



in a world of specialty chemicals

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Extending Equipment Life through Good Housekeeping

How Important is Good Housekeeping?

- ⇒ Fuel quality significantly impacts operations and profitability
- ⇒ Existing fuel specifications do not address a number of potential problems
 - Current standards may be insufficient to ensure trouble free operations
- ⇒ Associated changes with ULSD have further impacted tank maintenance practices
- ⇒ Addressing contaminants and housekeeping has become more critical than ever before

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Fuel Quality Management Issues

- Fuel Quality Management Concerns
 - Contaminants
 - Water
 - Entrained
 - Free
 - Particulates
 - Surfactants
 - Peroxides
 - Microbial Contamination
 - Problem Prevention
 - Tank Maintenance Practices (Housekeeping)

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Refining & Distribution

- **Refining**
 - Legislation
 - Refinery Processes
 - Feed stocks and imports
 - Fuel Blending Components

- **Distribution**
 - “Fungible Fuels”
 - Limited Storage Capacity
 - Market Forces
 - Product Diversity

Most Fuel is consumed within 30 days of Refining

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How Contaminants Enter the System

- ⇒ **Vents allow air, water & dust to enter during tank 'breathing'**
 - Condensation
- ⇒ **Cross contamination between systems**
 - Manifolds
 - From fuel delivery
- ⇒ **Leakage through fill cap AST/UST**
- ⇒ **Unsealed sounding ports and man-ways**
- ⇒ **Floating roof leaks**
- ⇒ **Ballast/Seepage water**
- ⇒ **Transfer piping: fixed & portable**
- ⇒ **Leakage into underground tanks**

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Entrained Water

- ⇒ Not to be confused with dissolved water
- ⇒ Many fuels have shown the ability to absorb and hold large quantities of water
 - Resulting in fuel/water emulsions
 - Reduced effectiveness of fuel/water separators
- ⇒ Typical problems caused by entrained water
 - Rapid fuel filter plugging
 - Increased microbial activity
 - Rust, etc.
 - Rapid increase in water bottoms
- ⇒ Surfactants can exacerbate the problem

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ICE

⇒ *Symptoms:*

- Plugged Filters
- Plugged Fuel Lines

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Free Water

- ⇒ Accumulates at the bottom of the storage tank resulting in a fuel/water interface
- ⇒ Primary causes
 - Poor housekeeping
 - Condensation
 - Leakage through fill cap AST/BST
 - Spill containment valve or piping
- ⇒ Water Bottoms Build Up
 - Increases potential for microbial activity, fuel water emulsions, rust, etc.
 - Can be pumped into vehicle tanks
 - Ice crystals form in fuel distribution system when ambient temperatures fall below freezing

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Particulates

- ⇒ Most commonly found bad actors in storage tanks
 - Dirt
 - Rust
 - Sludge, etc.
- ⇒ Diesel can also contribute to particulate formation
 - Oxidization
 - Polymerization
- ⇒ Bacteria waste & Bio-mass
 - Microbes feed on nutrients found in fuel
- ⇒ Economic penalties associated to particulates
 - Remediation of Dirty equipment
 - Fuel tanks
 - Filter plugging
 - Shortened filter life
 - Premature fuel pump wear
 - Fine particulates that pass through fuel system cause premature engine wear, injector spray hole deposits and/or erosion, etc.
- ⇒ “A 50% reduction in particulate will effectively double the life of injection equipment. Reference - particles in the 3 to 10 micron range”

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Surfactants

- ⇒ Reduce the surface tension of the fuel/water interface which promotes fuel/water emulsions
- ⇒ Surface active compounds derived from:
 - Refinery process treatment chemicals
 - Natural materials not removed from crude oil during processing
 - Poorly formulated fuel additives
 - Lube oil blended into the fuel
 - Micro organisms, etc.
- ⇒ Surfactants help entrain water in the fuel
 - Adversely affects the ability of fuel/water separators
- ⇒ Surfactants also disperse dirt, rust and micro organisms throughout the fuel system
- ⇒ Certain surfactants can actually cause fuel filter restriction by giving the fuel an electric charge

