Fuels and Lubricants to support Advanced Diesel Engine Technology

by

Rodica A. Baranescu

International Truck and Engine Corporation

11th Diesel Engine Emission Reduction Conference

Chicago, August 21-25, 2005

Fuel for Advanced Commercial Transportation

- **Fuel issues - global economy implications**
  - **New technology introduction worldwide**
  - **Globalization of environmental emission standards**
  - **Fuel characteristics harmonization**

- **World Wide Fuel Charter- a framework for fuel evolution and harmonization; developed jointly by:**
  - **Alliance, EMA**
  - **ACEA**
  - **JAMA**

World Wide Fuel Charter

- **Recognizes technological differences worldwide**
  - **Four categories of diesel fuels: I;II;III;IV**
- **Provides a road map for strategic fuel development**
  - **(critical elements)**
    - **Sulfur, cetane number, alternative blends**
- **It is a living document; it faces challenges**

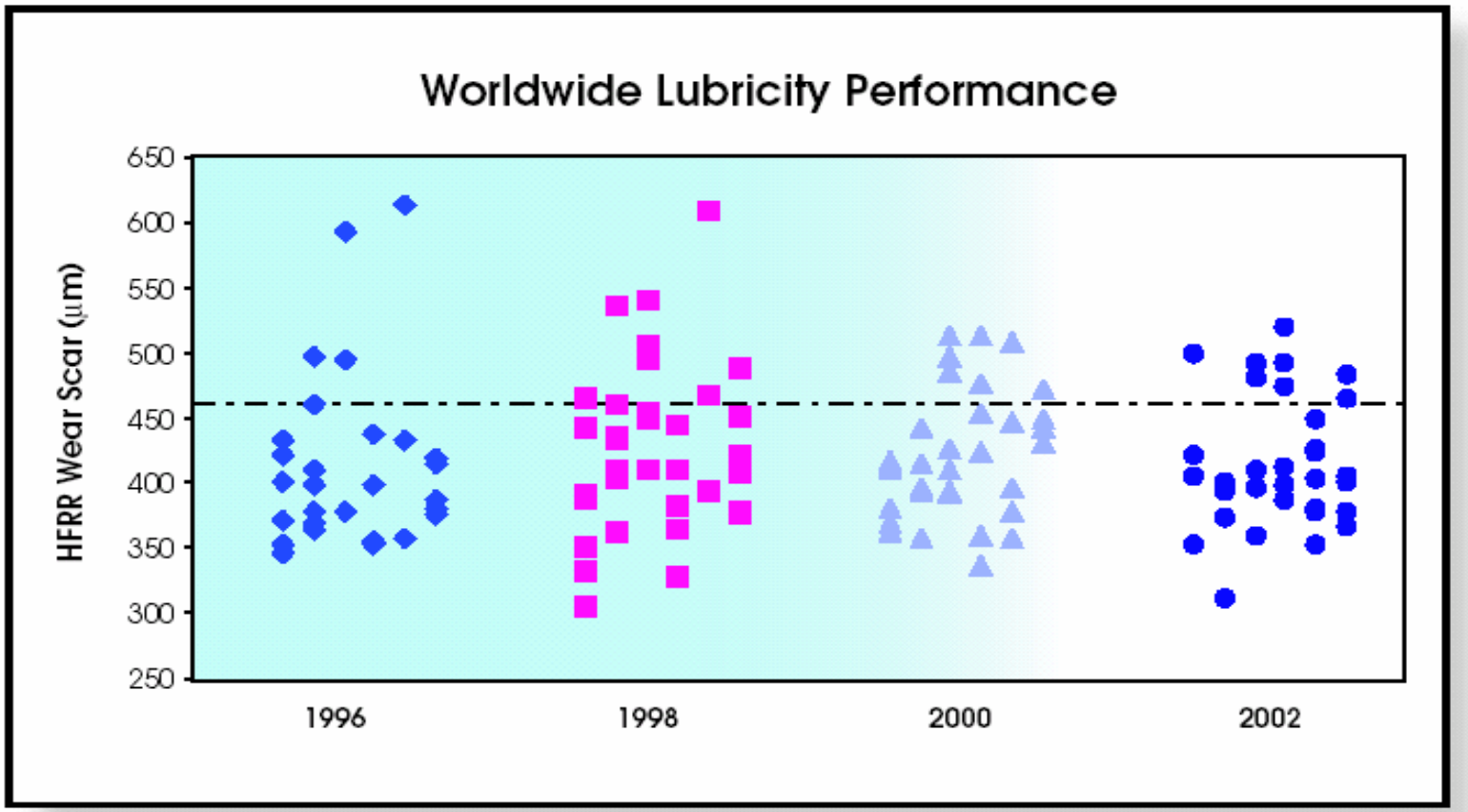
Diesel Fuel Quality- What have we achieved?

