesh, "my hope is that this column will help stimulate readers to 'think outside the tank,' to ponder why we do what we do, and to consider and share creative ways to improve our effectiveness—as we strive toward environmental protection." Mahesh can be reached at mahesh.albuquerque@state.co.us.

Compliance Makes Good Business Sense

What I Learned from Costco

My weekends used to be filled with trips to the mountains in my SUV to enjoy Colorado's great outdoors. Now with an almost two year old, we spend most weekends closer to home and they often involve checking things off the "honey do" list. So instead of loading up our SUV with mountain bikes or skis, we hop into our Nissan Leaf and head out to big box stores. One of our routine destinations is the neighborhood Costco store; recently I also filled up my SUV with gas there. Since we bought our plug-in electric vehicle my visits to gas stations have been few and far between, so my visit to fuel up at Costco was a new event.

First Impressions

As soon as I pulled in to the Costco gas station I noticed a difference from other gas stations. For one thing, traffic seemed more orderly. As I pulled in closer I realized it was because of the one-way traffic toward the pumps. There was a short line of cars waiting patiently to fill up, unlike the craziness at other gas stations. I noticed the pumps had longer hoses so you could fill up from either side of your vehicle. Then I noticed an attendant in a safety vest walking around and helping customers. As I got to the dispenser I noticed an emergency spill kit, with bucket and broom on each pump island. My regulator mindset kicked in: what a concept, having the spill kit right next to where you would need it in an emergency. The dispenser was clean and everything looked spotless, I was very impressed. I was able to fill up quickly and head out.

Digging Deeper

On my way home I was still thinking about how clean everything was and how quickly I was able to get in and out of the Costco gas station. It occurred to me that I had never heard of a significant release or cleanup at a Costco gas station. So the next day when I got in the office I queried our database to see their operational compliance record, check how many releases they have had, and how much we have reimbursed them from our fund for cleanup. I also phoned a few of our inspectors and asked them about their inspections at Costco gas stations. Lo and behold, Costco had a stellar compliance record, they only had a handful of releases and none of them required significant cleanup. Futhermore, they had only applied to our Petroleum Storage Tank Fund once for reimbursement of cleanup costs amounting to around thirty six thousand dollars. Our average cleanup cost is around one hundred and fifty thousand dollars.

I knew Costco operates 13 gas stations in Colorado, 426 across the country, and 71 more internationally. The following week I was at a tanks conference and met a number of my colleagues from other states. I asked them about their experience with Costco and got similar feedback from all of them. Costco had a stellar compliance record, their systems were well maintained, and they had almost no significant releases or cleanups.

The volume of gasoline Costco sells must be enviable to their competitors, yet they have maintained an awesome compliance record and have had very few major releases. They are a bright spot, and there is probably something we can learn from them.

So I did what I usually do when I need to research something, I googled them. That's where I came across their website and I found out about their commitment to environmental protection and safety in all aspects of their gasoline business. Costco's business philosophy emphasizes long-term trust relationships with their members and employees, all of whom live and work in the communities they serve. It was becoming clearer that Costco's exceptional environmental compliance was the result of their intentional actions.

Inside Scoop

Finally, I met with Costco's retail gas

station operations Compliance Manager. He was glad to hear about my experience at Costco. He cited some of the reasons for their stellar environmental compliance record:

■ **Trained and Certified Gas Station Attendants**
While Costco has state of the art UST systems, the best environmental and safety features of Costco gas stations are their trained fuel attendants. Their attendants work at the fuel islands so they can respond immediately to any safety or environmental issue. The attendants must pass a certification test before they can work at a Costco gas station, and they are all Class C operators. Costco also has an A/B operator supervisor at each gas station as well as an in-store manager who is an A/B operator.

Having the attendants stationed at the fuel islands helps ensure that the gas stations are safe places to buy fuel. The employees help customers in a variety of ways, including providing aid to anyone requiring physical assistance in fueling their vehicle. They are charged with enforcing the national fire code, including prohibitions against smoking, leaving the engine running, or filling portable containers not certified for such use.

