

Alternative Diesel Fuels & Light Duty Vehicles: Criteria for Use

Ellen Shapiro
Alliance of Automobile Manufacturers

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Overview

- Goal
- Context considerations
- Issues checklist
- Specific fuels: Biodiesel, ethanol-diesel blends, water emulsions, GTL
- Final comments

Goal

Ensure that the vehicle-fuel system delivers low emissions, good fuel economy, superior performance, long vehicle life and positive driving experience

Context Considerations

Captive fleet setting:

- Enables tighter fuel quality specifications
- Enables tighter control of fuel handling and storage
- Enables operators to control vehicle technology

Mass market setting:

- Wide range of fuel quality
- Wide range of fuel handling and storage conditions
- Fuel must be compatible with both existing fleet and new vehicles

Issues Checklist

- Safety
- Fuel uniformity, consistency
- Stability in storage, handling
- Public health risk
- Compatibility with vehicle and parts
- Impact on tailpipe and evaporative emissions
- Impact on fuel economy/overall energy use

Issues Checklist

✓ Safety

- Is the fuel safe for use in passenger vehicles?
- Given the diesel fuel base, is the fuel safe for any conditions under which diesel fuel is normally used or handled?
 - For example, is the fuel safe for the occasional use, such as space heating?
- Is the fuel likely to behave in unexpected ways that might increase risk?

Issues Checklist, cont.

- ✓ Fuel Uniformity, Consistency
 - Does U/C depend on blending process? Can blending at distribution points instead of refinery affect U/C in some cases?
 - Splash blending vs. submerged blending
 - Are additives needed to maintain U/C, avoid phase separation or avoid biological contamination?
 - What additive concentration is needed to maintain fuel quality?

Issues Checklist, cont.

- ✓ Fuel stability during storage and handling
 - How long will blend stay stable, including vehicle storage?
 - Can low tank turnover rates/long storage times reduce stability?
 - Will commingling occur? Would it affect fuel quality?
 - Increased instability or phase separation?
 - Impact of trace components from other fuels?
 - Could stratification lead to safety problems?
 - How will changes in temperature, pressure and altitude affect stability?

Issues Checklist, cont.

- ✓ Health Effects
 - CAA sec. 211(b) requires registration of new fuels and fuel additives
 - EPA may require health effects testing and other information as a condition of registration
 - Small volumes may be exempt
 - Possible exposures: inhalation, dermal

Issues Checklist, cont.

- ✓ Engine, vehicle and materials compatibility
 - Metal parts, hoses, seals or gaskets
 - Permanent or temporary? What if fuel is used interchangeably with conventional DF?
 - Increased component wear, reduced vehicle durability?
 - Does fuel interact with lubricant?
 - Impact on exhaust system, emission controls, sensors?
 - Engine response--impact on performance, N/V/H or power?
 - Adequate peer-reviewed testing for variety of conditions?
 - Does fuel have any properties that consumers might dislike?

Issues Checklist, cont.

✓ Vehicle emissions

- Has vehicle-fuel system been tested for emissions impact, with peer-reviewed results?
- Did testing:
 - Comply with all applicable federal and state test procedures?
 - Consider both older and newer vehicle designs?
 - Test under range of temps, P/altitudes and humidities?
 - Measure diurnal, running and refueling evap emissions?
 - Measure all regulated emissions (HC, CO, NO_x, PM, toxics)?
 - Control fuel parameters to test impact of individual fuel properties?

Issues Checklist, cont.

- ✓ Fuel economy/Energy use
 - What is the fuel's energy content (BTU) per gallon?
 - Does fuel help or hurt fuel economy?
 - Relative to base fuel
 - Does it vary with technology?
 - How significant is the impact?
 - What is the Well-to-Wheel energy impact, and how does it compare with other fuels?

Biodiesel

- Fatty Acid Methyl Esters (FAME)
 - Made from vegetable oils (e.g., rapeseed, soy, other) and animal fats (e.g., waste restaurant grease)
 - Production process matters
- Potential issues
 - Compatibility with vehicle hoses/seals/gaskets
 - Increased NOx emissions
 - Storage stability/biological contamination
 - Oxidation stability: emerging concern
 - Price



Biodiesel - Main Failure Modes (2)

Important Note:

The FIE failures shown on the following pages were obtained by operation with Biodiesel fuel. In the majority of cases we only received the damaged parts themselves without information about the quality of the Biodiesel fuel that caused the problem.

