The Tribology Laboratory: A Handy Environment for Failure Analysis?

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OUTLINE

• ROUTINE TESTING
  – Fuel & Lubricant performance
  – Physical properties

• IN-HOUSE MODIFICATIONS

• FAILURE ANALYSIS SUPPORT
ROUTINE TESTING

• PERFORMANCE TESTING
  – SRV, HFRR, BOCLE, SLBOCLE
  – FZG – Spur Gear Testing

• WEAR SCAR ANALYSIS
  – Optical microscope
  – Non-contact surface profiler
  – Particle size analysis

• PHYSICAL PROPERTIES
  – Viscosity: BROOKFIELD, STABINGER
  – Boiling point Curve, Flash point
ROUTINE TESTING
IN-HOUSE MODIFICATIONS

• DIESEL
  – Continuous vs Batch flow
  – Effect of Atmosphere: Water & Oxygen
  – Initial conditions: Running-in
IN-HOUSE MODIFICATIONS

• OPEN GEAR LUBRICANTS
  – FZG at constant temperature: Energy-efficiency determination
# IN-HOUSE MODIFICATIONS

<table>
<thead>
<tr>
<th>TEST NUMBER</th>
<th>TEMPERATURE (°C)</th>
<th>GEAR SPEED (ms⁻¹)</th>
<th>LOAD STAGE</th>
<th>TEST DURATION (hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>90 (50)</td>
<td>8.33 (8.33)</td>
<td>11 (11)</td>
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<td>2</td>
<td>70 (70)</td>
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<tr>
<td>4</td>
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<td>5</td>
<td>70 (90)</td>
<td>8.33 (16.66)</td>
<td>10 (11)</td>
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</tr>
</tbody>
</table>

**TOTAL DURATION FOR A TEST SEQUENCE:** 5 hrs
FAILURE ANALYSIS SUPPORT

• Analytical methods:
  – FTIR
  – TGA-GC-MS
  – ICP
FAILURE ANALYSIS SUPPORT

- Electron-microscopy: (SEM)
CONCLUSION

• Lubricants are complex – their behaviour even more so.

• Laboratory performance test results need to relate to an industrial environment.

• Understanding why lubricants behave in the way they do, is the purpose of laboratory-based research.