

Future Fuels: Issues and Opportunities

**2005 DEER Conference
Chicago, IL**

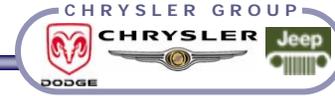
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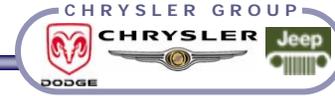
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Fuel Quality Issues



- Cetane
- Lubricity
- Aromatics
- Sulfur
- Biodiesel – adequate quality standards needed
- GTL, CTL, and BTL -- The Future

Cetane

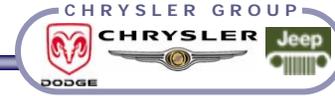


- **For both new and existing engines**
 - Long start times, cold start “white smoke,” increased NVH
 - European Auto/Oil studies link cetane to NOx
- **Critical for consumer acceptance of LDDV**
- **WWFC Category 4 recommends min 55 CN**
- **EU requires min 51 CN**
- **US has 44.0 avg CN¹**
 - world’s worst, incl. emerging countries²

¹Alliance North American Fuel Survey Winter 2003

²Infineum 16th Worldwide Diesel Fuel Quality Survey Winter 2002

Lubricity and Aromatics



Lubricity

- **Modern diesels need good lubricity**
 - Very high injection pressures ($\geq 24,000$ psi)
 - Risk of catastrophic failure
- **Additives work @ <0.5 cpg**
- **New ASTM standard (520 HFRR) inadequate**
- **WWFC Cat. 4 recommends 400 HFRR max**
- **US actual max = 651 HFRR¹**

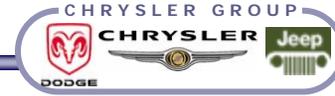
Aromatics

- **Precursors to soot & PM**
- **Can impair DPFs**
 - Plugging, regeneration, fuel economy
- **California restricts to reduce emissions**
 - CARB diesel reduces NOx by 7% & PM by 25%, compared to conventional DF²
- **WWFC Cat. 4 recommends 15 m% max**
- **US actual max = 44.1 m%¹**

¹Alliance North American Fuel Survey, Regular #2D (Lubricity - Summer 2002, Aromatics – Winter 2003)

²ARB Staff Report, June 6, 2003

Biodiesel Specifications



- Virtually every commodity which is traded in the U.S. is subject to a specification
- Without a specification precisely defining B20, it is difficult or impossible for a vehicle manufacturer to recommend B20 to its customers
- The current ASTM specification for B100 does not contain any limits on oxidation stability, a significant concern with biodiesel use
- An effective specification for a “plug-in” fuel must be both forward-, and back-ward compatible i.e., in order for a fuel like B20 to have a significant impact in the short- to mid-term, a B20 specification must assure that the fuel is compatible with existing as well as future vehicle designs

GTL, CTL, and BTL Fuels



- Recent months have seen many announcements of Fischer-Tropsch processes, including GTL, CTL, and CTL plants
 - Fischer-Tropsch fuels have very favorable cetane, aromatics, and sulfur levels
- The Mercedes Car Group is working in cooperation with VW and Choren Energy in Germany on the development of Biomass-to-Liquids (BTL) diesel fuel
 - The feedstock to the process can be virtually any carbon source, such as forestry waste, municipal waste, or purpose-grown crops
 - Choren Energy, in cooperation with Shell, has recently announced a commercial-scale plant
- CTL and GTL plants may be competitive with crude oil at \$65/bbl

Conclusions



- Conventional diesel fuel quality is controlled by ASTM specifications, and regulatory bodies
 - Long-term certainty in these specifications is essential to successful vehicle design, as the design process is fixed years ahead of actual vehicle/engine launch
- Specifications which assure that biodiesel fuels will meet quality standards are critical
 - ASTM D6751 specification for biodiesel is a good start, but does not specify oxidation stability limits
 - An ASTM specification for 20% biodiesel is needed before that fuel can become mainstream
- GTL, CTL, and BTL fuels may offer opportunities for high quality “designer fuels” for the future