■ **Continuous Leak Monitoring**
All Costco gas stations have state of the art, corrosion-proof, double-walled underground storage tanks and piping. Everything underground is continuously monitored for leaks via an electronic monitoring system. The entire station will automatically shut down if a leak is detected. Both the employees and the service providers monitor these electronic alarm systems around the clock.

■ **Spill Cleanup Program**
The best equipment in the world doesn't prevent the occasional surface spill. Spilled fuel is a safety and environmental concern, so Costco trains their gas station attendants on how to quickly and properly clean up a surface spill before it spreads. Every Costco station operates with a spill kit on the fuel islands.

■ **Business of Selling Fuel**
So while Costco is clearly committed to environmental protection and safety, they are also in the business of selling gasoline—a lot of gasoline. To sell a lot of gasoline your equipment needs to be operating efficiently, with minimum downtime. They change-out fuel filters periodically to ensure they maintain high flow rates at the pump. Costco's investment in state of the art equipment and its periodic maintenance minimizes equipment down time and enables them to efficiently refuel cars and maximize the volume of fuel sold.

An attendant at the pumps, along with handy spill kits, buckets, and brooms afford safety, efficiency, and cleanliness.

Other Bright Spots

One could argue that Costco is successful in selling more gasoline because of their commitment and investment in environmental protection and safety. While I know many of the hypermarket gas stations seem to realize this and operate similarly to Costco, I wonder if convenience stores share the same philosophy. I found out that the more successful stores that have high fuel throughput generally prioritize equipment maintenance to minimize downtime.

I realize it must be more challenging for smaller station owners to invest in state of the art UST systems, given that many of them have purchased their stations from someone else. However, in looking into this I was pleasantly surprised to find out that there are many single-station owners who also get this, and do what they can with what they have to ensure their equipment is maintained and operational. As one such owner pointed out, many have invested their life savings into their gas station and this business is their livelihood. They realize that having to deal with cleanup is costly and a huge liability and not something they want to hand down to their children, so they are motivated to do what they can to prevent releases.

Holding Out Hope

I am hopeful that the new double-wall and periodic testing requirements in the 2015 revision to USEPA's UST regulations will prompt other owners to begin to pay more attention to the maintenance of their UST systems. In doing this, releases will be detected and addressed earlier, reducing cleanup costs, and allowing them to be successful in their core business, which is sometimes selling more fuel. ■

2015 Annual State Fund Survey Results Now Available

The survey result tables are available on the ASTSWMO website (*www.astswmo.org-pubs.html*). At the site, click on any state fund survey table listed below. Many thanks to Lynda Provencher, Vermont DEC, for leading the effort and to the state programs that participated.

Summary

Table 1 (Part 1): Design Characteristics of State Financial Assurance Funds 2015

Table 1 (Part 2): Design Characteristics of State Financial Assurance Funds 2015

Table 2: Funding for State Financial Assurance Funds 2015

Table 3: Level of Activity in State Financial Assurance Funds 2015

Table 4: Cost Control Measures/State Fund Updated 2015

Field Notes

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

Three Updated PEI Recommended Practices Coming Soon

PEI/RP900

PEI's Underground Storage Tank (UST) System Inspection and Maintenance Committee met in February and acted on 98 public comments offered to update PEI's *Recommended Practices for the Inspection and Maintenance of UST Systems* (PEI/RP900). Many of the comments were accepted in one form or another. A few suggestions that were not incorporated into RP900 are also of some significance to regulators and other users of the document. Here is a summary.

The scope of the recommended practice was NOT expanded to include UST systems and associated equipment other than that used to store and dispense gasoline, diesel, and related petroleum products at vehicle fueling facilities. In other words, the document is not intended to apply to such fuel-dispensing venues as marinas, aviation facilities, farms, or emergency generators. I think the Committee decided against expanding the scope because it would have been beyond their area of expertise.

PEI does produce recommended practices that cover marinas (PEI/RP1000), aviation fueling (PEI/RP1300) and emergency generators (PEI/RP1400), and one idea was to assign each of those committees the responsibility of adding a walkthrough inspection chapter to their documents. There is also another PEI Committee considering the idea of producing a new recommended practice that would cover operations and maintenance procedures for the most common storage systems not covered by RP900 (e.g., used oil tanks, lube tanks, marina tanks, aircraft refueling tanks), while leaving out field-constructed tanks and airport hydrant systems because of their complexity and PEI members' lack of experience with those systems.

