Corrosion in Underground Storage Tanks (USTs) Storing Diesel

Update on EPA 2016 Research on the Prevalence, Search for Predictive Factors, and Potential Impacts
2016 Report Update
Target Release Date - June 2016

Research Goals:

- To better **understand the extent** of the problem and identify potential risks
- Identify **any correlations or predictive factors** among UST systems with severe or minimal corrosion

Process:

- **Field and lab work** – completed spring 2015
- **Stakeholder review** of initial draft – summer 2015
- **Peer-review** – winter 2015-16
Background - Corrosion in USTs Storing Diesel

- Reports began around 2007

- **Internal** metal components – (often STP shaft)

- Severe and rapid onset

- Yet unidentified cause – 1st major report in 2012 by Clean Diesel Fuel Alliance

- Extent not fully understood

- Appearance different and impacts more severe than corrosion in sump spaces of USTs storing gasoline/ethanol blends
Known Costs of Metal Corrosion for Owners

- Increased pace of **filter changes**
- More frequent servicing of equipment
- Possible shorter lifespan before replacement of equipment

Other questions to answer:

*How common is it?*

*What causes it?*

*How is it affecting other equipment?*
Collect Data on UST Conditions at Each Site

Collect samples:
- Vapor
- Fuel
- Water bottom

Inspect with internal tank video

Collect information on maintenance, throughput, fuel supply, biocide use, etc.
Sample Analyses

**Water**

### Water Content

- **Determination of Water in Petroleum Products, Lubricating Oils, and Additives by Coulometric Karl Fischer Titration (Procedure B)**
  - Method Identifier: ASTM D6304

### Density

- **Determination of Density, Relative Density, and API Gravity of Liquids by Digital Density Meter**
  - Method Identifier: ASTM D4052

### Total Acid Number

- **Acid Number of Petroleum Products by Potentiometric Titration**
  - Method Identifier: ASTM D664

### Corrosion Rating

- **Determining Corrosive Properties of Cargoes in Petroleum Product Pipelines**
  - Method Identifier: NACE TM 1-12

### Particulates

- **Particulate Contamination in Middle Distillate Fuels by Laboratory Filtration**
  - Method Identifier: ASTM D6217

### Water Bottom Analysis Methods

- **Determination of Ion Chromatography (IC) for short chain fatty acids**
  - Method Identifier: Modified EPA 300

### Conductivity

- **Electrical Conductivity of Aviation and Distillate Fuels**
  - Method Identifier: EPA 150.1

### pH

- **Nonhalogenated Organics Using GC-FID**
  - Method Identifier: SW846 8015B

**Vapor**

### Ullage % Relative Humidity

- **Ullage % Relative Humidity**
  - Method Identifier: Hygrometer used per manufacturer instructions

### Carboxylic Acids in Ambient Air Using GC-MS

- **Carboxylic Acids in Ambient Air Using GC-MS**
  - Method Identifier: ALS Method 102

### Determination of Lactic Acid in Ambient Air

- **Determination of Lactic Acid in Ambient Air**
  - Method Identifier: Modified NIOSH 7903

### Acetic, Formic, Propionic, Lactic Acids

- **Acetic, Formic, Propionic, Lactic Acids**
  - Method Identifier: Cations (Sodium, Calcium, Magnesium, Potassium, Ammonium) and Anions (Chloride, Sulfate, Nitrate and Fluoride)

### Ethanol and Methanol

- **Ethanol and Methanol**
  - Method Identifier: EPA 150.1
• **10 geographic clusters**
  • 42 sites
  • 24 fiberglass, 16 steel, 2 steel coated
  • 8 of 10 have steel and fiberglass in cluster

• **8 owners**
  • Government, retail, fleet
  • Single and multiple site
  • Large range of fuel throughputs and suppliers

• **Diverse USTs**
  • 1 – 29 years in service
  • 5,000 to 20,000 gallons in capacity
  • Different product storage histories
  • Various approaches to maintenance

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**Diverse UST Sample Population**

42 USTs by Capacity and Material

- **Steel**
- **Fiberglass**

![Graph showing 42 USTs by capacity and material.](image-url)
42 Inspection Sites
Key Results

• Corrosion more prevalent than anticipated – 83% had moderate or severe corrosion

• Many owners were not aware they had corrosion – sample was biased, but less than 25% initially believed they had corrosion

• No statistically significant predictive factors
Corrosion Prevalence in 42 USTs

Note: EPA asked for sites with corrosion, so sample is biased. But less than 25 percent of the sample population was aware of corrosion before investigation.

Red = steel  Brown = Fiberglass  (Total Population = 24 fiberglass, 18 steel)
Observed Corrosion Examples

STP Shafts
Drop Tubes
Tank Walls
Ball float cages
ATG floats/shafts
Potential **Risks** to the Environment – Exposed Metals in the Vapor Space

- Release prevention equipment could corrode and fail to function
  - Corrosion on *flapper valves* could restrict movement and allow an overfill
  - *Product level floats* get stuck on corroded shafts and fail to signal a rising product level, fuel release, or water infiltration
  - *Ball float valves* – ball or cage may corrode
  - *Line leak detectors* could be failing performance testing at higher rates
Potential **Risks** to the Environment (continued)– Bottoms of Tanks

- Metal components could potentially corrode through and possibly release fuel to environment
  - Diesel prone to collect water and sludge in bottom of tanks
  - Study results prompted conversations – heard handful of anecdotes of **bottom repairs** of primary walls of double-wall steel tank bottoms after leak to interstitial - sometimes a lack of leak detection alarms but fluid in interstitial space prompted further inspection
Takeaways

• **Microbiologically influenced corrosion (MIC) likely largely responsible** for the corrosion.

• **Eliminating water** is recognized as a key factor in preventing this corrosion.

• Unsure about **Emergency Generator Tanks** and **Aboveground Storage Tanks** – probably similar corrosion

• Several **resources** available from:
  – Coordinating Research Council, Steel Tank Institute, Clean Diesel Fuel Alliance, ASTM, Marathon, and others. Information will be available on OUST website when report released.
From ASTM D975:

- **X6 | MICROBIAL CONTAMINATION**
- **X6.1** Uncontrolled microbial contamination in fuel systems can cause or contribute to a variety of problems, including increased corrosivity and decreased stability, filterability, and caloric value. Microbial processes in fuel systems can also cause or contribute to system damage.
- **X6.2** Because the microbes contributing to the problems listed in **X6.1** are not necessarily present in the fuel itself, *no microbial quality criterion for fuels is recommended*. However, it is important that personnel responsible for fuel quality understand how uncontrolled microbial contamination can affect fuel quality.
- **X6.3** Guide [D6469](#) provides personnel with limited microbiological background an understanding of the symptoms, occurrences, and consequences of microbial contamination. Guide [D6469](#) also suggests means for detecting and controlling microbial contamination in fuels and fuel systems. Good housekeeping, especially *keeping fuel dry, is critical*. 
Next Steps

• Report to be released around June 2016

• Additional communication materials from EPA to highlight findings and actions owners can take

• Stakeholders continue to work on the issue
  – Possible future research
  – Prevention and treatment approaches across industry
  – Information sharing and gathering on corrosion and risks to equipment
Additional Information

• OUST Website
  https://www.epa.gov/ust

• OUST Emerging Fuels Contact
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