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Microbial Contamination

- ⇒ **Most common means by which microbes enter the fuel system is through air drawn into the tank**
 - As the fuel is dispensed and the tank breathing
- ⇒ **Other sources**
 - Ground water encroachment
 - Water in fuel transfer piping or hosing
 - Fuel delivery itself
- ⇒ **Bacteria and fungi reproduce creating biomass**
 - Accumulate wherever water droplets exists
 - As micro organisms die they settle out as sludge
 - As fuel is dispensed to equipment so are the sludge and living micro organisms
 - Pump shear can exacerbate the problem causing emulsification
 - Some bio films are clear and go undetected eventually causing catastrophic engine failure
- ⇒ **Once a microbial bio-mass is detected it is very difficult to completely remove them from tank walls without manual removal**
 - Pick and shovel
- ⇒ **ULSD processing removes natural microbial inhibitors**
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Microbial Contamination

- ⇒ Preventative maintenance
 - Visual inspection
 - Water bottoms detection
 - Water bottoms removal
- ⇒ Test for Microorganisms
- ⇒ Semiannual biocide treatment recommended
- ⇒ Shock treatment for severe infestation

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Preventive Tank Maintenance

- Test diesel fuel for stability characteristics and treat as needed;
 - Oxidative
 - Thermal
 - Peroxide formation
- Eliminate fuel contact with aggressive metals such as zinc, copper & other yellow metals
 - If these metals are present a metal deactivator should be used
- Establish a Fuel Maintenance Program
 - **Check Tanks for Water bottoms- weekly is recommended**
 - *Automatic Monitoring Systems*
 - *Manual – Water Paste*
 - ***Replace Damaged Caps & Seals***
 - ***Routine Biocide & Dri-Tek Treatment Program***
 - ***Periodic Tank Inspection & Cleaning***
 - *Annually*
 - ***Hydrosorb Filters on Dispensers***

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Preventive Tank Maintenance (cont.)

- ⇒ Tanks should be kept as full as possible
 - Half full tanks increase water build up through condensation and can promote corrosion at the top half of the tank
 - More of a problem in hot humid areas or rapid temperature swings
- ⇒ Install a recirculation filtration system
 - Benefits
 - This will help ensure the constant removal of basic sediment and entrained particulate matter
 - Filters should be changed regularly and examined for contents
 - Potential Detriments
 - Added exposure to air and water vapor
- ⇒ Tanks should be emptied, inspected and serviced by an accredited cleaning company at least every 5 years.
 - More often if there is gross contamination
 - Manual cleaning is only way to **completely** remove bacterial and microbial film on tank walls and bottoms.

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Preventive Tank Maintenance (cont.)

- ⇒ Ensure that fuel supplied meets recognized fuel quality standards e.g. maximum 0.05 % BS&W, stability specs, etc.
- ⇒ Add additional parameters that ensure “fit for purpose” including storage conditions
- ⇒ Establish a monthly surveillance testing regimen whereby fuel samples are used to monitor fuel quality
 - At the very minimum top and bottom samples should be collected
 - These samples can be visually examined on site for:
 - Color
 - Clarity
 - Sediment
- ⇒ Further fuel quality testing can be obtained through fuel provider or regional testing facility

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Caterpillar® Recommendations

- ⇒ Keep the fuel storage tank clear of water, debris and sediment.
- ⇒ Drain water and sediment from the fuel storage tank weekly.
 - Drain water and sediment before the tank is refilled.
- ⇒ Keep the area around the fuel tank filler neck clean of debris in order to prevent contamination of the fuel tank.
- ⇒ As required, clean the inside of the engine's fuel tank.
- ⇒ Drain water and sediment from the engine's fuel tank daily.
 - Drain the tank at the start of a shift.
 - After the fuel tank has been filled, allow the fuel to settle for 10 minutes. This will allow the water and sediment to settle from the fuel.
 - Then, drain the water and sediment from the tank.
- ⇒ Install water separators.
- ⇒ Drain the water from the water separator daily.

From "Caterpillar Machine Fluids Recommendations" SEBU6250-14

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Vehicle Maintenance

⇒ *PM Schedule*

- *Incorporate good housekeeping into the PM process*
- *Fuel - Water Separators*
- *Drain Fuel and Air Tanks regularly –especially in the Fall*

⇒ *Driver Training*

- *Secure Fill Caps*
- *Keep Fuel Tanks Full*
- *Daily Walk-Around Inspection*

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