Although the equipment covered in the recommended practice includes all below-grade, liquid and vapor handling components accessible from grade cover or near the top of the storage tank, the 2008 edition of RP900 did not mention the impact valve at the fuel dispensers. The Committee broadened the scope of the 2016 document to include the shear valve.

The Committee recognized that, in many instances, the new federal inspection requirements that became effective October 13, 2015, were less comprehensive than the inspection practices contained in the 2008 edition of RP900. After reviewing all the inspection requirements of the federal rule, the Committee revised the document to meet or exceed the walkthrough inspection requirements and frequencies contained in the federal regulation. In a few instances, the Committee included recommended procedures for walkthrough inspections in the document that were not included in the federal rule. The Committee also rejected several proposals to increase the frequency of some inspections (e.g., spill bucket drain valves, interstitial space of drain valves).

A number of comments dealt with water and the quality of fuel in the UST. The Committee made a few tweaks to Section 7.6.5.1 that now requires the owner to check to see if water is present and, if found, to notify the appropriate person in the company. Section 7.6.5.1 also will direct the owner to a new appendix that will discuss water issues and suggest strategies to keep water out of the tank. The appendix will probably be available for public comment before it is included in RP900.

All of the testing requirements contained in RP900 were removed from the document and will be considered for inclusion in PEI's *Recommended Practices for the Testing and Verification of Spill, Overfill, Leak Detection and Secondary Containment Equipment at UST Facilities* (PEI/RP1200). By this action, the Committee opted to provide one document to use for walkthrough inspections of UST systems (RP900) and another to test the equipment and verify it is working properly (RP1200). I had hoped PEI would be able to release both documents this summer, but delays always seem to crop up for the most unlikely reasons and, for regulators' planning purposes, I think a release date of September/October is the best bet at this writing.

PEI/RP1200

In March, the PEI committee responsible for the 2016 edition of RP1200 received 34 comments submitted in response to PEI's public solicitation and 24 comments from the RP900 committee (see above) that had to do with equipment testing and verification. Most comments focused on three sections of the standard:

- Annular space testing of USTs (changing protocols)
- Automatic shutoff devices and overfill prevention (amending test procedures and pass/fail criteria)
- Containment sump testing (adopting completely new alternatives to those currently provided in the recommended practice; changing some existing procedures; reuse of sump test liquid)

A July/August meeting of the RP1200 Committee is contemplated.

PEI/RP100

In July, the PEI Tank Installation Committee will complete work it began in March on 24 comments offered to amend and/or clarify PEI's *Recommended Practices for Installation of Underground Liquid Storage Systems* (PEI/RP100). If it was my decision—which it isn't—two changes must be made to keep RP100 in accord with the new federal tank rule: 1) Recognizing that ball float valves cannot to used in new UST installations and 2) Reflecting that double-walled systems must now be used at new UST

■ continued on next page

Field Notes *continued*

installations nationwide. Some of the other issues that will be considered by the Tank Installation Committee include:

- Expanding the scope of the document to include the storage of diesel exhaust fluid (DEF)
- Adding a chapter of definitions
- Changing backfill compaction language
- Adding a section on ventilating tank top sumps
- Determining the number of bends permitted with flex pipe
- Facilitating the detection and removal of water in storage systems.

These three PEI recommended practices (RP900, RP1200, and RP100) are referenced in the federal tank standard. As you can see, the committees responsible for writing each document are in various stages of wading through scores of comments to produce updated versions that can be used by the states as they work to update their regulations to meet the new federal standard. The industry should not have much longer to wait. ■

■ Whack-a-Leak *from page 15*

during the last 30 years. But there are still a few potentially gaping holes in our leak detection strategies for single-walled storage systems that give me pause. Here's my short list of solutions:

- If a facility is going to be open to fueling 24/7, then continuous ATG tank testing should be required.
- If continuous ATG tank testing is used, the ATG should be able to positively distinguish fueling activity from a leak, regardless of the size of the leak.
- Submersible pump manifolds should have secondary containment sooner rather than later.

