



Issues with using higher blends of biodiesel than B20

Evelynn Stirling

MDEC, 2015



Using higher blends than B20

- Issues with using higher blends of biodiesel than B20 are summarized below:
 - Fuel quality concerns – there is no ASTM standard for higher blends of biodiesel to be used as a fuel
 - Lesser oxidation stability of the fuel, causing deposits and corrosion of parts
 - Lubrication oil dilution
 - Long term effects on engine parts
 - Changes in emissions
 - Combustion system effects in the long term
 - Aftertreatment system performance in the long term
 - Higher fuel consumption with biodiesel



Evidence

- Some evidence highlighting issues with using higher blends of biodiesel are listed in the following slides

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Fuel oxidation concerns

Fuel Quality

• Oxidized Fuel

- Sludge formation
- Deposits
- Filter plugging



Deposits from oxidation in a B20 field test



Fuel pump hsg deposits and corrosion from low use test

Filter plugging seen even with B20 use (this was from a field test with B20) due to oxidation of fuel. With higher blends of biodiesel, issue might be more prominent.

Corrosion seen on parts in the fuel pump as well, due to low use of low blends of biodiesel.

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B100 use issues experienced by City of Berkeley, CA

CURRENT SITUATION AND ITS EFFECTS

City of Berkeley is not abandoning the biodiesel program. However, because of engine problems with numerous vehicles that used B100, staff temporarily scaled back from B100 to using B20 (a fuel mixture of 20% biodiesel and 80% Ultra Low Sulfur Diesel [ULSD]), while investigating and trouble-shooting to determine the problem source. The first problem is that the filters get clogged on the trucks--then staff has to replace the lift pump, which is like a fuel pump on the diesel trucks (which brings the fuel up to the engine) because these get gummed-up. The second problem is that the ejectors on the engine (which sprays the fuel down into the engine) are problematic because the seals require continual replacement. Each problem occurs at least every week--and necessitate that staff stock this equipment to keep the trucks running. Since vehicles began being fueled with B20, all the problems vanished.

Filter plugging, fuel lift pump failure, seals failure on injectors are some of the issues faced by City of Berkeley, CA when using B100.



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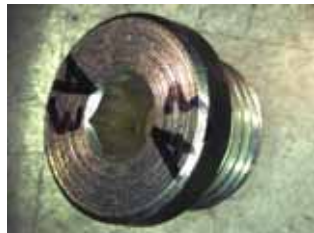
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Issues with Biodiesel use - Metal Compatibility

- Incompatible with Copper, Brass, Tin, Lead and Zinc
 - These metals act as catalysts for degradation of biodiesel
 - Will also degrade the metal

Zinc Plated Plug Aged 1000 Hrs at 100C



ULSD



B20



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Issues with Biodiesel use - Filter Plugging

- Cold biodiesel plugs filters
- Containments in biodiesel will also plug filters above cloud point
- These filters contained high levels of monoglycerides
- Other filter plugging containments include sterol glucosides, glycerin and metal carboxylates (soaps)



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Issues with Biodiesel use - Microbes

- Biodiesel also provides a good environment for microbes
- Microbes need food and water
- 8 Billion bacteria per gallon have no effect on fuel clarity
- Favorable conditions mean they double their population minutes



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Issues with Biodiesel use - Fuel Dilution of oil

- Biodiesel has higher distillation temperature
- Does not cook out as easy
- Reacts with detergents in the oil to form solids
- Lube oil will need to be changed very frequently

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Disadvantages of Biodiesel use

- Holds higher percentage of water up to 0.17%
- Less stable
 - Recommended to be used within 6 months



- Beaker on right contains 1% water
- Held @ 300 F for 1 ½ hr
- Biodiesel will get darker as it degrades
- Heat, water, air and certain metals will speed up degradation

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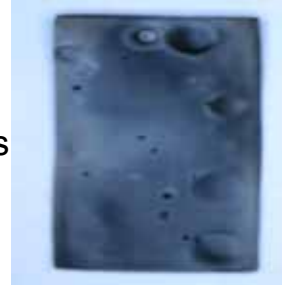
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Disadvantages of Biodiesel use

- Biodiesel is incompatible with natural rubbers, EPDM and Nitrile
- Also Incompatible with certain types of FKM
- Higher viscosity ~4.5 cSt
- Less energy ~10% less
- Higher cloud point
 - Feedstock dependant
 - Leads to plugged filters



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Materials Compatibility Research Metals

- Brass, bronze, copper, lead, tin, and zinc may accelerate the oxidation of diesel and biodiesel fuels and potentially create fuel insolubles (sediments) or gels and salts when reacted with some fuel components
- Impact is lessened as blend is diluted
- Detailed research on metal corrosion and biodiesel oxidation being led by Chemical Technology
- **Bosch pump overpressure valve, removal of zinc coating after 1 yr stand-by genset operation with B20 (300 hrs):**



Zinc coating removed by the fuel



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Materials Compatibility Research Non-Metallics

- Biodiesel will degrade, soften, or seep through some hoses, gaskets seals, elastomers, adhesives, and plastics with prolonged exposure.
- Biodiesel may attack or degrade any of the following:
 - Base polymer
 - Coupling agent
 - Dispersing agent – filler coagulation
 - Filler, composite
 - Stabilizers
- Formulations are proprietary with base manufacturers (3M, etc.)

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Summary

- There are numerous issues associated with using higher blends of biodiesel
- Interaction of various engine sub-systems to the fuel is very sensitive to the percentage of biodiesel blend
- It is NOT recommended to use higher than 20% blends of biodiesel in Cummins engines

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