RENEWABLE FUELS ASSOCIATION

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:

For many decades, underground storage tank (UST) manufacturers have approved their tanks for blends up to 100% ethanol (E100). For example, all steel tanks and double-walled fiberglass tanks have been approved for up to E100 since 1990. For those tanks with lower ethanol blend certifications, the U.S. Environmental Protection Agency's (EPA's) Office of Underground Storage Tanks (OUST) issued Guidance in 2001: Compatibility of UST Systems with Biofuels Blends, to enable alternative compliance with federal code as UST systems are typically in use for decades. This guidance allowed tank manufacturers to issue letters stating the compatibility of their tanks with specific ethanol blends. ALL existing tank manufacturers have issued such letters, and the majority of installed tanks are compatible with ethanol up to 15% (E15). Additionally, ALL existing pipe manufacturers have Underwriters Laboratories (UL) listing for E100. (1)

Scientific Research:

The U.S. Department of Energy's National Renewable Energy Laboratory (NREL) conducted a literature review of the past 15 years to determine if there were any negative impacts during the multi-year deployment of 10% ethanol (E10) nationwide. The review concluded that there were no incidents of E10 causing releases (also referred to as leaks) from UST. None of the reviewed literature noted any association between E10 and any specific UST release whatsoever. The EPA OUST's Performance Measures' data on UST releases was also reviewed, and as E10 was deployed nationwide, the trend was in fact fewer UST releases. Anecdotal input solicited from infrastructure industry experts said that they knew of no published reports of releases caused by E10 (1)

State Efforts:

The Indiana Department of Environmental Management (IDEM) chose to adopt a rule to address any potential issues with UST systems and compatibility of those products stored in them.

IDEM's Administrative Rule 329 IAC 9-3.1-3 requires UST systems to be compatible with the product stored. Further, Administrative Rule 329 IAC 9-2-1 places certain requirements on UST systems, which include ethanol standards. (3)

History of Fiberglass Equipment:

- Due to a requirement of EPA for alcohol storage, all double-wall fiberglass tanks and piping have been manufactured for storage of E100 since 1988 for piping and 1990 for tanks. (2)
- In 1988, UL began listing underground fiberglass piping for E100. It was determined that the fiberglass components used in pre-1981 tanks and pre-1988 piping were essentially the same as those subjected to UL compatibility testing and there was no technical reason to believe that the older USTs were not E-10 compatible.
- By 1990, Fiberglass tank manufacturers had modified their tanks constructions to handle gasoline with any level of ethanol up to 100% for all double-wall fiberglass tanks and in some cases single-wall fiberglass tanks. (2)
- In 1992, Owens Corning, the manufacturer of the oldest UL Listed fiberglass tanks for petroleum service, advised certain major oil companies that some tanks were approaching 30 years in age and their 30-year warranties would expire. As a result, the affected companies conducted surveys of these older tanks, including tanks with E10 (e.g., in the Midwest) and confirmed that the tanks were performing satisfactorily for continued service. In summary, technical evaluations and historical experience demonstrated that there is no material or technical reason why properly installed pre-1988 piping and tanks in conventional gasoline, or MTBE service, should not perform equally as well when handling E10. (2)

Timeline on Regulation for Two Top Manufacturers of Fiberglass Underground Storage Tanks

Containment Solutions

>1981	1981-1984	1984-1990	1990-1995	Since Jan 1995
Prior to Feb. 1981: No single or double wall tanks are warrantied for any alcohol or alcohol blended fuels	Jan. 1981 to June 1984: Single and double wall tanks are warranted for ethanol blends up to 10%.	July 1984 to June 1990: Single and double wall tanks are warranted for ethanol blends up to 10% and methanol blends up to 4.75%.	July 1990 to Jan. 1995: Double wall tanks only are warranted for all concentrations of ethanol or methanol.	After Jan. 1995: Both single and double wall tanks are warranted for all concentrations of ethanol or methanol.

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>1981	1981-1985	1985-1988	1988-2005	Since July 2005
Prior to Feb. 1981: No single or double wall tanks are warranted for any alcohol or alcohol blended fuels.	Feb. 1981 to July 14, 1985: Single wall tanks are warranted for ethanol blends up to 10%. No mention of double wall tanks.	July 15, 1985 to June 1988: Single and double wall tanks are warranted for ethanol blends up to 10% and methanol blends up to 4.75%.	June 1988 to July 2005: Double wall tanks only are warranted for all concentrations of ethanol. Single wall tanks only warranted for ethanol blends up to 10% unless premium resin used and documented	After July 2005: Both single and double wall tanks are warranted for all concentrations of ethanol or methanol.