The People Factor

There are human factors to consider as well. Leaks and leak detection issues keep popping up like Whack-a-Moles because people are always looking for short cuts or cost savings.

UST operators should not accept routine failed test results as normal. UST operators should understand that frequent failed tests mean that something is wrong with their leak detection methodology if not the UST system itself. In addition, they should understand that even with today's bells and whistles, no UST system is immune from leaks and spills. Operator training requirements now provide a mechanism for communicating this type of information, but are we using it?

Service technicians and regulators both need a detailed understanding of how leak detection equipment works so that full and effective compliance with leak detection regulations can be achieved.

Leak detection equipment manufacturers should be more forthcoming about either identifying the limitations of their equipment or providing more complete solutions to the challenges of leak detection. Otherwise they give service technicians, regulators, and their customers a false sense of security that can lead to major problems.

Given our Whack-a-Mole approach to UST leak detection, we need to be vigilant for the appearance of the next mole, and have our hammers ready.

Have any unforeseen leak detection issues popped up in your yard? Let me know at marcel.moreau@juno.com. ■

From Our Readers

This note was sent to Marcel Moreau regarding his issue #77 LUSTLine *article titled "What Does Stage I Vapor Recovery Have to Do with ATGs?" John is Program Administrator with the Missouri Department of Agriculture Weights, Measures, and Consumer Protection Petroleum/Propane/Anhydrous Ammonia. He can be reached at: john.albert@mda.mo.gov.*

Marcel, thanks for this excellent article. This "over-vacuumization" of USTs is a major concern, as was demonstrated by my recent experience during a training session at a convenience store in Missouri. The site has 1987-vintage stiP3 tanks with single-walled fiberglass lines, a pressurized delivery system, a flapper valve, an Incon tank gauge, and Husky model 5885 pressure/vacuum vent valves on each vent line. The owner/operator is diligent about compliance.

When I tried to remove the fill cap from the unleaded tank, I could barely get it off, due to the extreme vacuum that had been created inside the UST. Once I was able to remove the cap, we could hear the tank creaking as it "breathed in"—I purposely timed how long it took for the pressure to equalize, and it was a full 45 seconds! Several experienced emergency responders participating in the training were astonished; they were very concerned about stress on the tank caused by repeated deformation followed by "release and breathing" each time the fill cap is removed. Without exception, they expressed concern that this situation— caused by air pollution rules that seem to no longer have any basis—is actually *increasing the risk* of UST failures and leaks.

I hope the folks at CARB and EPA are reading *LUSTLine* and taking actions to solve this problem.

Matthew F. Garcia, ADEQ

FAQs from the NWGLDE

...All you ever wanted to know about leak detection, but were afraid to ask.

How the NWGLDE List of Leak Detection Systems Can Be Used to Assist Compliance with the Revised 2015 Federal UST Regulation

Please note: The views expressed in this column represent those of the work group and not necessarily those of any implementing agency.

Q. Can the NWGLDE List of Leak Detection Systems (List) still be used to comply with the revised 2015 Federal UST Regulation?

A. Yes. Most leak detection equipment on the current List is still acceptable under the 2015 revised federal UST regulation. The NWGLDE will update the List so that users can know which methods of leak detection are no longer acceptable by adding a note stating that a method is, "No longer a viable method under the 2015 federal UST regulation."

The mission of the NWGLDE is to:

- Review leak detection system evaluations to determine if each evaluation was performed in accordance with an acceptable leak detection test method protocol
- Ensure that the leak detection systems under review meet USEPA and/or other regulatory performance standards, if applicable
- Review draft and final leak detection test method protocols submitted to the Work Group by a peer review committee to ensure they meet equivalency standards stated in the USEPA standard test procedures
- Make the results of such reviews available to interested parties.

NWGLDE's mission is unchanged, particularly with regard to the second activity listed in our Mission Statement: "Ensure that the leak detection systems under review meet USEPA and/or other regulatory performance standards, if applicable" The NWGLDE List is still a relevant and very useful tool in helping users comply with regulatory requirements related to release detection for underground storage tank systems.

