BioFuels Compatibility Issues?

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Louisville, KY
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Outline

• Alternative or BioFuels – What’s out there?
• What compatibility issues exist?
  • Potential?
  • Actual?
  • Recommendations & Resources
• Examples of Findings
  • Pictures of Fittings
  • Videos Inside Tanks
• Recommended Actions
Types of BioFuels
Tier 3 Gasoline (ULSG)

- EPA requirement beginning in 2017
- Gasoline meets 10 ppm sulfur (average)
- Tracked at refinery (credits, averaging, banking)
- Goal: Reduce sulfur & NOx emissions
Must verify compatibility for >E10 and >B20 fuels.

<table>
<thead>
<tr>
<th>Area</th>
<th>1988 Requirement And Citation</th>
<th>Significant Changes To Requirements, Implementation,¹ And Preamble Location</th>
<th>Additional Information About The Change</th>
</tr>
</thead>
</table>
| Compatibility | Owners and operators must use UST systems made of or lined with materials that are compatible with the substance stored in the UST system. Two codes of practice are referenced in a note. \[§ 280.32\] | ▪ EPA adds a requirement that owners and operators notify the implementing agency at least 30 days prior to switching to a regulated substance containing greater than 10 percent ethanol, greater than 20 percent biodiesel, or any other regulated substance the implementing agency identifies and meet one of the following:  
  o Demonstrate compatibility through a listing by a nationally recognized independent testing laboratory or through equipment or component manufacturer approval;  
  o Or use another method determined by the implementing agency to be no less protective of human health and the environment than the compatibility demonstration methods listed above  
  ▪ EPA adds a requirement to maintain records to demonstrate compliance with 280.32 for as long as the UST system is storing regulated substances containing greater than 10 percent ethanol, greater than 20 percent biodiesel, or any other regulated substance the implementing agency identifies.  
  ▪ EPA removes references to one code of practice.  
  ▪ EPA revises definitions of motor fuel and regulated substance.  
  **Implementation:** immediately                                                                                                                                                                                                 | The 1988 UST regulation required UST systems to be compatible with the substance stored in them. This change does not alter that, but rather helps owners demonstrate their UST system is compatible with certain fuels before storing them. As newer fuels with different chemical properties enter the market place, it is even more important for owners and operators to clearly understand how to demonstrate that their UST systems are compatible with these fuels before storing them to ensure there are no releases to the environment due to stored fuels being incompatible with UST systems.                                                                                                                                                                                                 |

¹ Significant changes to requirements and implementation, and changes to the preamble are indicated by italicized text.
• Certain materials commonly used with gasoline may be incompatible with mid- and high-level alcohol blends.
• Ethanol blends may impact metallic and elastomer materials in fueling systems.
• E85 acts like a cleaning agent and will initially mobilize sludge in storage tanks. E85 can also cause corrosion of some soft metals…
• Blends below E25 do not cause corrosion of metals (unless accompanied by a separate aqueous phase).
• Can combine with water and form “phase-separation” with high alcohol content that sinks to bottom of tank.

May cause cleaning of tank and temporary increased filter changes (>B20)

B100 gels at higher temperature so may need heaters.

B100 is not compatible with some hoses and gaskets.

B100 is not compatible with some metals and plastics.

ASTM D975, allows for up to 5 vol% biodiesel to be blended into compliant diesel fuels.

• Checklist for B20 Installation
• Notify AHJ
• Verify equipment compatibility
• Proper labels (dispenser & fill)
• Clean tank of all water and sediment
• Ensure all fittings are tight
• Conduct precision test after 7 days
• Maintenance: Check for water regularly
BioDiesel Board – Materials Compatibility

- B100 may degrade some hoses, gaskets, elastomers, glues, and plastics with prolonged exposure.
- Rubber/nitrile & Tygon vulnerable
- Teflon, Viton, and Nylon have very little reaction
- Most tanks materials o.k.
- Brass, bronze, copper, lead, tin, and zinc may have problems
- B20 has smaller effects
- Many compatibility studies done

• Steel: If precautions are undertaken to keep water out of tanks, and stress corrosion cracking is not a factor, then the corrosion potential is minimized and E15 offers no added risk to metal corrosion than E10.

• Fiberglass: The pre-1990 resin was severely damaged from exposure to CE25a, along with one of the post-1990 resins. The remaining post-1990 resin and the advanced resin type both remained intact after exposure to CE25a.

• The technology and materials used in the manufacture of FRP tanks also applies to underground FRP piping systems as well. Therefore the compatibility of FRP piping systems should be the same or similar to FRP underground storage tanks.

• In general, the materials used in existing UST infrastructures would not be expected to exhibit compatibility concerns when moving from E10 to E15.

Elastomer Results: Some level of swelling (or volume expansion) upon exposure to fuels is expected for elastomeric materials, and this swelling serves to provide a tight seal to prevent leakage.

