Rampant Diesel Corrosion in Underground Storage Tanks Containing Ultra-low Sulfur Diesel

Inside of an ATG riser pipe looking down toward the probe

Corrosion on the inside of a filter removed from diesel dispenser

Sludge and corroded pipes in the Under Dispenser Containment

Corrosion deposits on the top of an ATG probe

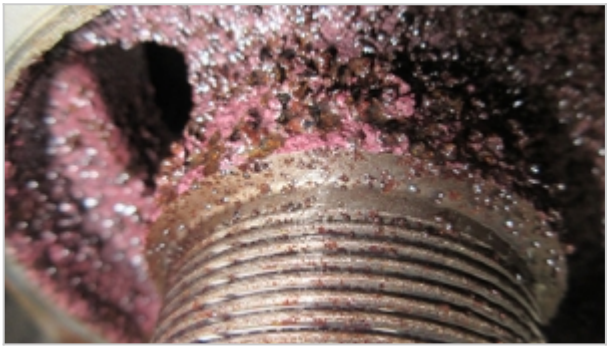
Corrosion on the functional element, a component of an STP

A severely corroded ball float inside a fiberglass tank

Severe corrosion and tubercles on a bung inside a fiberglass tank

Corrosion and tubercles on the internal section of an STP

Internal view of corrosion inside a steel tank



A corroded filter housing inside a diesel dispenser

A severely corroded STP shaft that was removed from a diesel tank

A corroded flapper valve from a diesel tank, next to another flapper valve from the gasoline tank at the same site

When the United States Environmental Protection Agency (EPA) recently revealed the results of its study on the increasing presence of substantial corrosion in diesel fuel tanks throughout the U.S., it proved that the problem is much larger than anyone realized.

The facts are astonishing:

- 83% of the diesel tank systems exhibited moderate-to-severe corrosion.
- 75% of the owner/operators of those diesel tanks had no idea it was happening.
- The corrosion is developing in *both* steel and fiberglass tank systems.

Even more staggering is the severity of the corrosion.

I have been an engineer in the petroleum industry for my entire career, first with Exxon and for the

last 23 years, with Tanknology. I have never in my life seen corrosion of this magnitude in a fueling system. The fact it was found in moderate-to-severe states in 83 percent of the systems points to a major industry problem.

Tanknology partnered with Battelle and performed all the fieldwork for this EPA study, which the agency termed the “largest field research of this issue to date.” Our fieldwork consisted of inspecting and sampling each of the 42 tanks in the survey. The sites were from all over the country, covering widespread geography.

Our work consisted of collecting fuel, water, and vapor samples, and inspecting fuel filters and the tank system access points for signs of corrosion. We also used our TankCam® remote internal video system to record the conditions inside the tanks. The images you see here are representative of the extreme conditions we discovered.

In this article I’ll address a little more about what we found, why it might be happening, and what an owner/operator can do to mitigate the potential for severe corrosion degradation of their diesel system.

Our Findings

During our fieldwork for this study last year, as well as subsequent studies performed for our clients, we have observed and documented what I consider to be unique, rapidly accelerated corrosion on the metal components of USTs storing diesel. Virtually all on-road diesel for sale today in the U.S. is Ultra Low Sulfur Diesel, or ULSD, which has been in use since 2006.

Unlike the mild orange-colored oxidation that would be typical for corrosion in this environment, we have seen large tubercles and nodules that can vary in color from yellow to orange to reddish brown and even black. The metal components in the vapor space of both steel and fiberglass tanks, including bungs, risers, caps, plugs, STP shafts, ball float assemblies, and flapper valves have all exhibited this unusual form of aggressive corrosion.

It has not been uncommon to find a severely corroded ball float assembly or bungs completely covered in tubercles, some of which can be up to an inch long. On one occasion, the top of a riser pipe broke completely in half as a result of the corrosion.

We have pulled completely corroded STP shafts from tanks, and in some cases are not even able to remove them due to the excessive corrosion in the riser. Layers of corrosion and tubercles have built up so severely that the inside of the riser is no longer wide enough for the STP motor to be removed or serviced.