This article is the first in a series and broadly discusses how release detection systems on the NWGLDE List can be used for compliance with new and revised federal UST release detection requirements. Subsequent articles will discuss in greater detail how to get the most out of the information already provided in the List to address some of the 2015 changes to the federal regulation. Specific changes to the federal regulation include:

- Alternative release detection options for Field-Constructed Tanks (FCT) and Airport Hydrant Fuel Distribution Systems (AHS)
- Continuous In-Tank Leak Detection (CITLD) methods
- Statistical Inventory Reconciliation (SIR) methods

Q. Are there alternative release detection options for field-constructed tanks (FCT) and airport hydrant fuel distribution systems (AHS) in the NWGLDE List?

A. USEPA has removed the deferral on the release detection requirements for FCTs and AHSs. These deferrals had been in place since the original 1988 UST regulation. The date when release detection will be required on these UST systems will vary, depending on the state in which the UST system is located.

The release detection requirements for these previously deferred UST systems are not the same as those for UST systems located at more common UST sites, such as convenience stores. Although USEPA allows the use of traditional release detection methods on FCTs and AHSs, because of the greater size, operating pressures, and other substantial differences specific to these systems, USEPA also allows alternative release detection methods. These release detection methods must detect leak rates that are several orders of magnitude larger than traditional release detection methods.

NWGLDE's Bulk Underground Storage Tank Leak Detection Methods, intended for tanks 50,000 gallons or greater, may be used to meet USEPA's release detection requirements for FCTs. This section of the List includes eight vendors with 18 separate test methods among them, capable of testing various size FCTs. The performance of the volumetric methods on this list depends on the surface area of the liquid in the tank being tested. The NWGLDE List includes formulas based on the surface area of the liquid that can be used to calculate the size leak that can be detected, the pass/fail threshold for the method and the maximum size tank on which the method can be used.

NWGLDE's Large Diameter Line Leak Detection Methods may be used to meet USEPA's piping release detection requirements for FCTs and AHSs for sections of piping with a volume greater than 50,000 gallons. This section of the List currently includes eight vendors with 19 separate test methods among them. The List provides information that

FAQs... *continued from page 20*

can be used to determine the leak rate that can be detected, the pass/fail threshold for the method and the maximum volume of the pipe on which the method can be used.

In our next article in the series, we will discuss these methods in greater detail and provide examples of how the information in the List can be used to evaluate whether a specific method is appropriate for a specific FCT or AHS.

Q. Which release detection systems qualify as Continuous In-Tank Leak Detection Methods?

A. The 2015 revised federal UST regulation added Continuous In-Tank Leak Detection (CITLD) as a release detection method. CITLD encompasses all statistically based methods where, within a 30-day monitoring period, the system incrementally gathers measurements on an uninterrupted or nearly uninterrupted basis to determine a tank's leak status.

There are two major categories of release detection used by CITLD methods. USEPA refers to the first category as continuous statistical release detection, also known as continuous automatic tank gauging. NWGLDE lists this group of CITLD methods under the category of Continuous In-Tank Leak Detection Methods (Continuous Automatic Tank Gauging). This section of the List currently includes nine vendors with 12 separate test methods among them.

USEPA refers to the second group of CITLD methods as continual reconciliation. NWGLDE lists this group of CITLD methods under the category of Continuous In-Tank Leak Detection Methods (Continual Reconciliation). This section of the List currently includes one vendor with one test method. Continual reconciliation methods are further distinguished by their connection to dispensing meters that allow for automatic recording and use of dispensing data in analyzing a tank's leak status. Delivery volume, sales volume, and the volume of fuel in the tank are analyzed to account for all fuel.

In an upcoming article in the series, we will discuss the differences between CITLD and SIR methods.

Q. Which release detection systems are allowed as statistical inventory reconciliation methods?

A. The 2015 revised federal UST regulation formally added Statistical Inventory Reconciliation (SIR) methods to the list of acceptable leak detection methods. Previously, these methods were covered under the "Other Methods" category recognized by the federal UST regulation.

