M+P – consulting engineers
Müller-BBM group
Acoustics
Noise and vibration control
Air quality

Road surface effects on PM_{10}

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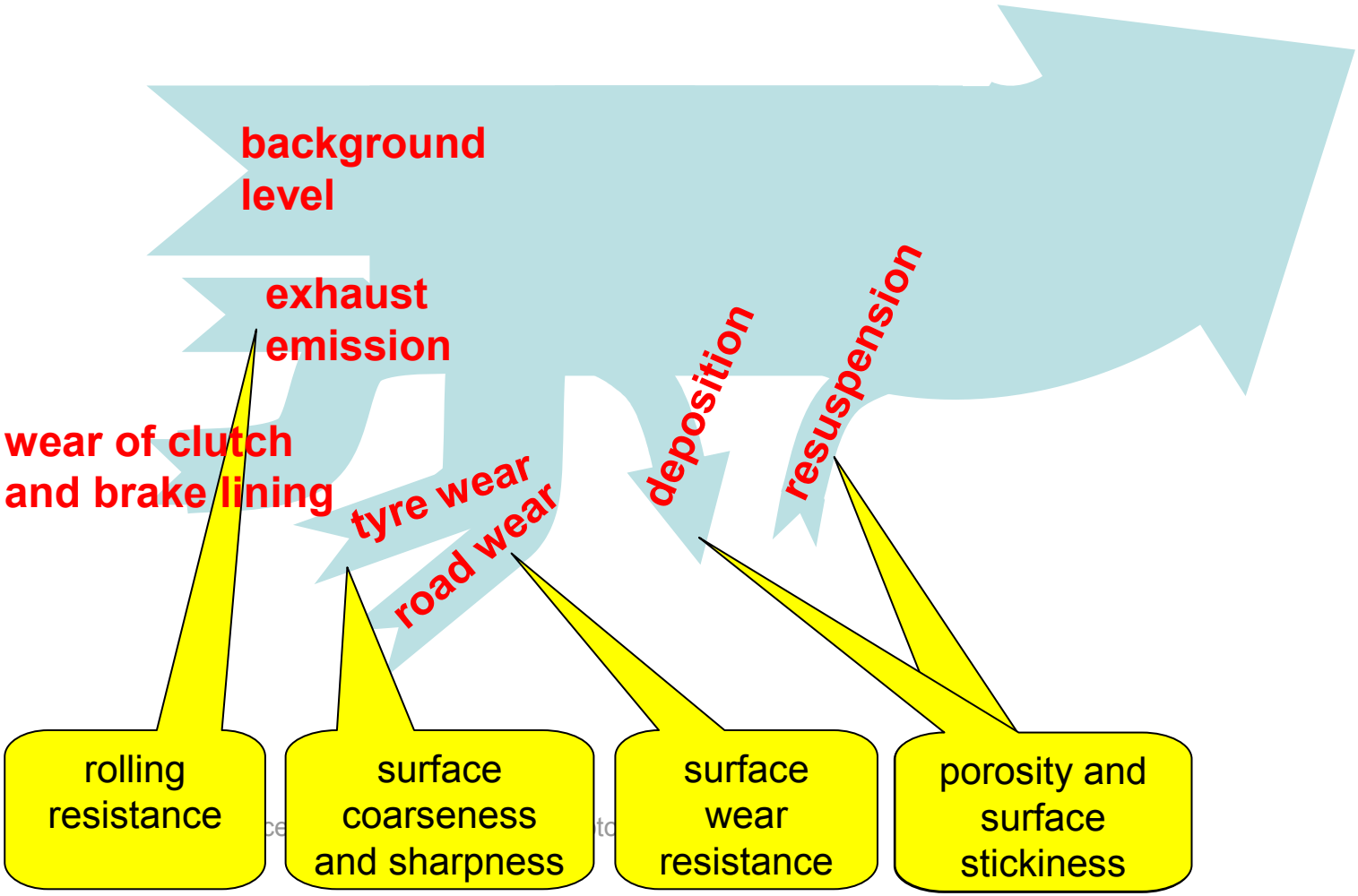
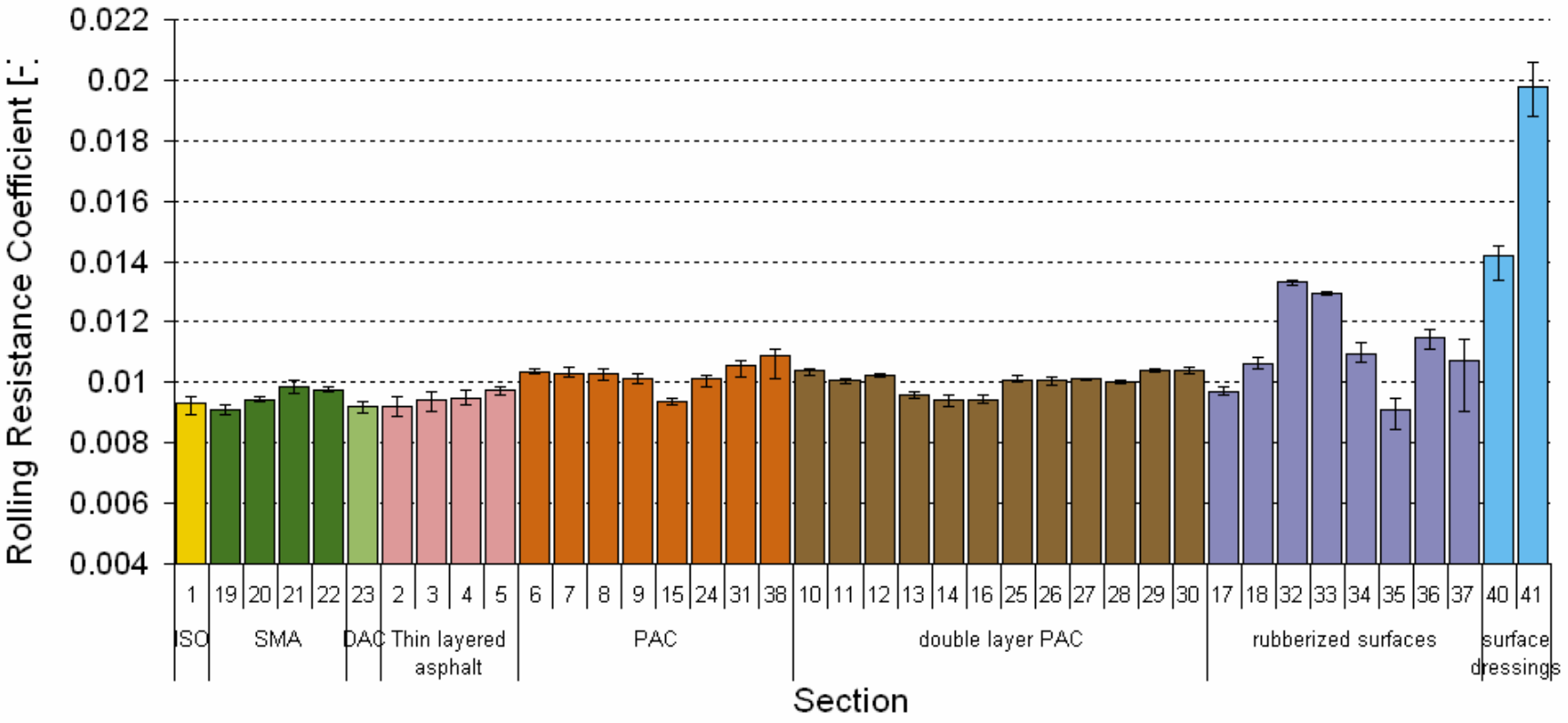
The road surface affects both source and propagation of PM_{10}



