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The Potential Effects of Alternative Fuels on the Lubricating Condition of Compression-ignition Engines

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ABSTRACT

The dielectric constant and the moisture value of the lubricating oil measured from a IC engine running with different alternative fuels on line show a clear difference from the baseline diesel. This demonstrates that alternative fuels will have a noticeable impacts on engine lubrication, Further studies should be carried out on clarifying the influences mechanisms and corresponding resolutions.

Table 1. **Properties of the tested fuels**

	Methanol	F-T fuel	Standard Diesel
Density (20°C) (g/cm³)	0.80	0.76	0.83
Viscosity (20°C) (mm²/s)	0.75	2.14	4.65
Cetane number	5	74.8	45
Lower heating value (MJ/kg)	19.7	44.2	42.6
Aromatic content (Volume fraction) (%)	0	0.1	34.7
C /% (wt)	37.5	84.3	85.5
H /% (wt)	12.5	15.2	13.9

A great deal research works have bend on finding new alternative fuels for CI engines. However, the impacts of long-term use of the alternative fuels on the reliability and service life of CI engine have not yet been fully understood.

The dielectric constant and the moisture value of the lubricating oil can be used to gain a quantitative understanding of the corresponding relationship between the alternative fuel combustion and the change of lubricating oil condition. Comparing these measurements with that of a normal diesel allows a determination of an influence degree of the alternative fuels under investigation. The dielectric property and moisture content of the lubricating oil are significantly varied in the range of alternative fuels. The results show that these parameters will be used in future to monitor the condition of the engine running with alternative fuels.

The fuels used in the experimental investigation are standard diesel, FT (Pure Fischer-Tropsch diesel fuel), M20 (the methanol proportion in the methanol-diesel blended fuel is 20%), Emulsified diesel (The proportion of water is 15%). The main components of the emulsified diesel: 15% water+ additive+ catalyst+ combustion adjuvant+ 80% conventional diesel.

Experimental Setup and Methodology

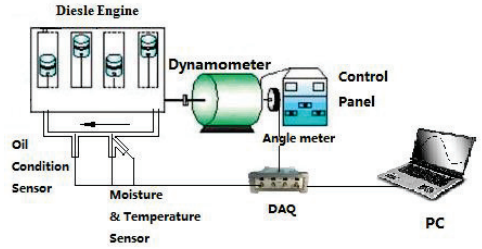

Fig.1 Schematic of experimental setup utilising a 4100QBZL 74KW engine for alternative fuels combustion test.

Table 2. **Engine operating conditions**

Engine speed (rpm)	Load (Nm)	Running time (min)
Warm-up running (1500)	30	20~30
Full-throttle test (1200~2800)	Cannot be set	15~20
1200	10/50/100/150	7/3/3/3
1600	10/50/100/150/200	7/3/3/3/3
2000	10/50/100/150/200	9/3/3/3/3
2400	10/50/100/150/200	8/3/3/3/3

RESULTS

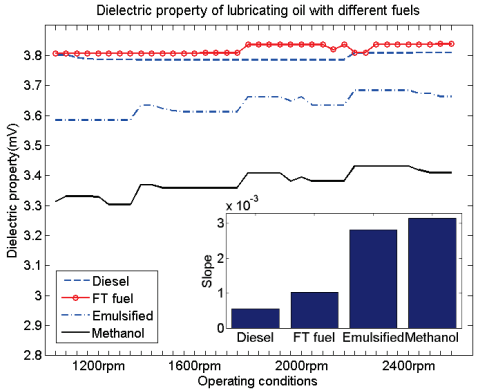

Fig.2 The relationship between the dielectric properties and the engine speed is not clear, in other words, it does not show a linear relationship. With the time goes on, the dielectric property is increased steadily. It can be seen that the dielectric property (DP) can be used to characterize the oil deterioration and degradation degree.

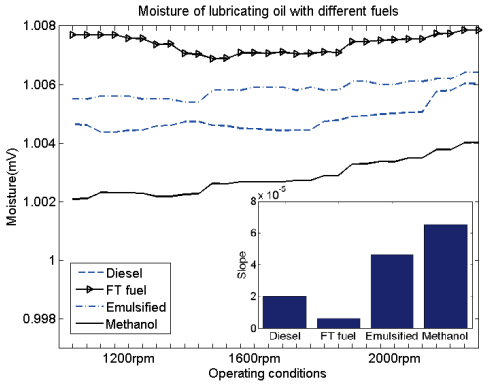

Fig.3 The correlation between the moisture change and the engine operating conditions can be seen clearly. With the increase of speed and load, the moisture curve is steadily increaseing.

CONCLUSION

- ❑ The dielectric property of lubricants is not change significantly along with the operating conditions.
- ❑ The rising rates of the lubricating oil condition of emulsified diesel and methanol are greater than that of diesel.
- ❑ Due to the physical characteristic of methanol, the degree of lubricant deterioration of the methanol is more serious than that of other fuels under the same conditions.
- ❑ Due to the similar chemical characteristics of F-T fuel and diesel, the degradation rates of F-T fuel and diesel are closer.
- ❑ The water content of the combustion products plays a significant role in promoting the increase of the moisture in lubricating oil.
- ❑ The dielectric property and moisture content can be used to characterize the oil deterioration and degradation degree.

FUTURE WORK

- ❑ More in-depth understanding and quantitative analysis will be carried out with the application of FT-IR.
- ❑ Combine with the acoustic emission monitoring technology, the impact of lubrication degradation and deterioration on the engine condition, especially on the friction and wear of the cylinder will be analyzed quantitatively.
- ❑ Physical and chemical models of cylinder friction and wear will be developed to simulate lubricant degradation process under different fuels combustion.
- ❑A comprehensive method will be developed for on-line prediction of lubricant degradation.

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