

Fire Protection and Ethanol

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Overview

- What is ethanol?
 - Ethanol/gasoline fuel blends
- Fire incidents
- Potential fire fighting hazards
 - Traditional foam use questioned
- United States Ethanol Emergency Response Coalition (EERC)
 - Fire tests 2007
- Other issues
- Closing and questions

Renewable Fuels Emerge

- Energy Policy Act of 2005
 - Legislation established targets for renewable fuels
- Renewable fuel – motor vehicle fuel produced from plant or animal products or wastes
 - Biodiesel and ethanol
 - 2008 – ethanol industry produced 9 billion gallons blended into over 70% of nation's gasoline supply

Ethanol and Gasoline Fuel Blends

- Ethanol
 - Also known as ethyl alcohol, grain alcohol
- Denatured ethanol – E95: blend of 95% ethanol with 5% unleaded gasoline
 - Bulk transport by rail cars, tank trucks, barges
- Two blends used as motor vehicle fuel
 - E10: blend of 10% ethanol with 90% unleaded gasoline
 - E85: blend of 85% ethanol with 15% unleaded gasoline

Ethanol and Gasoline Fuel Blend Properties

Property	Comment
Vapor density	Heavier than air, ethanol vapor disperses rapidly
Solubility in water	Fuel ethanol mixes with water, at higher concentrations separates
Toxicity	Less toxic than gasoline or methanol; no carcinogens in pure ethanol, gasoline blend carcinogenic due to benzene

Fire Hazard Properties

Property	Comment
Flash Point	Gasoline = -45° F Ethanol = 55° F E 85 = -20° to -4° F
Flammable Limits	Ethanol LEL = 3.3% UEL = 19% E 85 LEL = 1.4% UEL = 19% Gasoline LEL = 1.4% UEL = 7.6% Wider range than gasoline

DOT Alert – Responding to Incidents Involving Ethanol and Gasoline Fuel Mixtures (April 2006)

- PHMSA recommends use of alcohol-resistant foam
- Recommends first responders use *Guide 127 – Flammable Liquids Polar/Water-Miscible* from Emergency Response Guidebook
 - Incidents involving E85 and other fuel mixtures containing more than 10% alcohol
 - <http://hazmat.dot.gov/pubs/erg/g127.pdf>

Fire Incidents

- Since 2000 – at least 26 major fires involving polar solvents
 - 14 at ethanol plants
 - 3 ethanol tankers
 - 6 train derailments, 5 with fires
 - Australia, Maryland, Pennsylvania, New Jersey, Texas



US Ethanol Emergency Response Coalition

- Coalition formed to look at emergency response issues associated with bulk distribution and storage of ethanol-blended fuels
- Members
 - Tyco/Ansul Fire Protection
 - International Liquid Terminals Association
 - Industrial Fire World
 - International Association of Fire Chiefs
 - Renewable Fuels Association

Fire Tests – Overview

- Tests on ethanol and ethanol/gasoline blend conducted in February 2007
 - E10 (gasohol) and E95 (denatured ethanol)
- Test protocol based upon UL 162, *Standard for Safety, Foam Equipment and Liquid Concentrates*
- 43 individual tests conducted on E10 and E95
- Foam formulations generally at 3% concentration

Fire Tests - Protocol

- UL 162 requires following test series:
 - Type II – involves application against a vertical surface producing more gentle delivery to the fuel surface; applicable for polar/miscible fuels such as ethanol
 - Type III – involves surface application and generally application for hydrocarbon fuels
 - Sprinkler test includes testing of air-aspirated and non air-aspirated sprinkler devices similar to system installation at loading racks
 - Tests also include burn-back resistance

Fire Tests – Extinguishing Agents

- Alcohol-resistant, aqueous film-forming foam (AR-AFFF)
- Traditional aqueous film-forming foam (AFFF)
- Class-A foam intended for fire involving ordinary combustible, or Class A materials
- An emulsifier
- Conventional fluoroprotein foam
- Alcohol-resistant film-forming fluoroprotein (AR-FFFP) foam

Fire Tests – E95 Summary of Results

- Only alcohol resistant products (AR-AFFF & AR-FFFP) successful with top side fire tests
 - The AR-FFFP required a higher application rate to extinguish the fire
- Only AR-AFFF successful in burn back resistance tests
- Only the AR-AFFF successful in sprinkler tests with non-aspirating sprinkler heads
 - Each manufacturer's UL Listing will have to be referenced relative to the proper application rate for a sprinkler system.

Fire Tests – E10 Summary of Results

- Only AR-AFFF and regular AFFF successful in Type III fire tests at UL test rate
 - AR-AFFF required increased application rate to pass burn back
 - Regular AFFF unable to pass the burn back even at an application rate equal to NFPA minimum for spill fires
- AR-AFFF successful in sprinkler testing using non-aspirating sprinkler heads
- Regular fluoroprotein foam successful in sprinkler testing using air-aspirating sprinkler heads

Potential E-Blend Fuel Issues

- Phase separation
- Solvency
- Metal corrosion
- Permeation of nonmetals
 - Elastomers and polymers

Other issues

- Material compatibility
- Leak detection – automatic tank gauges with capacitance probes will not work
- Test methods based on detection of water at the tank bottom may be less effective in ethanol blends
- UL listing for fuel dispensing devices suspended
 - Components for fuel dispensing devices for use with alcohol blended fuels containing greater than 15%

Metal Compatibility with E85

Compatible

- Unplated steel
- Stainless steel
- Black iron
- Bronze
- Nickel plate

Non Compatible

- Zinc
- Brass
- Lead (lead alloys)
- Aluminum and certain aluminum alloys
- Terne plate
- Copper

Elastomer/Plastics Compatibility with E85

Compatible

- Teflon
- Nitrile
- Viton
- Polypropylene
- Buna-N
- Neoprene rubber
- Thermo-plastic pipe
- Thermo-set reinforced fiberglass

Non compatible

- Natural rubber
- Cork
- Leather
- Polyurethane
- Some plastics and thermo-set plastics

"The use of vegetable oils for engine fuels may seem insignificant today. But such oils may become in the course of time as important as the petroleum and coal tar products of the present time."

Rudolph Diesel, 1912

Any Questions?

