

CORROSION CONTROL & SAE J1488_201010 FILTRATION

Diesel **pure**
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What We Will Cover

Timeline: Water in Diesel

Timeline: Corrosion in Diesel

Why Corrosion Now?

Corrosion Control: SAE J1488_201010 Filtration

Three Fuel Tests Under \$100

Suggested Readings



Timeline: Water in Diesel 1

1900 – 2006, few issues with diesel, fuel kept useable with basic housekeeping of cleaning the tank bottom of freestanding water and sludge

2006 – Ultra Low Sulfur Diesel (ULSD) introduced, sulfur ↓ 500 ppm to 15 ppm

Chemistry of the fuel changed: immediately noticed excessive engine wear/failure, fixed with additives and fuel components

Timeline: Water in Diesel 2

InterFacial Tension (IFT) dropped: IFT ability of two fluids to repeal each other

↑ IFT, diesel and water do not mix; water collected on the tank bottoms: 1900-2006

↓ IFT, emulsified water absorbed and bonds with the diesel, 2006+

2010 - SAE J1488 updated to reflect ↓ IFT. Tests filtration efficiency of removing bonded/emulsified water from ULSD and biodiesel blends

Timeline: Corrosion in Diesel

2007 - Corrosion first noticed 2007. Intense study begins.

2012 - Battelle report “Severe and rapid corrosion has been observed in systems storing and dispensing ultra low sulfur diesel (ULSD) since 2007”. “MIC suspected” (Microbial Influenced Corrosion)

2016 - EPA’s final report on corrosion report states **83 percent** of the USTs studied have **moderate to severe corrosion**; since corrosion continues over time, this will reach all severe


Significant indicators of corrosion are entrained (bonded/emulsified) water, and particulate levels in the fuel

Why Corrosion Now?

Water has migrated off the tank bottom into the fuel column as bonded/emulsified water. Microbes have followed,  growth volume, microbes produce acids

Main corrosion factor: **location** of the bonded/emulsified water **in** fuel column

Polar Bonds – additives, fuel components, and water molecules are polar, water becomes bonded/emulsified in the fuel column, difficult to remove

ULSD blends: IFT  absorbs much more bonded/emulsified water into the fuel column

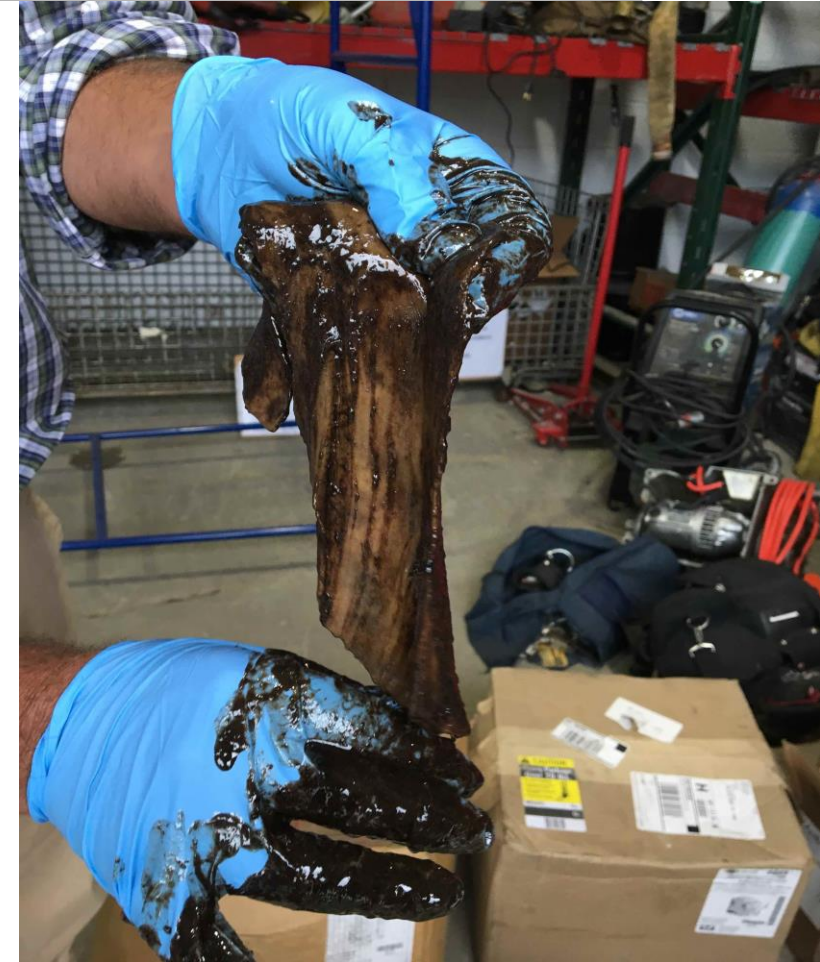
Impact of lower sulfur levels on microbial growth ????????

