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

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

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine type</td>
<td>4100QBZL</td>
</tr>
<tr>
<td>Number of cylinders</td>
<td>Four</td>
</tr>
<tr>
<td>Compression ratio</td>
<td>19.5:1</td>
</tr>
<tr>
<td>Cylinder liners</td>
<td>Cast iron replaceable wet liner</td>
</tr>
<tr>
<td>Start of fuel injection</td>
<td>142° BTDC</td>
</tr>
<tr>
<td>Rated power</td>
<td>70/3200 kW/hr/min</td>
</tr>
<tr>
<td>Max torque</td>
<td>245/2200 Nm/min</td>
</tr>
</tbody>
</table>

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.