Plastic Results: The plastics that exhibited the lowest volume swelling (and smallest change in hardness) in the test fuels were the permeation barrier materials: PPS, PET, PVDF, and PTFE.

Plastic Results: Four fiberglass resins were tested and all were found to be sensitive to alcohol blends.

Metal Results: Very little corrosion was noted for the metallic specimens exposed to any of the test fuels.

Miscibility with water is limited.
2016 version no longer mentions concern about fiberglass UST’s.

Compatibility of UST Systems with Biofuels
June 2013

standard. In some regions of the country, mounting evidence from failures and field observations also suggest there may be some impacts to fiberglass USTs. Thus, even with E10, there is a real possibility that many equipment failures may be associated with equipment incompatibility but are not investigated sufficiently to be recognized or reported as such.
ASTSWMO – Aging Tanks

ASTSWMO – Corrosion Observations

- http://astswmo.org/astswmo-corrosion-observations-tool/

ASTSWMO Corrosion Observations Tool
So What Could Possibly Go Wrong?

Is Your Fuel Attacking Your Tank System?
Possible Issues

- Corrosion of Metallic Components
  - Often when water intrusion and/or microbial growth present
  - Tank Fittings
  - Overfill Equipment
  - Leak Detection Equipment
  - Dispenser meters, filters, fittings, etc.
  - Tanks & Piping?
  - Biodiesel may exacerbate issues?

- Degradation of Plastics and Elastomers
  - Often dependent on age and rating of equipment
  - Gaskets, O-rings, sealants, etc.
  - Some “soft” metals
  - Tanks & Piping?

- Accelerated Corrosion in Sumps (Ethanol)
- Future Fuels - ???
Failed Overfill Protection - ULSD

Failed Overfill Protection - ULSD

Heavily corroded.
Broken spring.
Stuck float.
Failed Overfill Protection in ULSD

Corroded ball float in tank with ULSD

Regular gasoline tank at same site
Corrosion more likely in Diesel tanks.
Same Site, Different Reactions

E10 Gasoline
• Blisters and flaking.
• Minimal corrosion on ball float.

Diesel (ULSD)
• Smooth/glossy fiberglass.
• Heavy corrosion on ball float.
BAD FUEL = CORROSION PROBLEMS
Patrick Eakins - Dixon Pumps CFE

One of the constants in the petroleum equipment industry is that corrosion problems are increasing, not decreasing. When I talk with tank owners, they think that corrosion is a result of moisture. Although that is a contributing factor, the real culprit is microbial contamination.

All fuel has some level of contamination. If left unchecked and unmanaged, the fuel will continue to degrade at an alarming rate due to the contaminants in the fuel. Microbial-influenced corrosion or MIC results in damage of varying degrees. As microbes reproduce in the fuel, their waste by-products continue to disperse throughout the fuel system. The waste is often acidic. Acidic sludge and slime will accumulate at the bottom of the tank. This acidic layer, its dispersants, and off-gassing vapor cause damage.
STP's
STP Parts – Functional Elements
Line Leak Detection
ATG’s
Tank Fittings & Risers
ULSD Corrosion
STP in ULSD - Corrosion

Top Section

Bottom Section & Motor
DWF Pipe – Dripping from secondary piping
Widespread Blisters in FRP (E10)
Corrosion in Steel Tank (ULSD)
FRP Blistering & Flaking (E10)
Technician poured a small amount of water into interstitial monitoring pipe for troubleshooting purposes.
Technician poured water into interstitial space to confirm crack in tank wall.
DW Steel – Leaking Interstitial - ULSD
Steel Tank – Diesel

Sludge but no water observed.
Deflection/Wrinkles/Ingress in FRP Tank

Premium(E10) Tank
Interstitial Leak – Diesel DW Steel
Steel Tank. “Slime” on STP. E85
Corrosion in ULSD Steel Tank
Blistering and Flaking (E10)
Corrosion in E10 Steel Tank
Leak in SW Fiberglass Tank
Corrosion in Steel Tank
Failed Tank Lining (E10)
Crack - DW Fiberglass Tank
Sludge and Slime

Maybe growing a new fuel source in the tank?
Sludge and Debris
Tank Cleaning – FRP Tank with ULSD
Water Ingress – SW Fiberglass Tank
Water Ingress – Steel Tank
Fuel Delivery into Empty Tank
New DW FRP Tanks