- **ULSF - the "technology enabler" for 2007 emission standards – on its way!**
  - **By June 2006, over 80% of on-road diesel fuel will have less than 15 ppm Sulfur!**
  - **By 2010, all on-road diesel fuel will be ULS**
  - **In 2010-2014, off-road diesel fuel will be ULS**
- **Performance of catalytic systems will be maximized (new technology)**
- **Particulate reduction benefits for all vehicles (new and old)**

Lubricity ?

- **Lubricity has become a requirement for diesel fuel (included in standard)**
- **Is the current specification good enough for 2007 Advanced Fuel Injection System?**
- **Will ULSF have adequate lubricity?**
  - **Some concerns with early ULSF in the market**

Trend of Diesel Fuel Lubricity



Source: Infineum Worldwide Winter Diesel Fuel Quality Survey 2002

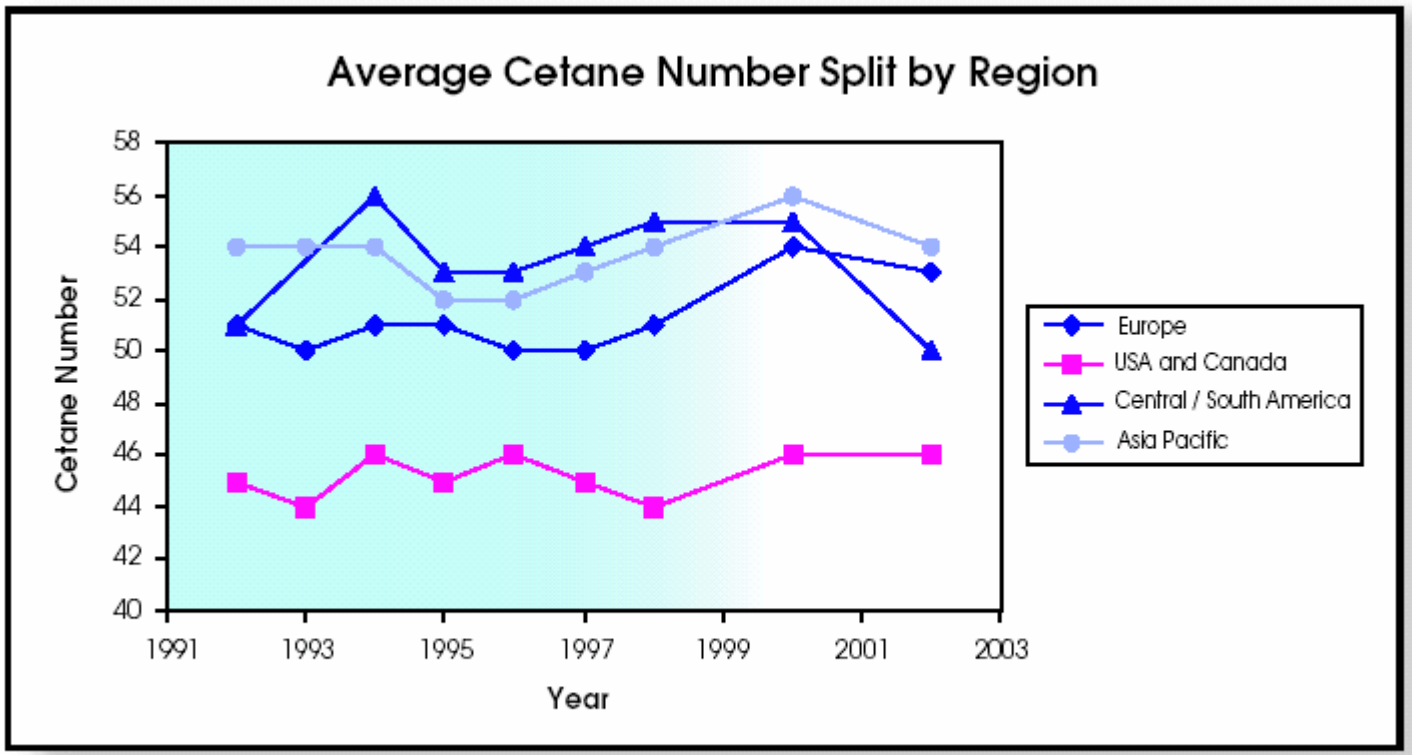
Diesel Fuel Quality- Where do we fall short?

