Some tribological issues on flex-fuel engines

Dr. Eduardo Tomanik - MAHLE Metal Leve SA
Flex fuel engines – Some issues (1/3)

**Engines**
- Higher efficiency
- More compact engines
- **CO2 Emissions reduction**
- Lower fuel consumption

**Flex Fuel Engines**
- PCP increase (20 to 30%)
- More fuel injection (+30%)
- Spark time changed

**Engine parts**
- Higher Loads
- Less lubrication (ethanol low lubricity and fuel dilution)
- Tribological Severity Increased

Cold 15°C  Hot 50°C
- Ethanol lower lubricity

- Fuel dilution on cold start

- PCP is higher and closer to TDC

Valve Issues

Fuel dilution on lube

Gel in the fuel pump

Europe 2011: “Carmakers rethink sustainability approach amid E10 fuel fiasco”
Ethanol effects on Lube and Bearings


Hikita et al. “Ethanol effects on Lube and Bearings”

Turbo Engines
Power: 175 kW/l
Torque: 78 Nm/l

Engine loading will increase
R&D Consortium TriboFlex
Tribological Challenges on Flex-Fuel Engines

**Objective:** Structured knowledge on tribology, especially in the modelling and experimental analysis of:
- ring/lube/bore
- valve/interface/ valve seat

**Partners:** USP (Poli/LFS), UNICAMP, UFABC, Petrobras, MAHLE, Fiat, VW, Renault

**Funding Entity:** FAPESP

**Total Project Budget:** 3.9 Mio BR$
2 Main engine tribosystems were chosen:

- ring/lube/bore
- Valve/valve seat

Others can be investigated if more partners/resources appear.
R&D Consortium TriboFlex
Sub-Projects

00- Tribological Characterization of flex-fuel engine components
0.01 – Characterization of the mechanisms of wear and of the component surfaces.

01- Ring-Lube-Bore Tribo system
1.01 – Wear mechanisms on bore as function of its properties.
1.02 – Physic – Chemical interaction of oxides and lube film.
1.03 – Study of the variation of lubricity from engine use degraded oils on the ring materials.
1.04 – Low friction films for piston rings.

02- Valve-interfacial media-valve seat tribology
2.01 – Topography and tribological performance of valves.
2.02 – Influence of temperature and speed on the disk-plate tests.
2.03 – A bench test reproducing the environment found on flex-fuel engines.
2.04 – Tribological performance of metal and ceramic materials for valves.

03- Modeling of materials and loadings
3.01 – Modeling of materials and/or films to support the study of materials under the engine thermal/mechanical loads.
3.02 – Modeling study of the lubrication in the ring/bore to investigate the friction mechanisms.

04 – Formation of specialized Human resources
Conclusions

Ethanol fuel brings both advantages and disadvantages in terms of combustion and tribology. So far, engines are mostly adapted from gasoline engines, not ethanol optimized.

More concentrated efforts on R&D are needed to fully explore the ethanol potential as engine fuel.

Better tribological understanding may also bring friction/fuel reductions.
Thanks for the attention

eduardo.tomanik@br.mahle.com