Diesel Aerosol Monitoring with a high speed Laser Spectrometer

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GRIMM  Laser Spectrometer

1. Instrument Concept
2. Measurement Arrangement
3. Results
4. Instrument Conclusions
Optical Particle Counter Concept

ADVANTAGES:
• Count Concentrations $10^4 / \text{cm}^3$
• Min. refractive index influences
• High sheath air cleaning
• Automatic ZERO test
• Sample collection on filter
• Instant results
• Portable and light weight
• Optional:
  • Dehumidification system
  • Dilution System
  • Remote (MODEM) control
  • Extra sensor attachment
  • Software package

ETH Zürich, Aug. 20th, 2002
Optical Detection System

Upstream the Filter

Sample Filter

Downstream the Filter

SAMPLE AIR FLOW TO PUMP

Focused Laser Light

SHEED-AIR

SHEED-AIR

GRIMM
DUAL Method

Laser

Light Scattering
For Real Time

Particles in Air

Collection Filter
For GRAVIMETRIC use

From 300 nm upwards

ETH Zürich, Aug. 20th, 2002
1st LATEX
Monodisperse Particle Calibration

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2. MASS-Calibration
**INSTRUMENT VERIFICATION**

<table>
<thead>
<tr>
<th>Present 1.109</th>
<th><strong>CONTROL PARAMETERS FOR EACH UNIT:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Size Range</td>
<td>* Calibration of all 12 or 16 size channels</td>
</tr>
<tr>
<td></td>
<td>• Flow control system setting for 72 l/h</td>
</tr>
<tr>
<td></td>
<td>• Count control to $10^7$ Particles/dm³</td>
</tr>
<tr>
<td></td>
<td>• And Mass control to 10 mg/m³</td>
</tr>
<tr>
<td>from 0.25</td>
<td>• 1 sec Size distribution control</td>
</tr>
<tr>
<td>0.30</td>
<td>• 1 sec Data refreshed control</td>
</tr>
<tr>
<td>0.35</td>
<td>• Data protocol in counts and mass</td>
</tr>
<tr>
<td>0.40</td>
<td>• Data storage on data logger card</td>
</tr>
<tr>
<td>0.45</td>
<td>• Communication control via RS-232</td>
</tr>
<tr>
<td>0.50</td>
<td>• Port control for Temp.- +rel.Humidity</td>
</tr>
<tr>
<td>0.60</td>
<td>• Build-in dust collecting filter</td>
</tr>
<tr>
<td>0.70</td>
<td>• Build-in battery charger control</td>
</tr>
<tr>
<td>0.80</td>
<td>• Battery and VAC control at 110 / 220</td>
</tr>
<tr>
<td>1.00</td>
<td>• Driver and GRIMM software control</td>
</tr>
<tr>
<td>1.60</td>
<td>• Physical inspection.</td>
</tr>
<tr>
<td>and 2 micron</td>
<td></td>
</tr>
</tbody>
</table>

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Instrument Concept

2. Measurement Arrangement

Obtained Results

Instrument Conclusions

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Example of an 1.108 Laser Spectrometer used for Real-time „AIR-SCANNING in combination with an 8 stage impactor
Example of a 1.108 Laser spectrometer in combination with a portable Diluter
Stationary Test System Configuration

Sampling: (Rot. Disk Diluter, MATTER Eng.)

195.587 p/cm³

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Sampling

Arrangement: A rotating disk diluter (Matter Inc.) is used for instant Measurement assuring proper sample feeding at variable MOTOR conditions.
Background Measurement (Data in Seconds)

Counts and Size Range

- Ca 85
- Ca 25
- Ca 5

Test

Door opened
Particle Size and Count Change in 4 size channels at Repeated Constant Motor Load in KW

The #1.108 has 16 different size channels

Count limit

- 300 nm
- 400 nm
- 500 nm
- 650 nm

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Particle Counts and Motor Load Curve (in KW)

Acceleration peaks

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Dust Mass, Particle Size and Motor Load
in µg/cm³
(in KW)

Konz. [P/Nccm]

Dust Mass, Particle Size and Motor Load
in µg/cm³
(in KW)

Konz. [P/Nccm]
Particle Counts and Motor Load at different conditions (in KW)
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Instrument Concept
Measurement Arrangement
Obtained Results

4. Instrument Conclusions
Conclusion:

**DIESEL Particles can be measured in real time**

at any specific sampling point with the rotating disk diluter *(Matter)* and the attached

* „white“ model (1.108)
  
  (= 15 channels from 0.3 to 20 µm)

* or the „silber“ model 1.109
  
  (= 12 channels from 0.2 to 2 µm)
INSTRUMENTATION OUTLOOK

Possible integration of a

- Dilution system
- Sample conditioner
- 19“ rack solution

Instrument improvement for

- Sensitivity below 100 nm
- Selve test intelligence
- Application software

GRIMM AEROSOL TECHNIK

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An interesting way for future optical Instrument Applications...

THANK YOU FOR YOUR ATTENTION