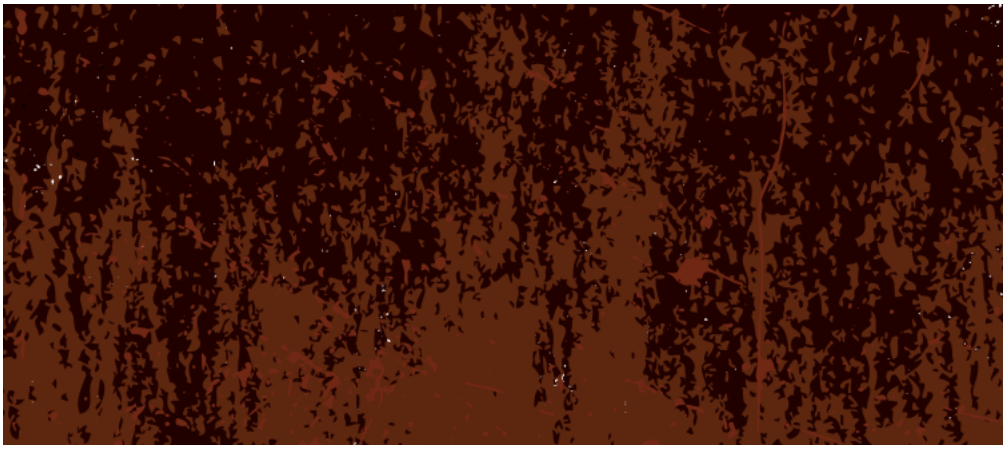

January 2018

FEATURE

TANK CORROSION

Lower levels of sulfur in today's diesel fuel supply bring increased risk. What you can do—and what NACS is doing—to address the problem.

By Jerry Soverinsky

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While diesel fuel boasts a century-plus history powering engines around the world, it wasn't until the late 20th century that automakers in the United States began very slowly embracing diesel-fueled automobiles (by the late 1990s, only two foreign automakers, Mercedes and Volkswagen, even offered diesel models of their cars in the United States, despite a wide portfolio available in Europe).

But improved performance and enhanced efficiency, along with government incentives, spurred diesel's growth over the last two decades, and along with it, an unforeseen consequence has emerged: tank corrosion.

No, this is not the slow, decades-long corrosion that characterized the post-World War II steel underground storage tanks (USTs). Rather, this is a fast-acting corrosion (think weeks and months, rather than decades) that can cause substantial performance issues for your dispensers.

NACS and the Fuels Institute are working closely on what has become an evolving industry issue, providing guidance for you to address the integrity of your diesel storage tanks and fuel.

DIESEL IN THE 21ST CENTURY

According to the Environmental Protection Agency (EPA) in its 2016 report, "Investigation of Corrosion-Influencing Factors in Underground Storage Tanks with Diesel Service," the diesel storage tank corrosion phenomenon traces its roots to three significant events.

Prior to 2006, diesel fuel could contain up to 500 parts per million (ppm) of sulfur. In an effort to reduce pollutants from diesel-powered engines, the EPA restricted the allowable sulfur content in diesel fuel, phasing in standards over several years that eventually limited diesel fuel to no more than 15 ppm sulfur (the result was ultra-low sulfur diesel, or ULSD).

At roughly the same time, Congress enacted the Renewable Fuel Standard (RFS), which mandated higher levels of ethanol and biodiesel to be blended into petroleum-based fuels. The latter was blended into diesel fuel, and helped replace some of the lubricity lost from the diesel as it reduced its sulfur content.

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And finally, retailers began selling more diesel fuel in the mid-2000s, often storing it in tanks that previously stored mid-grade gasoline, as demand for the latter had declined.

Not long after the confluence of these three factors, in 2007, the first reported incident of a corroded diesel fuel storage tank was posted on the Petroleum Equipment Institute's (PEI) website, the first of several reports.

By 2010, PEI had fielded a number of such reports and distributed a survey to station operators, field technicians and storage tank manufacturers in an effort to better study the issue, compiling a list of impacted equipment (see table below).