We have seen the same problem with ATG probes; corrosion build up in the riser pipe can make it impossible to remove the ATG floats. Consequently, the probes and STP’s remain in the corrosive environment of the upper vapor space, either unable to be serviced, or in some cases replaced with

smaller diameter ATG floats once the original floats are knocked off and left to fall down into the tank.

As the study concluded, 83 percent of the tanks exhibited moderate to severe corrosion. This large percentage of such a diverse experimental group indicates that this issue is not limited by geographic conditions. It can, and is, happening everywhere.

This corrosion can, and in some cases did, compromise the functionality and structural integrity of the UST systems, leaving even the most responsible of UST owners unaware of the problem and potentially exposed to significant environmental impact.

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Why is this happening?

Unfortunately, the EPA study was unable to pinpoint a direct cause. Multiple factors are likely acting as confounding variables, including bacteria and gasoline-ethanol blended fuels.

Ethanol was found in 90 percent of the fuel samples taken in the study. Obviously, ethanol is not intentionally blended with diesel, so this suggests that cross contamination is prevalent. As the EPA study concluded, it's "likely the norm, not the exception."

As close as EPA got to a cause was the consistent presence of water content and particulate matter in the fuel tested from these tanks. We know that water is no friend of diesel; it is the essential element for microbes to develop and grow in the water-diesel interface – and that results in corrosion.

The water and particulate content, EPA concluded is "the closest to being statistically significant predictive factors for metal corrosion, but causation cannot be discerned."

What can be done about it?

So the experts can't determine why, exactly, this is happening and even the most diligent of owner/operators could have a severe corrosion problem they aren't even aware of. What can they do to protect themselves?

They can take steps to monitor, and even prevent, this corrosion while industry experts continue to look for additional answers.

Here are some steps we recommend:

- Perform regular visual inspection inside the ATG or other riser pipes accessible from grade, looking for any sign of potential corrosion.
- Remove and inspect the ball float or flapper valve overfill prevention equipment – perhaps incorporated as part of a periodic inspection such as PEI RP900.
- The single biggest thing to focus on is *managing water*. Operators should everything possible to keep water from entering the tank:

- Remove standing water, ice and/or snow around tank fill covers.
- Make sure all opening bungs, caps and cord grips are tight and replace caps or gaskets as needed.
- Keep fill and vapor recovery spill buckets clean. Pump out any water; clean out excess fuel and dirt. Don't drain water into tanks!
- Change filters frequently, especially if slow-flow occurs, and look for signs of corrosion on the filter and housing.
- Pay close attention to leak detection equipment and call for immediate service if any leak alarms or conditions occur.
- Verify that tank vents have rain caps.
- Avoid prolonged periods of low tank volume to minimize tank water from condensation.
- Check tanks for water bottoms frequently, especially before and after deliveries.
- No detectable water is acceptable in a diesel tank. It should be removed as soon as possible. Removed water should be tested for microbes and, if detected, appropriate corrective action should be taken immediately.

When it comes to corrosion in a UST, if you can see it during a visual inspection, it's most likely the tip of the iceberg. It almost surely exists elsewhere in the system. It's important to know about – and be addressed as quickly as possible.

One of EPA's recommendations is to perform an internal video inspection of the suspect tanks. Tanknology's TankCam® remote visual tank inspection service can be used for this purpose, as it was for the EPA study. The TankCam provides a clear picture of what's happening inside the tank without having to empty it. All of the interior photos in this article were captured via the TankCam.

More recommendations can be found in the *Preventive Maintenance Guide for Diesel Storage and Dispensing Systems*, published by the Coordinating Research Council (CRC). We have posted this document, many more actual corrosion photos, and more information about theof corrosion in diesel fueling systems on our website at *Tanknology.com/DieselCorrosion*.

For information about licensing Tanknology's TankCam or PetroScope® remote visual tank inspection technologies, contact the company's International Division at international@tanknology.com or +1-512-380-7129

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