Corrosion on STP Shaft from “Dirty” Ballast Water
Recommended Actions

- Inspect for signs of degradation
  - Risers, filters, caps, gaskets, overfill equipment
  - Internal inspections for “at risk” equipment
- Keep water and microbes out of tanks
  - Check caps/gaskets and spill bucket drains.
  - Stick for water. ATG may not detect all water.
  - Checks or sweep along tank bottom.
  - Remove water and clean tanks if needed.
  - Treat with biocide as needed.
- Ensure compatibility
  - Tanks, piping, pumps, sumps, dispensers, hanging hardware, gaskets, filters, thread sealant, spill, overfill & leak detection systems.
  - Get accurate age equipment
  - Check resources or approval letters
  - Make proper notifications when changing to >E10 or >B20
RP900: Recommended Practices for the Inspection and Maintenance of UST Systems
Water Management in Storage Systems

- Water Management more important than before
  - Gasoline is now ethanol-blended (E10, E15?)
  - Diesel is now ULSD and likely has some biodiesel
- Water can enter UST’s in a number of ways
  - Holes/cracks/fittings/caps/gaskets
  - Delivered with load of fuel
  - Ballast water
  - Condensation
- Water Detection is challenging
  - ATG’s might not be good enough
- Water Removal is challenging
  - Might need to search along entire tank bottom
Water in UST’s Storing E10 Gasoline

• Water Issues with E10 Gasoline
  • Can normally absorb about 0.5%
  • Can cause “Phase Separation” in greater amounts

• Indications of water in E10 Gasoline
  • Water finding paste on gauge stick
  • ATG probe indicates water or density increase
  • Water block filters clogged
  • Hazy/cloudy fuel
  • Stalled vehicles or equipment failures

• Strategies
  • Prevent water entry
  • Detect water (filters, stick with paste, upgrade ATG)
Water in UST’s Storing Diesel Fuel

- Water Issues with Diesel
  - Can cause increased microbial growth
  - Can cause corrosion of UST components

- Indications of water Diesel
  - Water finding paste on gauge stick
  - ATG probe indicates water or density increase
  - Water block filters clogged
  - Hazy/cloudy fuel
  - Corrosion or failure of metallic components

- Strategies
  - Prevent water entry
  - Detect water (filters, stick with paste, upgrade ATG)
  - Manage Water Bottoms (sample & test)
  - Use Biocide and Have Tanks Cleaned (if microbial growth)
Sticking Tanks For Water

- Must use Water Finding Paste compatible with *ethanol fuels*.
- Follow directions carefully. Time in tank and color change vary.
How to Sample Fuel

- Bacon Bomb Sampler
- Vacuum Jar Sampler
Where to Take Samples

- Search for a “representative” sample
- Fill Pipe – worst location to check – usually clean
- ATG probe – better
- STP – best – if accessible
- Drag vacuum jar sampler tubing along bottom of tank
Water in Bottom of ULSD Tank

Even small puddles across bottom of tank can host microbes.
Water in Bottom of ULSD
Steel Tank with ULSD & NO water

No Water

-------
No Problems
Upgraded ATG Probes & Float Kits

- Many manufacturers offer probes to provide better detection of water than standard probe.
- Options for “Phase Separation” or “Density”
Other Strategies (not in RP900)

- Internal Inspections
- Options:
  - Manned Entry
  - Removal and inspection of components (STP, Ball Floats, Filters, etc.)
  - Remote Video Inspection

(That’s pretty much what the first part of this presentation was all about!)
Other Strategies (not in RP900)

- **Nitrogen Blanketing System**
  - Eliminates moisture and oxygen
  - Commonly used in bulk storage
  - Vaporless Manufacturing markets product for UST’s and other tanks systems up to 50K gals.
Other Strategies (not in RP900)

• Tank Vent Desiccant System
• Eliminates Moisture from ullage space
• Donaldson Company (and others)
**Preventive Maintenance Guide for Diesel Storage and Dispensing Systems**

This guide provides practical tips for maintaining underground storage tanks (USTs), minimizing fuel contamination and maximizing fuel system cleanliness necessary for diesel equipment. Adopting these guidelines can help improve fuel quality, prolong equipment life, reduce corrosion and owner’s operating expenses. All suggestions below should be performed in a safe, legal and environmentally sensitive manner.

**Good water management eliminates most fuel quality problems:**

Keep water from entering tanks to minimize tank water bottoms:

- Remove standing water, ice and/or snow around tank fill covers.
- Make sure all tank opening bungs and caps are tight – inspect and replace any broken gaskets.
- Keep fill and vapor recovery buckets clean – pump out any water, clean out excess fuel and dirt (don’t depress drain plungers allowing contamination into the tank).
- Verify tank vents are installed and caps are sealing properly – replace cap or repair as needed.
- Avoid prolonged periods of low tank volume to minimize tank water from condensation.

No detectable water is desirable and if found should be removed as soon as possible. Test removed water for microbes. If detected, take appropriate corrective action. If biocide is used, expect more frequent filter changes for a brief period.

**Methods of detecting contaminants/water**

Tank gauging—physically stick tank bottoms with water finding paste weekly and compare to automatic tank gauge electronic measurements (if available).