SIR methods analyze inventory, delivery, and dispensing data collected by the facility operator over a period of time to determine whether or not a tank or piping is leaking a regulated substance. Each operating day, the product level is measured using a gauge stick or other tank level monitor. The operator must also keep complete records of all withdrawals from the UST and all deliveries to the UST. After data have been collected for the period of time required by the SIR vendor, the operator provides the data to the SIR vendor.

The SIR vendor conducts a statistical analysis of the data to determine whether or not the UST system is leaking. The SIR vendor provides a test report of the analysis back to the operator.

USEPA no longer allows qualitative SIR methods to be used as a SIR method of leak detection. NWGLDE lists SIR methods under the test method category Statistical Inventory Reconciliation Test Method (Quantitative). This section of the List currently includes 15 vendors with 24 separate test methods among them.

The minimum number of operating days for these methods ranges from 15 to 42 days. However, to meet the federal release detection requirement, a quantitative report must be generated and returned to the operator so the operator can determine the leak status of his or her tank at least once every 30 days.

NWGLDE also lists SIR methods under the test method category Statistical Inventory Reconciliation Test Method (Qualitative). This section of the List includes three vendors with four separate test methods among them. NWGLDE plans to add an indication to this section that these methods are no longer a viable method under 2015 revised federal UST regulation.

In addition to the future articles mentioned above, other articles may be added as questions relevant to the new federal UST regulation are posed to the NWGLDE. Stay tuned for more information. ■

About the NWGLDE

The NWGLDE is an independent work group comprising eleven members, including ten state and one USEPA member. This column provides answers to frequently asked questions (FAQs) the NWGLDE receives from regulators and people in the industry on leak detection. If you have questions for the group, contact them at questions@nwglde.org.

NWGLDE's Mission

- Review leak detection system evaluations to determine if each evaluation was performed in accordance with an acceptable leak detection test method protocol and ensure that the leak detection system meets EPA and/or other applicable regulatory performance standards.
- Review only draft and final leak detection test method protocols submitted to the work group by a peer review committee to ensure they meet equivalency standards stated in the U.S. EPA standard test procedures.
- Make the results of such reviews available to interested parties.

The Enigma of TPH *from page 9*

of using the SGC method, it could be done on a site-specific basis to provide a snapshot at the beginning and end of a project, or it could be based on the exceedance of a threshold requiring further fractionation. This would provide a more accurate and substantial case for closure or continued remediation. Also, comparison between the two methods could help project managers decide whether additional compound-specific analysis (e.g., EPA 8260) should be completed to evaluate compounds that represent risk-drivers prior to site closure. The ITRC TPH Risk Evaluation Team will grapple with this issue, as well as many other difficult and enigmatic questions posed by the presence of TPH fractions at cleanup sites.

Like so many other complex regulatory issues that are resource and funding limited, it's important to recognize the trees despite the forest. We have to focus on those issues that represent the largest potential threat to human health and the environment. In the words of one friend, "remember that most states still do not consistently test for ethyl-dibromide, a compound 40 times more carcinogenic than benzene."

Here, here! Still, we have not answered some of the more difficult questions involving the potential synergistic effects of petroleum hydrocarbons mixed with families of polar compounds. The current discussion is focused on the toxicity of these families. Forgetting for a moment about the taste and odor concerns of water containing TPH compounds, what about the long-term carcinogenicity of biodegrading TPH mixtures? Should we be concerned? ■

References

(1) EPA, 2015, p. 2, Technical Guide for Addressing Petroleum Vapor Intrusion at Leaking Underground Storage Tank Sites (EPA 510-R-15-001). Office of Underground Storage Tanks, Washington, DC. *https://www.epa.gov/sites/production/files/2015-06/documents/pvi-guide-final-6-10-15.pdf.*

(2) TPH Criteria Working Group Series, Volume 1, pg. 2, Amhearst Scientific Publishers, March 1998.

(3) *http://www.itrcweb.org/Team/Public?teamID=76.*

(4) Zemo D.A., O'Reilly K.T., Mohler R.E., Tiwary A.K., Magaw R.I., Synowiec K.A. 2013. Nature and estimated human toxicity of polar metabolite mixtures in groundwater quantified as TPHd/DRO at biodegrading fuel release sites. *Groundwater Monitoring and Remediation.* 33(4): 44–56.

