A Study of Potential Effects of Alternative Fuels on the Combustion Engines using Acoustic Emissions

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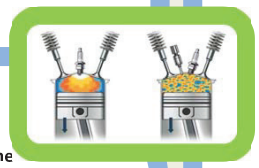
Introduction

The limit of mineral fuel motivates researchers into finding alternative energy sources for diesel 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.

Some of alternative fuels have different properties from the normal diesel, which may influence the performance of engine, mainly in processes of piston lubrication, valve seal and combustion.

The recent studies shows that processes of piston lubrication, valve seal and combustion will generate acoustic emission (AE) signals. offering the potential to monitor operating conditions.

In this study, using four types of fuels(Fischer-Tropsch fuel, methanol-diesel blended fuel, emulsified diesel and standard diesel), the condition changes of CI engine have been investigated by AE techniques.



Testing Facilities and Methods

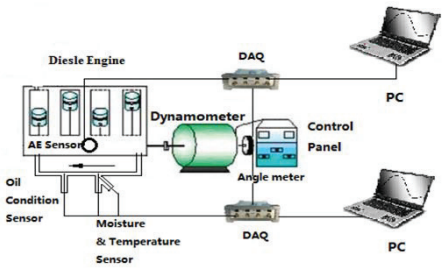


Fig.1 Schematic of experimental bench

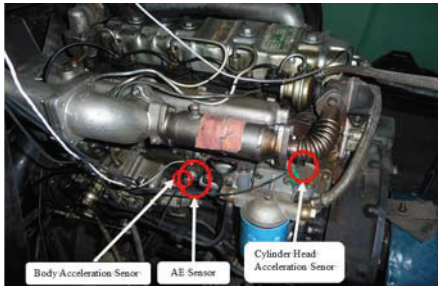


Fig. 3. AE sensor and Vibration Sensor of the engine body and cylinder head Installation

Tab.1 The parameters of the 4100BZL engine

Manufacturer/model	Kunming Yunnei Power Co., Ltd., PR. China
Engine type	4100QBZL
Number of cylinders	Four
Combustion system	Direct injection, toroidal combustion chamber
Bore/stroke	100/105 mm
Displacement volume	3.298 L
Compression ratio	17.5:1
Cylinder liners	Cast iron replaceable wet liner
Start of fuel injection	14±2° BTDC
Rated power	70/3200 kW/r/min
Max. torque	245/2200 Nm/r/min

Tab.2 The 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

Diesel-0 is standard diesel
cFT-100 is coal F-T fuel
M20 is the methanol-diesel (the proportion of methanol is 20%)
HF-II is Emulsified diesel from Hong Feng Inc.

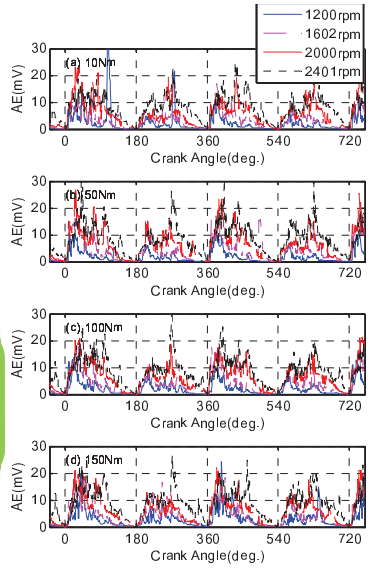


Fig.4 RMS of acoustic emission signals under different operating conditions

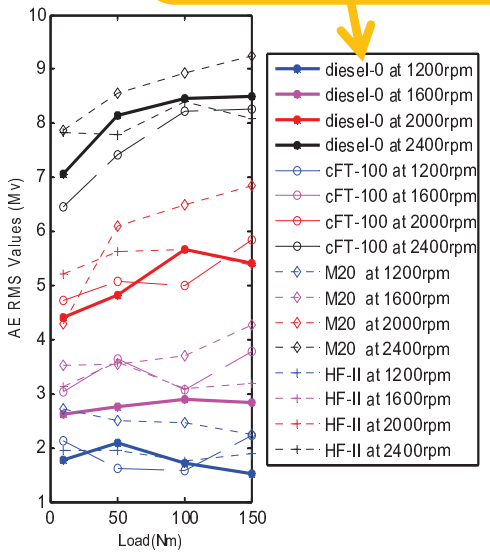


Fig. 5 Average AE RMS of different fuels under different speeds

Figure 4 shows the behaviour of AE RMS values for a engine cycle under different speed and loads for the baseline diesel. The AE RMS values in the middle of piston stroke is enhanced while the high bust around TDC is suppressed significantly. A clear increase of AE energy can be seen as the speed increases. As shown in the Fig. 5, methanol fuel produces a clearly higher average AE energy for nearly all operating conditions .

CONCLUSION

- ❑ The methanol diesel has the worst impact on the engine running state.
- ❑ It has little difference between diesel and other two fuel in AE signals.