Outside Factors Associated with UST Failures:

- Published studies available on this subject all have concluded that components other than the tank itself – i.e., piping, joints, connectors, gaskets, dispensers, etc. – are the source of most UST leaks.1, 2 Those desiring to learn more about how to properly investigate and document the source and cause of a release may refer to ASTM E2733-10(2015), "Standard Guide for Investigation of Equipment Problems and Releases for Petroleum Underground Storage Tank Systems." (5)
- Over the past two decades, many new fuel formulations have entered the marketplace. Increased corrosion on the inside of tanks, and other UST components not required by law to have corrosion protection, has become extremely common. Corrosion has been commonly reported in USTs storing diesel fuel, and ethanol-blended fuels. Anecdotes suggest when storing diesel fuel, corrosion generally appears on metal components inside USTs. The best way to minimize the risk of corrosion is to regularly monitor the diesel UST system for water in the tank and remove it. Monitoring for water and keeping it to a minimum is standard industry practice and part of a critical regular maintenance routine. Maintaining water presence as close to zero as possible is the best way to minimize the chance of corrosion and risks to functional failure of the tank or equipment due to corrosion. When storing ethanol blended fuels, corrosion generally appears in sumps rather than the tanks. Instances of this corrosion began appearing about a decade ago. External corrosion is commonly found coating metal components in the submersible turbine pump spaces, also called sumps, of USTs storing gasoline blended with ethanol. This type of corrosion can be caused by bacteria through a process called microbiologically-influenced corrosion and may impact the serviceability or functionality of equipment in the sumps. New technology is currently being tested to eliminate this corrosion issue in all USTs. (4)
- In states where private insurance is the dominant financial responsibility mechanism, insurance underwriting criteria – which include profitability and risk considerations – may become a trigger for removal or replacement of high-risk UST systems. Specifically, increased premiums or cancellation notices may trigger UST closure or replacement. These States have observed the following factors as significant in insurers' underwriting decisions:

    - Installation dates
    - Tank and piping construction
    - Retro dates
    - Presence of historical contamination
    - Bulk rating and credits when more than one tank or site is underwritten (5)

Nationally recognized environmental engineering firm EMS published a finding based on historical files from over 300 leaking underground storage tanks (LUST) and determined the top 10 causes of leaks to be:

1. Steel product lines and fittings
2. Tank overfills

3. Leaks from dispensers
4. Steel tanks – of note these leaks were for tanks built prior to 1980 when tanks were constructed predominantly of steel. Newer tanks employ cathodic protection systems to prevent oxidation
5. STP sumps
6. Fuel delivery errors
7. Leaking overfill and dispenser protection devices
8. Leaking fiberglass product lines and tanks - Most leaks occur due to incorrectly constructed fittings or due to improper installation which allowed the fiberglass to flex and crack
9. Customer errors
10. Other leak causes - Other causes include inadvertent instances such as drilling through tanks or lines during construction or environmental investigations and errors made during maintenance. (6)

In May 2012, the U.S. Department of Energy's Oak Ridge National Laboratory (ORNL), published study results on dispensing material compatibility with ethanol-blended fuels, including E85. The test fuels included highly aromatic gasolines, and aggressive fuel-grade ethanol, which contain water, sodium chloride, acetic and sulfuric acids. These test fuels are much more aggressive than fuels actually found in the marketplace. Terephthalic polyester and novolac vinyl ester resin (fiberglass tank and piping materials) remained intact after testing with all test fuels.

Conclusion:

After detailed review of available published information concerning historical UST failures, there is no link to one common source, and the vast majority of documented issues point to factors completely independent of ethanol itself. These can include equipment installation, transportation of fuel, external intrusion from water, tank related components, retrofit equipment and human error – none of fault to ethanol itself.

For more information on this topic, please contact Cassie Mullen, RFA Director of Market Development, at cmullen@ethanolrfa.org.

Additional Resources:

- Petroleum Equipment Institute - www.pei.org
- Steel Tank Institute – www.steeltank.com
- Federal Facilities Environmental Stewardship and Compliance Assistance Center – www.fedcenter.gov

Cited Sources:

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4. Environmental Protection Agency “Emerging fuels and underground storage tanks” https://www.epa.gov/ust/emerging-fuels-and-underground-storage-tanks-usts
5. ASTSWMO - The Association of State and Territorial Solid Waste Management Officials, Inc. “Aging tank report” http://www.astswmo.org/files/policies/Tanks/2015-10-ASTSWMOAgingTanks%20Report-Final.pdf
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7. Oak Ridge National Laboratory “Analysis of Underground Storage Tank System Materials to Increased Leak Potential Associated with E15 Fuel” https://info.ornl.gov/sites/publications/Files/Pub36356.pdf