Break down in individual processes (1)
-- rolling resistance --

- rolling resistance → engine load → exhaust emission
- every 10% resistance difference → 5% exhaust emission effect



Break down in individual processes (2)
-- tyre and surface wear --

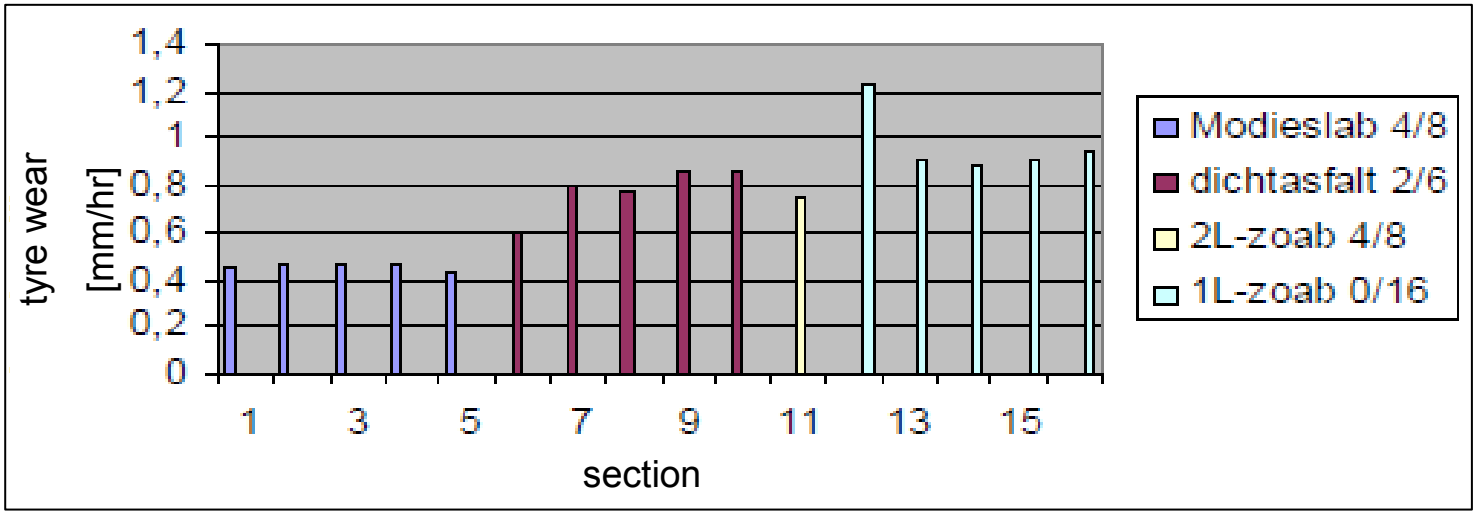
- Wear components become more relevant as exhaust emission is reduced (EURO 4, 5, 6,…)
- Estimated 20% of total PM_{10} emission is related to clutch/brake lining components
- Estimated 20% of total PM_{10} emission is related to tyre and surface wear
- Data on relative contribution from the tyre and the surface is scarce and contradictory

Simulation of tyre and surface wear with “rotating surface abrasion test”

Picture:
Wear of test wheel and wear of road material determined on different road surfaces with RSAT
(source: Breijn)

Simulation of tyre and surface wear with “rotating surface abrasion test”

- wear material originates 90% from test wheel and 10% from test surface
- results show significant differences between road surfaces



Break down in individual processes (3)
-- surface cleaning --

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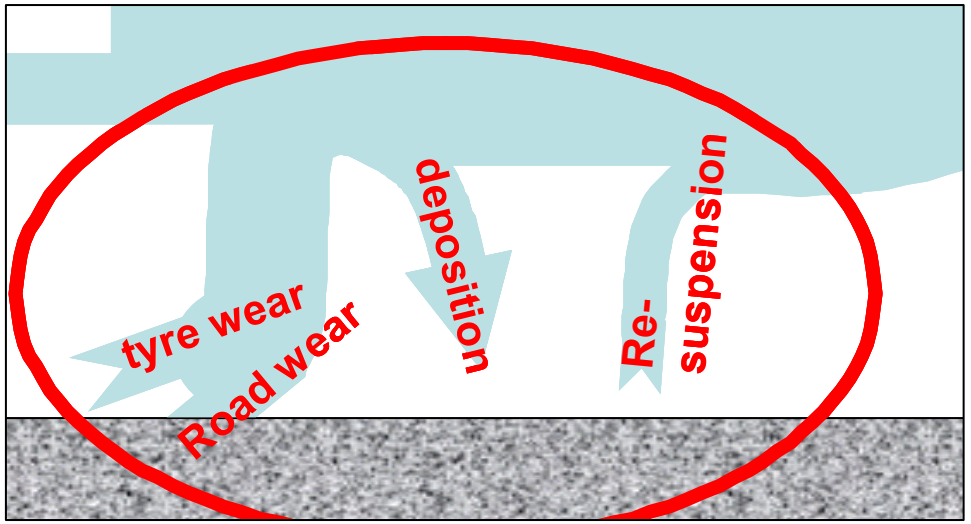
-- surface cleaning --