New - Biofilms

“WOW. Never saw anything like this, check out the last picture. This was the consistency of boiled pig skin. It was lining the bottom of the tank. This is a tank that we could not rinse in situ. Super bugs.” $\frac{1}{4}$ to $\frac{1}{2}$ sludge under the biofilm

Biofilm can cause 3 types of failures:

- 1 – biofilm concentrate corrosion on tank bottoms
- 2 – biofilm could separate, plug pipes
- 3 – biofilm could disintegrate, plug filters



Corrosion Control

SAE J1488_201010 Filtration

“To determine the ability of a fuel/water separator to separate emulsified or finely dispersed water from fuels.”

SAE J1488 updated in 2010 to address lower IFT in ULSD and Blends

SAE J1488_201010 assigns an efficiency rating to a filter for removing bonded/emulsified water in diesel and biodiesel blends at IFT's of 34.5 and 15 mN/m

Bonded/Emulsified Water ↓ 200 ppm Controls Microbial Growth

Corrosion Control

SAE J1488 201010 Filtration

200 ppm also warranty standard for generator manufacturers, a 92% efficiency keeps water ↓ 200 ppm: $2500 \text{ ppm} * (1.00 - .92) = 200 \text{ ppm}$

Methodology: 2500 ppm of bonded/emulsified water is added to the fuel, and then the fuel is filtered

Test 1: IFT 35, filter pure diesel, no additives or fuel components. Every filter should be able to remove 100% of the bonded/emulsified water

Test 2: IFT of 15. Emulsified water now bonded to the additives and fuel components. Harder to remove.

Bonded/Emulsified Water ↓ 200 ppm Controls Microbial Growth

Test Your Fuel, Three Tests Under \$100

Karl Fisher Titration: <200 ppm - tests for all water:
bonded/emulsified and free

ISO 4406 particulate: 18/16/13 - includes microbial growth

Total Acid Number (TAN): ASTM D664 < 0.1

Suggested Readings

EPA (2016) Investigation Of Corrosion-Influencing Factors In Underground Storage Tanks With Diesel Service

Uptime Article (2017) “Reconsider Your Diesel Fuel Supply”

NFPA110 (2016) replace fuel regularly: yearly ?

The British Standards Institution BS 5410-3 (2016) only use SAE J1488_201010 Filtration for Critical Emergency Backup Generators

Battelle Report (2012) Corrosion in Systems Storing and Dispensing Ultra Low Sulfur Diesel (ULSD)

Moisture Absorption In Biodiesel And Its Petro-Diesel Blends (2007)

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First to Filter Bonded/Emulsified Water < 200 ppm

Per SAE J1488_201010: 96.3% Efficiency, 2011

Leader Worldwide in Filtering Bonded/Emulsified Water

Articles - Uptime Institute, BioFuels Digest

Lecture at McGill University - Advanced BioFuels Course

Focus – Emergency Backup Systems That Cannot Fail

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