- **Performance and Sociability Characteristics of Diesel Engine:**
  - **ease of start; noise,**
  - **white smoke; odor**
- **Influenced by diesel fuel properties:**
  - **Cetane Number**
  - **Low Temperature Operability**
- **Affect all diesels but especially, buses, diesel cars, pickup trucks, SUVs**

Cetane Number- CN

- **ASTM D 975 specifies CN of 40 min.**
- **This value has not changed since first standard issue!**
- **Diesel engine technology has changed!**
- **Market surveys show that average CN is higher!**
- **Isn’t it time to change CN?**

Worldwide Trend of Cetane Number



Source: Infineum Worldwide Winter Diesel Fuel Quality Survey 2002

Premium Diesel Fuel

- National Council on Weights and Measures (NCWM) approved a Premium Diesel Fuel Specification – effective January 1, 2004 published in the 2004 NIST Handbook
  - Cetane Number (47 minimum)
  - Low Temperature Operability
  - Thermal Stability
  - Lubricity (520 HFRR)
- This specification would give customers a choice for a better diesel fuel
- Would enhance the performance of new diesel vehicles in the market and demonstrate the real potential of advanced diesel technology.

Other Diesel Fuel Issues

- Energy content
- Fuel additives
- Stability (as sulfur is removed)
- Low temperature operability
- Cleanliness (water and impurities)
- Worldwide harmonization of fuel specification

Lubricants Issues

- **New generation of lubricants - PC-10 Category is under very active development in US**
  - **Compatible with the 2007 engine technology**
- **Industry-wide effort that includes:**
  - **Trade associations**
  - **Independent test laboratories**
  - **Corporate laboratories**
- **Complex process development with large participation, cost sharing and aggressive test schedule, to provide timely introduction of PC-10 lubricants by mid- 2006**

Lubricants Issues-(cont'd)

- **Challenges:**
  - **Provide equal or better performance of oils, while protecting after treatment systems**
  - **Maintain or improve oil drain intervals**

- **Chemical limits for :**
  - **Sulfated ash (1.0% max)**
  - **Phosphorus (0.12% max)**
  - **Sulfur (0.4% max)**

- **Development of new additives**

Alternative Fuels

- Natural Gas
- Biodiesel
- Syntethic Diesel (FT fuel/GTL fuel)
- Dimethylether (DME)
- Alcohols (methanol, ethanol)
- Blends (diesel/water, diesel/alcohol)

Alternative Fuels - Relevance

- **Driving forces**
  - **Lower emissions (some pollutants)**
  - **Domestic resources, less dependence on imports**
  - **Long term potential when crude oil is depleted**

Alternative Fuels- Challenges

- Availability,
- Infrastructure
- Technology maturity
- Cost
- Fuel quality, specifications
- Emissions?

Future Engines; their Fuel Requirements

- **Hybrid (IC/Electric) powertrain**
  - **Increased performance and efficiency**
  - **Lower emissions**
  - **Same fuel requirements**
- **Hybrid combustion (HCCI)**
  - **Fuel Characteristics ?**
- **Fuel Cells**
  - **Hydrogen fuel energy system**
    - **Fuel production and distribution**
    - **On-board storage**
    - **Fuel usage (engines, cells, etc.)**
    - **Applications**

Conclusions

- **Fuels and compatible lubricants are an "enabling technology" for the development of low emissions engines:**

  (both traditional and new concepts)

Conclusions

- **Fuels and lubricants formulations will maximize the potential of high performance engines with benefits in:**
  - **Environmental impact (emissions and greenhouse gases)**
  - **Fuel efficiency (better use of resources)**
  - **Customer acceptance**
- **The conventional fuels will continue to support transportation (as long as they can be produced economically from existing resources)**

Conclusions

- **Alternative fuels and energy will evolve and grow in competition with traditional fuels**

- **The energy picture of the future will be a combination of various resources and technologies**