PM10 Emissions of Road Traffic from Abrasion and Resuspension Processes

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Motivation

• Known emission factors from dynamometric testing
• Actually circulating fleet
• Emissions from abrasion and resuspension
Goals of the project

• PM10-emission factors for specific traffic situations
• Discrimination of emissions from exhaust pipe and from abrasion/resuspension
• Emissions of light-duty and heavy-duty vehicles
Measurement concept (1)

- **Downwind site**
  - Background pollution + traffic contribution

- **Upwind site**
  - Background pollution only

Wind direction

Road
Measurement concept (2)

$\Delta$PM1 interpreted as exhaust pipe emissions

$\Delta (PM10-PM1)$ interpreted as emissions from abrasion and resuspension

Dilution from $\Delta NOx$ und EF(NOx)
Measurement concept (3)

\[ \Delta \text{NO}_x = \frac{\text{EF}_{\text{NO}_x, \text{HDV}}}{v} \cdot n_{\text{LDV}} + \frac{\text{EF}_{\text{NO}_x, \text{HDV}}}{v} \cdot n_{\text{HDV}} \]

\[ d = \frac{\text{EF}_{\text{NO}_x, \text{LDV}} \cdot n_{\text{LDV}} + \text{EF}_{\text{NO}_x, \text{HDV}} \cdot n_{\text{HDV}}}{\Delta \text{NO}_x} \]

\[ \Delta \text{PM}_{1} = \frac{\text{EF}_{\text{PM}_{1}, \text{LDV}}}{d} \cdot n_{\text{LDV}} + \frac{\text{EF}_{\text{PM}_{1}, \text{HDV}}}{d} \cdot n_{\text{HDV}} \]

\[ \Delta \text{PM}_{10} = \frac{\text{EF}_{\text{PM}_{10}, \text{LDV}}}{d} \cdot n_{\text{LDV}} + \frac{\text{EF}_{\text{PM}_{10}, \text{HDV}}}{d} \cdot n_{\text{HDV}} \]
## Measurement sites (1)

<table>
<thead>
<tr>
<th>Site</th>
<th>Traffic situation</th>
<th>total veh./h</th>
<th>% HDV</th>
<th>speed (km/h) LDV/HDV*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aathal (rural)</td>
<td></td>
<td>1173</td>
<td>6.1</td>
<td>50/50</td>
</tr>
<tr>
<td>Birrhard (motorway)</td>
<td></td>
<td>2760</td>
<td>9.6</td>
<td>120/85</td>
</tr>
<tr>
<td>Humlikon (motorway)</td>
<td></td>
<td>1681</td>
<td>12.5</td>
<td>85/75</td>
</tr>
<tr>
<td>Rosengartenstrasse</td>
<td>(urban, slope 8%)</td>
<td>2909</td>
<td>5.8</td>
<td>50/40</td>
</tr>
<tr>
<td>Schimmelstrasse</td>
<td>(urban, directly at traffic lights)</td>
<td>1154</td>
<td>6.9</td>
<td>0-50/0-50</td>
</tr>
<tr>
<td>Weststrasse</td>
<td>(urban, 50 m distance from traffic lights)</td>
<td>1080</td>
<td>6.1</td>
<td>0-50/0-50</td>
</tr>
</tbody>
</table>
Measurement sites (2)
Measurement sites (3)
Measurement sites (4)
Results Birrhard (motorway)
Emission factors (all vehicles)

- EF(PM1); exhaust pipe
- EF(PM10-PM1); abrasion, resuspension

mg/km

Aathal | Birrhard | Humlikon | Rosengartenstr. | Schimmelstr. | Weststrasse

TFEIP-Workshop, Pallanza, Oct-04
Emission factors of PM1 (all vehicles)

- Aathal
- Birrhard
- Humlikon
- Rosengartenstrasse
- Schimmelstrasse
- Weststrasse

mg/km

measured
Handbook

TFEIP-Workshop, Pallanza, Oct-04
Emission factors (LDV)

- EF(PM1); exhaust pipe
- EF(PM10-PM1); abrasion, resuspension

mg/km

Aathal  |  Birrhard  |  Humlikon  |  Rosengartenstr.  |  Schimmelstr.  |  Weststrasse

TFEIP-Workshop, Pallanza, Oct-04
Emission factors (HDV)

mg/km

- EF(PM1); exhaust pipe
- EF(PM10-PM1); abrasion, resuspension

Athal  Birrhard  Humlikon  Rosengartenstr.  Schimmelstr.  Weststrasse
EF(PM10): Comparison with other studies

- Aathal: 67
- Birrhard (flüssiger Verk.): 83
- Birrhard (stockender Verk.): 118
- Humlikon: 71
- Rosengartenstrasse: 56
- Weststrasse: 104
- Schimmelstrasse 2002: 184
- Cottbus Bahnhofstr. 1999: 161
- Frankfurt/Oder Leipziger Str.: 151
- Potsdam H.-Thoma-Str. 1999: 133
- Berlin/Frankfurter Allee 1999: 126
- Berlin/Schildhornstraße: 89
- Leipzig/Lützner Straße: 660
- Berlin/Lerchpfad: 200
- Berlin/Tunnel Tegel 1998: 88
- München/Brudermühlentunnel: 91

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Conclusions

Exhaust pipe emissions from dynamometric tests confirmed.
Particle emissions from abrasion and resuspension processes are considerable.

Open questions

Unsufficient knowledge about sources of particle emissions from abrasion and resuspension.
Toxicological assessment of emissions from abrasion and resuspension.