A Closer Look at ULSD

Mahesh Albuquerque
Director
Background

• Diesel fuel is a combustible liquid used as fuel for diesel engines, ordinarily obtained from fractions of crude oil that are less volatile than the fractions used in gasoline.

• Rudolf Diesel invented the compression ignition engine in the 1890’s.

• Most notable specification change has been the reduction of sulfur and the blending of biodiesel.
Basic Refining Processes

- **Separation** – distillation column, gases rise to top, over gasoline, kerosene, diesel, etc.
- **Upgrading** – hydrotreating, hydrogen and catalyst to remove undesired compounds (e.g., sulfur removal)
- **Conversion** – cracking (thermal or catalytic), breaks high boiling point (large molecules) to lower boiling point (smaller molecules)
- **Blending** - blend available streams to meet all performance, regulatory, economic and inventory requirements
Diesel Specifications

• ASTM D 975 – *Standard Specification for Diesel Fuel Oils*

• Covers seven grades of diesel fuel oil suitable for various types of diesel engines.

• Up to 5% biodiesel (B5) can be blended in diesel without disclosure.
Highway Diesel Rule

• In 2001, EPA’s Highway Diesel Rule was finalized.

• Intended to make heavy-duty trucks and buses run cleaner.

• Required a 97% reduction in the sulfur content of highway diesel fuel from 500 ppm (low sulfur diesel, or LSD) to 15 parts per million (ultra-low sulfur diesel, or ULSD).

• Refiners began producing the cleaner-burning diesel fuel, ULSD, for use in highway vehicles beginning June 1, 2006.
Phase-in of ULSD

- ULSD was phased in for Highway diesel fuel from 2006-2010.

- Low sulfur (500 ppm) and ULSD fuel was phased in for Nonroad, Locomotive, and Marine (NRLM) engines from 2007-2014.

- Since 2014, all diesel (Highway and NRLM) should be ULSD.
Clean Diesel Fuel Alliance

Ultra Low Sulfur Diesel is the primary highway diesel fuel produced.

The full transition to ULSD fuel is complex and involves coordination at many levels. Under the EPA standards:

- Effective June 1, 2006, refiners and importers nationwide are now required to ensure that at least 80 percent of the volume of the highway diesel fuel they produce or import is ULSD-compliant.
- Diesel fuel classified as ULSD is flowing to distribution and marketing points downstream from refineries (i.e., pipelines, distributors, terminals and transporters) and is now available at many retail locations.
- Diesel fuel classified as Low Sulfur Diesel fuel may still be sold at retail locations outside of California until December 1, 2010.
- The State of Alaska received an extension of the highway fuel 15 ppm requirement until 2010.
- Click here for Corrosion in Systems Storing and Dispensing ULSD, Hypotheses Investigation
- Click here for Guidance for Underground Storage Tank Management at ULSD Dispensing Facilities

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Although ULSD fuel is the dominant highway diesel fuel produced, EPA does not require service stations and truck stops to sell ULSD fuel. Therefore, ULSD fuel might not be available at every service station or truck stop. Diesel retailers may choose to sell Low Sulfur Diesel fuel instead of ULSD fuel until December 1, 2010, when only ULSD fuel will be available for highway use. The industries involved in the transition are doing all they can to minimize potential

www.clean-diesel.org
Field Observations Since 2006

• Fuel seeps and leaks around certain gasket fittings in UST systems storing and dispensing ULSD

• Need to replace dispenser fuel filters more frequently due to clogging with particulates or biomass

• Erratic operation or failure of tank and line monitoring equipment due to rust buildup

• An increase in the number of ULSD systems showing internal corrosion

• Minimal external evidence of corrosion
Fuel Instability

• Involves the chemical conversion of precursors to species of higher molecular weight with limited fuel solubility.

• Tend to be nitrogen and sulfur-containing compounds, organic acids and reactive olefins.

• Conversion process often involves oxidation of the precursors.

• Dissolved metals, especially copper, contribute by functioning as oxidation catalysts.
Blending with Biodiesel

- Biodiesel fuels degrade more rapidly than conventional diesel fuel and may lead to increased biological growth during storage.

- Biodiesel is also more susceptible to oxidative degradation than petroleum diesel.

- Contrary to intuition, two fuels that, by themselves, have good stability may form a less stable blend when they are combined.
Noteworthy Properties of ULSD

- Sulfur content reduction
- Lubricity additives
- Oxidation stability
Sulfur Content

• The presence of sulfur in diesel can have an adverse effect on microbial growth.

• As the sulfur content in diesel dropped from 500 ppm to 15ppm, the fuel’s “antibiotic” properties diminish, possibly allowing for more microbial activity.
Detecting presence of microbes
Detecting the Presence of Microbes

No Microbial Growth

Positive Microbial Growth

Photo courtesy of NJ DEP
Sludge from ULSD UST

Photo courtesy of NJ DEP
Lubricity

- Lubricity of diesel fuel decreases as sulfur is removed during the refining process.

- To compensate for this loss, lubricity additives are blended into ULSD to minimize engine wear.

- The net effect is that ULSD fuel may not be compatible with certain non-metallic seals and gaskets.
ULSD Leak in Meter Housing

Photo courtesy of CO OPS
Oxidation Stability

• The natural anti-oxidation properties of diesel fuel also decrease as sulfur is removed during the refining process.

• ULSD, without the natural oxidation inhibitors which are removed by hydrotreating, may form peroxides during long-term storage.

• Biodiesel is also more susceptible to oxidative degradation than petroleum diesel.

• Can result in the buildup of oxidation products, commonly seen as rust or sediment buildup.
Rusted STP Shaft
ULSD STP

Photo courtesy of NJ DEP
ALLD Spring and Piston
Best Management Practices

- Aggressive Water Management – monitor for the presence of water in tanks and remove water bottoms promptly.

- Periodic Inspection and Maintenance – monthly walk-through inspections of dispenser cabinets, spill buckets and sumps.

- Periodic Internal Tank Inspections – remove drop tubes and ATG probes.

Storing ULSD for a Long Time

• Purchase clean, dry fuel from a reputable supplier and keep the stored fuel cool and dry.

• Presence of free water encourages the corrosion of metal storage tanks and provides the medium for microbiological growth.

• Add an appropriate stabilizer that contains an antioxidant, biocide and corrosion inhibitor.

• Regularly test the fuel, and add fresh stabilizer as necessary.
ASTSWMO Publication

- New ASTSWMO Publication – *Compatibility Considerations for UST Systems*
- Online Compatibility Evaluation Tool Kit
- Compatibility Evaluation Checklists
- Field observation summaries and templates for submittal of new information
- Links to helpful resources
Questions?

Mahesh Albuquerque, Director
Colorado Division of Oil and Public Safety
(303) 318-8502
mahesh.albuquerque@state.co.us