- The following will affect the water level measurements: Striker plate below gauging equipment, drop tube tank protection devices, sloping tank, and correct use of water finding paste.
**Examples of microbial contaminated samples and corroded fuel system parts:**

- F1 - ATG Floats w/Corrosion Products
- F2 - Diesel Tank Bottom Sample w/ Microbes
- F3 - Corroded Dispenser Filter

## Evidence of contaminants and/or water:

<table>
<thead>
<tr>
<th>Dispenser filters</th>
<th>Other indicators</th>
</tr>
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<tbody>
<tr>
<td>• Clogging/frequent replacements</td>
<td>• Meter failure</td>
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<tr>
<td>• Slow flow, especially after new receipts—indicates possible contamination</td>
<td>• Automatic Tank Gauge (ATG) water warnings/alarms</td>
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<tr>
<td>(should be &gt;5 gallons per minute)</td>
<td>• Automatic nozzle shutoff failures</td>
</tr>
<tr>
<td>• Observed rust, microbial slime or other contamination</td>
<td>• Customer complaints</td>
</tr>
<tr>
<td></td>
<td>• Check valves not seating</td>
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</tbody>
</table>

- ✓ Check for tank water bottoms before and after fuel deliveries.
- ✓ Evaluate the use of corrosion inhibitors and/or biocide to help control problematic systems.
- ✓ Consider use of water-sensing filters for diesel retail dispensers to help indicate water presence.
- ✓ Carefully take weekly dispenser nozzle samples in a clear jar. Fuel should be clear & bright without haze or particulates.
- ✓ Unless needed as retains, carefully dispose of samples in an approved, environmentally sound manner.
Underground Storage Tank Compatibility with Ethanol and Associated Leak Research

Background:

The compatibility of underground storage tanks (USTs) with ethanol is challenged periodically by those hoping to squelch ethanol demand. This document has been created to address these false claims against ethanol and its impact on USTs. This document also includes information on associated lead research.

To dispute these claims we have compiled the following information including a timeline to represent the advancements in introducing higher blends of Ethanol in UST systems:

Determining Compatibility:
EPA – Compatibility With BioFuels

- [https://www.epa.gov/ust/ust-system-compatibility-biofuels](https://www.epa.gov/ust/ust-system-compatibility-biofuels)
**UL Certification Website**

- [http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/index.htm](http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/index.htm)

### Search results

<table>
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<th>Company Name</th>
<th>Category Name</th>
<th>Link to File</th>
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<td>Aboveground Flammable-liquid Tanks</td>
<td>EEEV.MH5086</td>
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<td>Aboveground Flammable-liquid Tanks Certified for Canada</td>
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<td>Oil/Water Separators</td>
<td>EGZ1.MH18131</td>
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Model number information is not published for all product categories. If you require information about a specific model number, please contact [Customer Service](http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/index.htm) for further assistance.
PEI – Compatibility Letters

- https://www.pei.org/ust-component-compatibility-library

UST COMPONENT COMPATIBILITY LIBRARY

On July 5, 2011 EPA published guidance in the Federal Register regarding compatibility of underground storage tank (UST) systems with biofuel blends. The guidance discusses how owners and operators who wish to store gasoline containing more than 10 percent ethanol or diesel containing more than 20 percent biodiesel in their UST systems may demonstrate compliance with the compatibility requirement in 40 CFR 280.32.

COMPLIANCE LETTERS BY MANUFACTURER
Prior NTC Presentations (2015)

Compatible? Can You Prove It?

Biofuels & Infrastructure

National Tank Conference 2015
Kristi Moriarty
September 16, 2015

NYC Fleet

New York City’s B20 Compatibility Program for its Fleet Diesel Fuel Storage Facilities

Presented by:
Dr. Ramona Ledesma-Garrido, Ph.D., PMP
NYC Fleet Senior Project Manager
rgarrido@deas.nyc.gov

Presented at the 25th National Tanks Conference & Exposition held on September 14-16, 2015 in Phoenix, Arizona

2015 National Tanks Conference Compatibility “3rd Option”

Nate Blasing
September 15, 2015

Minnesota Pollution Control Agency
Summary of Tips for Maintaining Tanks

1. Store products that are compatible with materials.
2. Maintain and monitor leak detection and C.P. systems.
3. Inspect and verify overfill and spill prevention.
4. Cycle product through tank regularly (or keep tanks full).
5. Keep out water, sediment, debris, sludge, microbes.
7. Check equipment for signs of corrosion or degradation.
8. Internal inspections for “at-risk” tanks or planning purposes.
9. Use tank cleaning and biocides if/when necessary.
10. Consider other options for extreme cases.
11. Make proper confirmation of compatibility and notification if switching to >E10 or >B20 blends.
Any Questions?

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