The damages reported do not permit any conclusion of how critical the operation of the FIE with Biodiesel under field conditions really is. The failures, however, should make aware, that Biodiesel fuel quality is the key issue that decides on function and lifetime of FIE.



Unit Injector Failures (2)

Increased nozzle coking

- spray deflection by deposits around the nozzle holes (influence on exhaust gas composition)
- leaning by deposition of ageing products inside the holes (power loss)



Nozzle hole blocked

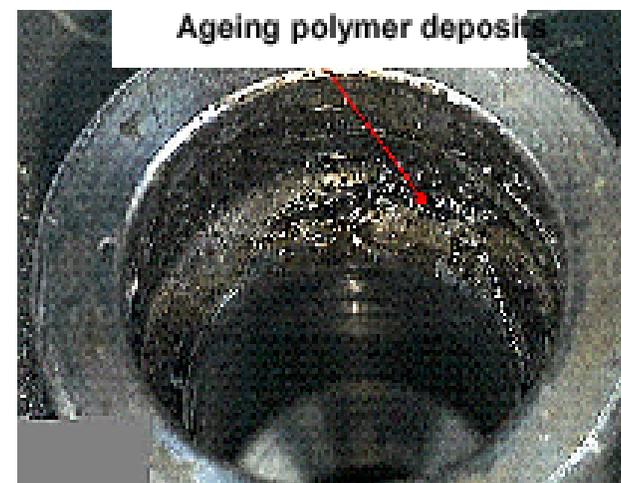
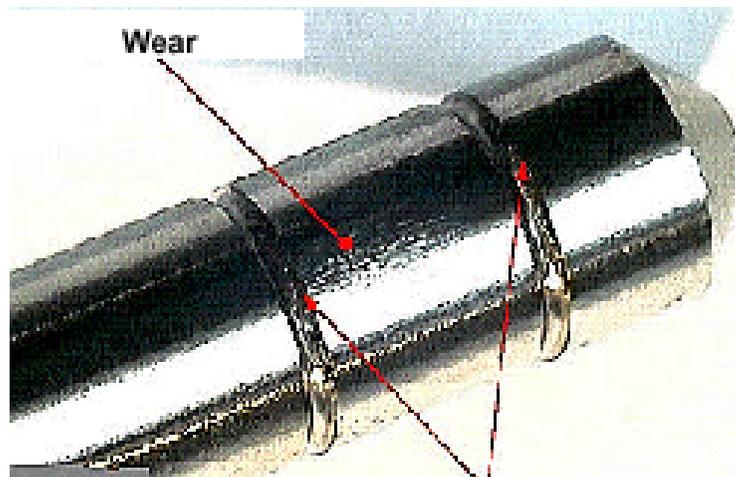
Sodium carbonate and glyceride deposits





Common Rail Failures (1)

Ageing polymer deposition at connectors [right], at drain fittings [bottom right] and plunger slots [bottom]