So what happened? While reduced sulfur levels delivered on the EPA's goal to reduce exhaust pollutants, there were some unintended effects, among them, a decrease in the inhibitors to biological growth. As a result, while microbial growth increased, storage tank corrosion increased.

> **"This is highly aggressive corrosion. We've seen pictures of tanks that, just six months after a clean inspection, show the [wear] of a 20-year-old tank."**

"When we pulled the sulfur out, a controlling agent was lost," said John Eichberger, executive director of the Fuels Institute. "According to one theory, the bacteria in the fuel can now eat the organic ingredients in the fuel and there's not enough sulfur to kill them. And that could be a reason why we're seeing an increase in microbial-induced corrosion."

And lest you think bugs would be no match for your steel, cathodic-protected UST, think again. "This is highly aggressive corrosion," Eichberger said. "We've seen pictures of tanks and connected equipment that, just six months after a clean inspection, show the [wear] of a 20-year-old tank."

As a result of the corrosion, Eichberger said, the pumps become inefficient as filters clog with what appears to be coffee ground-like materials, slowing their ability to dispense fuel. "These materials are products of the microbial contamination. Once corrosion is discovered, tank owners have to take remedial action to clean their systems."

By 2014, the EPA's Office of Underground Storage Tanks had begun an intensive effort to understand both a cause and solution of diesel storage tank corrosion, conducting inspections across the country and documenting their findings. "[C]orrosion may be commonly severe on metal surfaces in the upper vapor space of UST systems," the EPA reported. "Furthermore, it appears that many owners may not be aware of the corrosion nor are they aware that corrosion, which could affect the operability of their UST systems, could already be at an advanced stage."

The problem was severe, as the EPA noted 83% of the tanks that it inspected "had moderate or severe metal corrosion," while less than 25% of the station owners had reported an awareness of the corrosion prior to the inspections. In addition to potentially impacting equipment functionality, the corroded tanks also posed an increased risk of leaking fuel.

WHAT YOU CAN DO

While tank corrosion potentially impacts any operator that stores diesel fuel, fortunately, there are steps you can take to minimize risks as well as remedy compromises.

The Clean Diesel Fuel Alliance, a collaboration of public and private organizations (NACS is a participating member) facilitating the introduction and use of ULSD fuel, has issued "Guidance for Underground Storage Tank Management at ULSD Dispensing Facilities," a document that helps operators identify and address diesel tank corrosion.

The comprehensive approach requires an ongoing effort focused on both the tank and fuel, incorporating cleaning, maintenance and repair (tank), along with testing, the introduction of additives and winterization (fuel). Let's take a closer look*:

Identify Symptoms

While a reduction in your dispenser's normal flow rate typically indicates an issue with the dispenser filter, frequent flow rate reductions may indicate more than just a routine maintenance issue. A rotten egg odor in the fuel or filter often indicates microbial contamination, which can be confirmed by the presence of a "rag" layer from a tank bottom sample and/or corroding interior metal filter parts. As microorganisms are dependent on water, this indicates the presence of water in the storage tank.

UST Equipment Reported Most Frequently Experiencing Operational Problems

Affected Equipment	Operational Malfunction
Dispenser fuel filters	Clogging and requiring more frequent replacement
Seals, gaskets, O-ring	Deterioration
STP and pump components	Replacement / column pipe wear / motor problems
Tanks	Rusting and leaking (includes tanks on vehicles)
Meters	Premature failure
Line leak detectors	Damaged or broken
Automatic nozzle shutoff	Failure / shorter lifespan
Tank probes	Malfunctioning
Check valves	Not seating
Shear valves	Not seating / failing tests
Hose swivels	Failing prematurely
Dispenser	Leaks / failure / premature replacement
Solenoid valves	Clogged / failing
Riser pipe	Corrosion
Pipes	Failure

(Source: EPA, "Investigation of Corrosion-Influencing Factors in Underground Storage Tanks with Diesel Service")

(https://www.nacsmagazine.com/sites/default/files/Jan18_NACS_Tank-Corrosion_01.svg)

Manage Fuel Systems and Fuel Deliveries

Implement a systematic process to monitor fuel quality and fuel systems, including the following:

1. At the beginning and end of each day, read all totalizing meters and gauge tanks for water content, removing anything in excess of an inch.
2. Before and after a fuel delivery, gauge all tanks and remove standing water, checking the tanks for water. Also, remove water from the inside spill containment bucket any time the tank fill cover is removed. Finally, reinstall all gauge caps, ensuring their integrity.
3. After a fuel delivery, make sure fill and gauge caps are tightened and locked, noting inventory adjustments for any increases in water levels after the tanks have time to settle out.
4. After a night fuel delivery when the station is closed, check for water in the tank, calculate any difference between opening and closing gauges and reconcile with the invoice total, and then tighten and lock gauge caps.

Manage and Monitor Water Content

Whether you employ manual or automatic tank gauging, pull samples from the lower end of the tank, as tanks are often installed with a slight tilt to promote any water collection in the concentrated, lower area. Take samples from each end of the tank, if possible, while visually inspecting both tank openings. A water-finding paste can also be used to check for water at the bottom of a storage tank.

Carefully inspect the fuel sample, checking for a haziness or waxiness (cold weather) that indicate the presence of water.

Prevent the ingress of water by carefully sealing all fuel tank openings, raising the tank fill area above ground level and inspecting product spill containment buckets.

Prevent microbial growth by removing water accumulation in excess of one inch from the bottom of the tank. Additionally, check the tanks quarterly to semi-annually for microbial activity, treating them with an appropriate and EPA-approved biocide. Employ third-party contractors to examine, maintain and clean the inside of the tank.

Clean Your Tank

Whenever you detect an appreciable level of tank bottom sludge or metallic material, tap an expert in microbial mitigation to clean the tank, monitoring it closely afterwards for any reappearance of water.

Converting a Tank

Clean, inspect and verify any tank that you convert to use with diesel fuel, noting whether any subsequent storage of ULSD or biodiesel will impact the cleanliness of the fuel tank or durability of the filter.

*This is a summary of the major recommended steps. For comprehensive guidance, download the guidance document from the CDFA website at www.clean-diesel.org (http://www.clean-diesel.org).

WHAT NACS IS DOING

Even with ongoing vigilance, the threat of diesel tank corrosion, along with other aspects of diesel fuel quality, are not fully resolved and understood. As a result, NACS has contributed to a research project led by the Coordinating Research Council (CRC) to determine what factors are primarily responsible for the occurrence of tank corrosion. In addition, the Fuels Institute has launched an industry collaborative effort (the Fuel Quality Council) to evaluate overall quality of diesel fuel at the nozzle and the performance of diesel fuel in modern high pressure engines. Together, these efforts strive to improve operating conditions for diesel fuel and engines.

Look for more information at www.fuelsinstitute.org (http://www.fuelsinstitute.org).

GET INVOLVED

The Fuel Quality Council, a project of the Fuels Institute, is conducting exhaustive research on the most critical issues facing diesel fuel and engine markets. It encourages fleet operators, refiners, biofuel producers, distributors, retailers, fuel storage tank and dispenser maintenance providers, among others to get involved and participate in the organization's research to discover answers to the challenges facing the diesel market and to evaluate potential solutions.

For more information, contact the Fuels Institute at (703) 518-7970 or visit www.fuelsinstitute.org (http://www.fuelsinstitute.org).

WHY IT MATTERS

With myriad competitive challenges facing your business, ensuring the integrity of your fuel equipment is paramount for success. Preventing diesel storage tank corrosion is an ongoing pursuit, yet a procedural necessity to minimize fuel dispensing disruptions and quality issues.

This is not anecdotal but rather systemic, Eichberger insists, a reflection of new diesel fuel formulations. And it's not a matter of reversing that formulation—recall, the change was made to address environmental concerns—but actively monitoring your tanks for signs of corrosion, controlling for water and cleaning them as necessary.

"It's more than a LUST (leaking underground storage tank) issue, which is environmental, but also an operational one," he says. "This affects your ability to distribute fuel efficiently, which adds an economic component."

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About Jerry Soverinsky

Jerry Soverinsky is a Chicago-based freelance writer. He's also a *NACS Magazine* contributing writer.

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