TPH Analysis at LUST Sites *from page 7*

the degradation of petroleum contaminants in groundwater. *Geochimicaet Cosmochimica* Acta 58, 863–877.

Espino Devine, C., Zemo, D., Magaw, R.I., Mohler and R.E., Wegesser, T., 2015. *Nature and Estimated Toxicity of Polar Metabolite Mixtures in Groundwater Quantified as Extractable "TPH" at Biodegrading Fuel Release Sites.* Poster Session. 25th National Tanks Conference. New England Interstate Water Pollution Control Commission.

Federal Register. 2005. Methods Innovation Rule and SW–846 Final Update IIIB. 70:113 p. 34538.

Hawaii Department of Health. 2013. *Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan.* HDOH Office of Hazard Evaluation and Emergency Response. *http://www.hawaiidoh.org/tgm-content/2500a.aspx?m=True.*

Lang DA, Bastow TP, van Aarssen BGK, Warton B, Davis GB, Johnson CD. 2009. Polar compounds from the dissolution of weathered diesel. *Ground Water Monitoring and Remediation* 29:85–93.

Langbehn A., Steinhart H. 1994. Determination of organic acids and ketones in contaminated soils. *Journal of High Resolution Chromatography* 17: 293-298.

Lundegard PD, Sweeney RE. 2004. Total petroleum hydrocarbons in groundwater—Evaluation of nondissolved and nonhydrocarbon fractions. *Environmental Forensics* 5: 85–95.

Massachusetts Department of Environmental Protection. 2004. Method for the Determination of Extractable Petroleum Hydrocarbons. MA DEP Division of Environmental Analysis. *http://www.mass.gov/eea/docs/dep/cleanup/laws/eph0504.pdf* .

Texas Commission on Environmental Quality. 1997. Method 1006: Characterization of C 6 to C 35 Petroleum Hydrocarbons in Environmental Samples. *http://www.tceq.state.tx.us/assets/public/remediation/trrp/method1006.pdf.*

Washington Department of Ecology. 1997. Analytical methods for petroleum hydrocarbons. WA DOE Toxics Cleanup Program. Publication ECY 97-602. *https://fortress.wa.gov/ecy/publications/summarypages/97602.html*

Uhler, A.D., Stout S.A., McCarthy K.J. . 1998. Increase success of assessments at petroleum sites in 5 steps. *Soil & Groundwater Cleanup* Dec/Jan: 13–19.

United States Environmental Protection Agency. 2009. Hazard Communication Document: Alkylphenols Category.

United States Environmental Protection Agency. 2014. Disclaimer for the Test Methods for Evaluating Solid Waste: Physical/Chemical Methods Compendium (SW-846). *https://www.epa.gov/sites/production/files/2015-10/documents/disclaim.pdf.*

Zemo, D.A.,Bruya J.E., Graf T.E. 1995. The application of petroleum hydrocarbon fingerprint characterization in site investigation and remediation. *Ground Water Monitoring and Remediation*. 15, 147–156.

Zemo D.A., Foote GR. 2003. The technical case for eliminating the use of the TPH analysis in assessing and regulating dissolved petroleum hydrocarbons in ground water. *Ground Water Monitoring and Remediation*. 23: 95–104.

Zemo D.A, O'Reilly K.T., Mohler R.E., Tiwary A.K., Magaw .R.I., Synowiec K.A. 2013. Nature and estimated human toxicity of polar metabolite mixtures in groundwater quantified as TPHd/DRO at biodegrading fuel release sites. *Groundwater Monitoring and Remediation.* 33(4): 44–56.

Zemo D.A., O'Reilly K.T., Mohler R.E., Magaw R.I., Espino Devine, C., Ahn, S., and Tiwary, A.K. in review. Life Cycle of Petroleum Biodegradation Metabolite Plumes, and Implications for Risk Management at Fuel Release Sites. In Review at *Integrated Environmental Assessment and Management,* SETAC Journal.