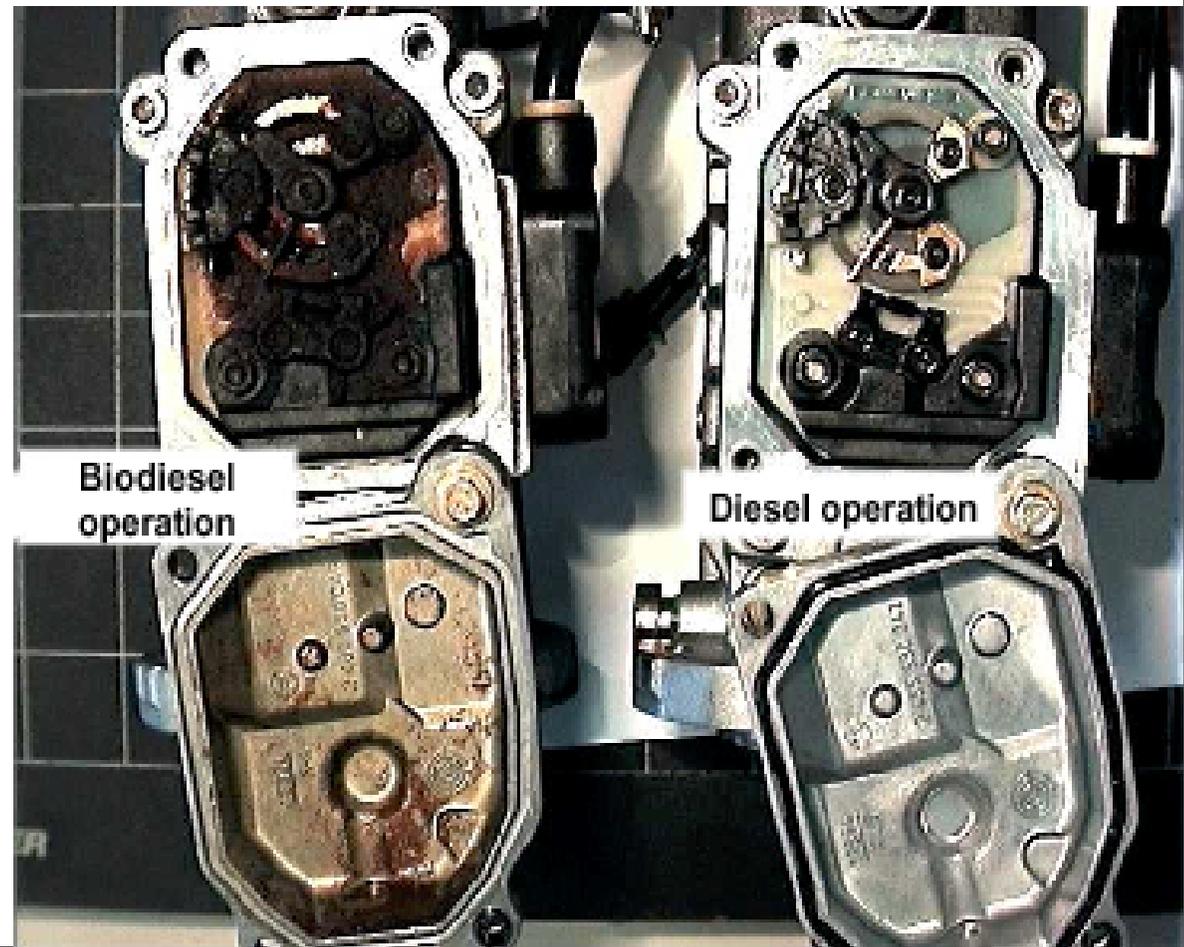
Ageing polymer deposits



High Pressure Distributor Pump Failures (3)

Setting mechanism:

- corrosion by ageing acid evolution
- sticking moving parts by polymer deposition
- hysteresis increase



Biodiesel, cont.

- Issues depend on concentration
 - B5 \neq B20 \neq B100
 - WWFC accepts up to 5% FAME for existing fleet if specs met; uncertainty for Tier 2 vehicles
- Storage turnover rates important
- ASTM B100 spec meant for blendstock; inadequate for neat use
 - EN 14214 better, but more still needed
- Acceptance requires successful completion of controlled tests + adequate specs for both blendstocks & finished blends

Ethanol in Diesel

- Flunks safety criterion
 - Flash point impact causes unacceptable safety risk
 - Possible phase separation in tanks increases explosion risk
 - Additives cannot fix
- Other basic criteria also not met
- Auto and Oil industry consensus

Water Emulsions

- Some automakers do not recommend
- Concerns:
 - Inadequate lubricity
 - Impact on fuel economy
 - Impact on peak power

GTL

- Gas-to-liquid diesel fuel is almost a perfect diesel fuel
 - Completely miscible with diesel fuel
 - Ultra-clean: Very high cetane, Zero aromatics, Zero sulfur; minimizes vehicle emissions
 - Needs lubricity
 - Improving economics?
- Perfect for extending ULSD supply
- Biomass fuel sources can be used

Final Comments

- More research needed
- Adequate knowledge base and fuel quality specifications will help automakers accept most alternative diesel fuels
- In-use fuel quality must be assured
- Goal: ensure that vehicle-fuel system delivers low emissions, good fuel economy, superior performance, long vehicle life and positive driving experience
- www.autoalliance.org