The Measurement of Number, Size and Mass of Automotive Particulate Emissions
A CONCAWE Study
2nd ETH Workshop - ‘Nanoparticle Measurement’

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Zurich

The Measurement of Number, Size and Mass of Automotive Particulate Emissions
A CONCAWE Study

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The Measurement of Number, Size and Mass of Automotive Particulate Emissions

Ambient PM (PM10, PM 2.5) ultrafines

PM SOURCES:
Traffic
Stationary sources
Agriculture
Domestic
Demolition
Wood fires
etc

? Impact on Human Health

Source: CONCAWE
The Measurement of Number, Size and Mass of Automotive Particulate Emissions

- literature study identified best available test methods for particulate emissions sizing (CONCAWE report no 96/56)
  - electrical mobility analysers for size distribution
  - impactors for mass distribution

- objectives
  - develop information on particulate size, number and mass distribution from current LD Diesel and LD gasoline engines
  - compare results from currently available measurement techniques
  - compare results from different laboratories

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TEST PROGRAMME

• detailed structured test procedures/methodology to provide a sound technical documentation
  – importance of back to back repeats
  – essential to check baseline recovery
• in co-operation with recognised outside experts
• validation of complex test results
  – regulated emissions checked against EPEFE protocol
  – detailed investigation of robustness of sizing equipment

(CONCAWE report 98/51)
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<table>
<thead>
<tr>
<th>TEST FUELS</th>
<th>TEST VEHICLES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Diesel</strong></td>
<td><strong>Diesel</strong></td>
</tr>
<tr>
<td>D1 - Summergrade</td>
<td>V1  1.91</td>
</tr>
<tr>
<td>D2 - Wintergrade</td>
<td>V2  1.91</td>
</tr>
<tr>
<td>D3 - Swedish Class I</td>
<td>V3  2.51</td>
</tr>
<tr>
<td><strong>Gasoline</strong></td>
<td><strong>Gasoline</strong></td>
</tr>
<tr>
<td>G1 - low S/low aromatics</td>
<td>V4  1.9</td>
</tr>
<tr>
<td>G2 - high S/high aromatics</td>
<td></td>
</tr>
</tbody>
</table>

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TEST PROTOCOL

• daily test procedure (for single vehicle/fuel combination)
  – cold start MVEG cycle
  – 3 x ‘hot’ start MVEG cycles (oil temperature control)
  – steady state testing (idle, 30km/h, 50km/h, 70km/h, 120km/h)
  – vehicle pre-con for next day

• repeat of daily test procedure
  – day 1 (fuel A); day 2 (fuel A)
  – day 3 (fuel B); day 4 (fuel B)
  – day 5 (fuel A)
  – repeated as required

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Measurement of particle sizes

• steady state testing
  – complete scan across size capability of instrument
• transient testing
  – individual sizes monitored across each cycle

SMPS: - 25, 60, 100nm
DMPS: - 100, 200, 400nm

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(total number of particles emitted per kilometre, averaged over all fuels)
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Gasoline – ECE + EUDC Cycles

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The Future??
• for automotive:
  - mass measurement more accurate and gives better discrimination across a wide range
  - number measurement less accurate and appears to show less discrimination between current LD Diesel technology

• need to identify species to be measured
• need to prepare standard procedures and establish reference methods

COMMUNICATION ACROSS DISCIPLINES ESSENTIAL

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