A Message from Carolyn Hoskinson*...continued from page 11*

2015 UST regulation. Our plan is to make the training available to federal, state, territorial, local, and tribal regulators—as well as the public—by the end of 2016.

In the 2015 federal UST regulation, USEPA designated three specific classes of operators who must document knowledge of their UST systems and essentially pass a test that demonstrates their knowledge. As the implementing agency on tribal lands, USEPA will develop an internet-based test as a cost-effective way to ensure all operators on tribal lands have access to testing. In addition, we will make the test available on CD for those who have difficulty accessing the internet. Both the CD and internet versions of the test provide for printing certificates as proof of testing. We plan to make the internet and CD versions available well before the October 13, 2018 deadline, which is when all operators must document knowledge of their UST systems per the federal requirement. Of course, there are many other outstanding training and testing options provided around the country, and operators can certainly take advantage of those options as well.

I realize there are many new requirements in the 2015 UST regulation, and those new requirements affect UST owners and operators as well as those who implement the UST program at state and local levels. With that in mind, we are doing the very best we can to help all UST stakeholders forge ahead in meeting the 2015 UST requirements and, as a result, protect our land and groundwater from underground storage tank releases. If you think of anything else USEPA can do to assist tank owners and operators understand and comply with the 2015 UST regulation, please share your ideas with me or Elizabeth McDermott at mcdermott.elizabeth@epa.gov. ■

TanksTidbit … … … … … … … …

Utah's Fund Introduces Rebates for Environmental Assurance Fees

In 2015 Utah's Petroleum Storage Tank Fund began implementing a rebate program for a portion of its throughput-based environmental assurance fees. The Utah Department of Environmental Quality (UDEQ) worked with the State Tax Commission to develop the process for determining rebates and refunding the eligible environmental assurance fee. The amount of the rebate depends on the relative risk of the tank systems at each facility.

Rules adopted by the Utah Solid and Hazardous Waste Control Board describe the formula for calculating the relative risk of a facility. Risk is lower for tank systems that have containment:

- at the tank top
- under the dispensers
- at the fill riser.

Other factors such as tank age and material of construction also affect risk. Each facility is assigned a risk tier that takes these factors into account.

In order to receive "credit" for containment, the sumps, secondary piping, and secondary tank walls must be tested at least every three years to document that they are still able to contain a release. For the first year (2015), all systems with containment were assumed to be tight. Testing has been required beginning in2016 to document the condition of containment systems and receive credit for this year and beyond.

The risk status for each facility is calculated each December 15th and applies to the following calendar year. Table 1 summarizes the eligible rebate for facilities in each risk tier. Tank owners/operators can access the UDEQ's website to determine how to lower their tank system risk and obtain a larger rebate. To learn more about Utah's rebate program, contact Doug Hansen at (801) 536-4454. ■

Send your UST/LUST/FR TanksTidbits to lustline@neiwpcc.org. ■

Table 1 Environmental Assurance Fee Rebate Table

Risk Tier	Facility Risk Value (rounded to nearest 0.0001)	Rebate: % of surcharge paid
Tier 1	<0.10	40%
Tier 2	0.10-0.2499	25%
Tier 3	0.25-0.3499	10%
Tier 4	>0.35	none

L.U.S.T.LINE

New England Interstate Water Pollution Control Commission
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■ **A Tale of Two Gas Stations** *from page 4*

The Exxon station received a "No Further Action" letter this past December 2015. The Mobil Station is still on semi-annual monitoring due to residual contamination in bedrock near the tank pad location.

The development of a residential community dependent on private well water, downgradient of a business area, and populated with gasoline stations and a dry-cleaner, would raise red flags in any town in Rhode Island today. Canob Park was originally a neighborhood, and almost from its inception became part of two LUST cases, simply known in the beginning as contaminated drinking water sites. The promulgation of national UST regulations in 1984, gave enforcement power to government agencies to protect human health and the environment. The Canob Park neighborhood got what it needed — public water. And although questions may still remain as to the quality of the bedrock aquifer beneath this neighborhood, it is no longer a LUST case. It is simply a neighborhood! ■

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