- Effects with dust cleaning devices are relatively small, often within measurement error (corroborated by similar studies in Germany and UK)
- Wet cleaning of porous road section in Nijmegen showed positive effect (but relatively short observation period and non negligible measuring errors)
- Active rinsing of porous surface is still under test

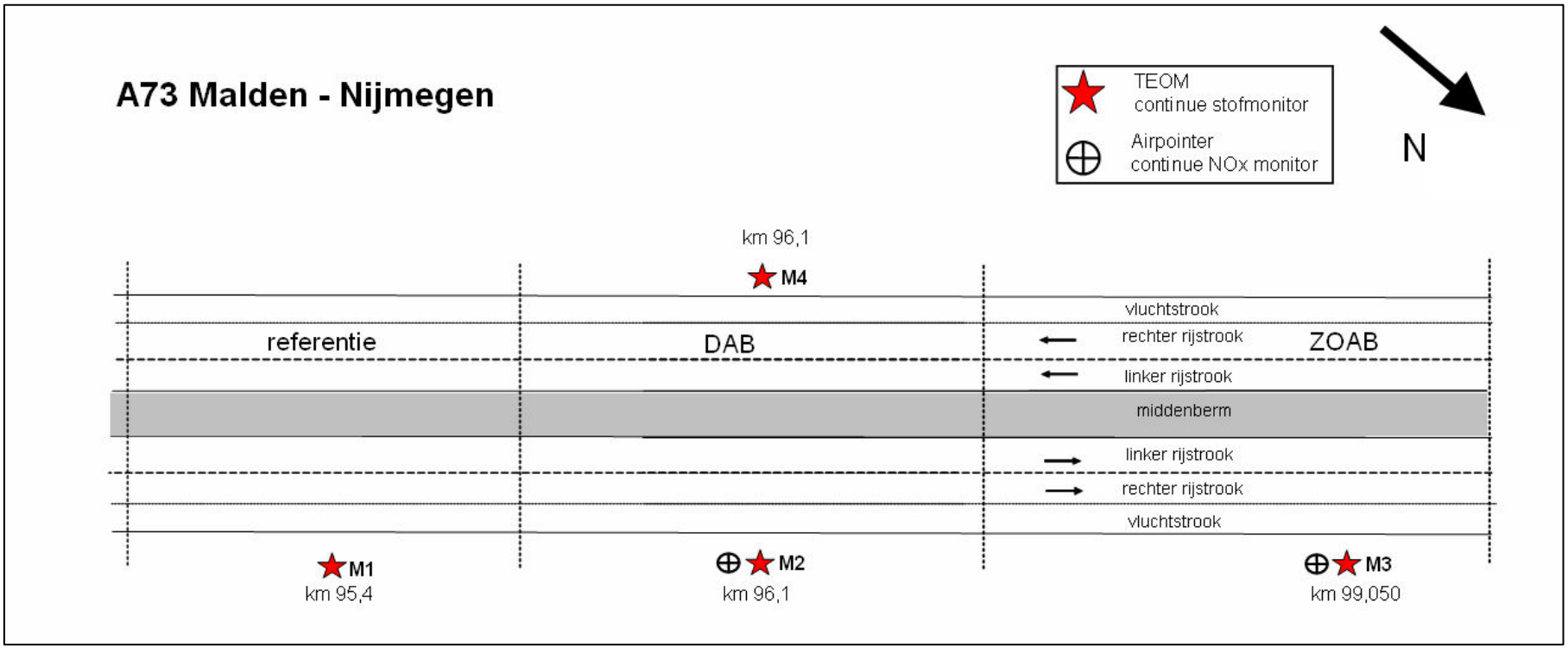
Break down in individual processes (4)
-- resuspension suppression --

Premise:

- transport of tyre and road wear particles occur (partly) through deposition and re-suspension on the road
- PM_{10} improvement can be obtained by making surface sticky (e.g. with $CaCl_2$ spraying)

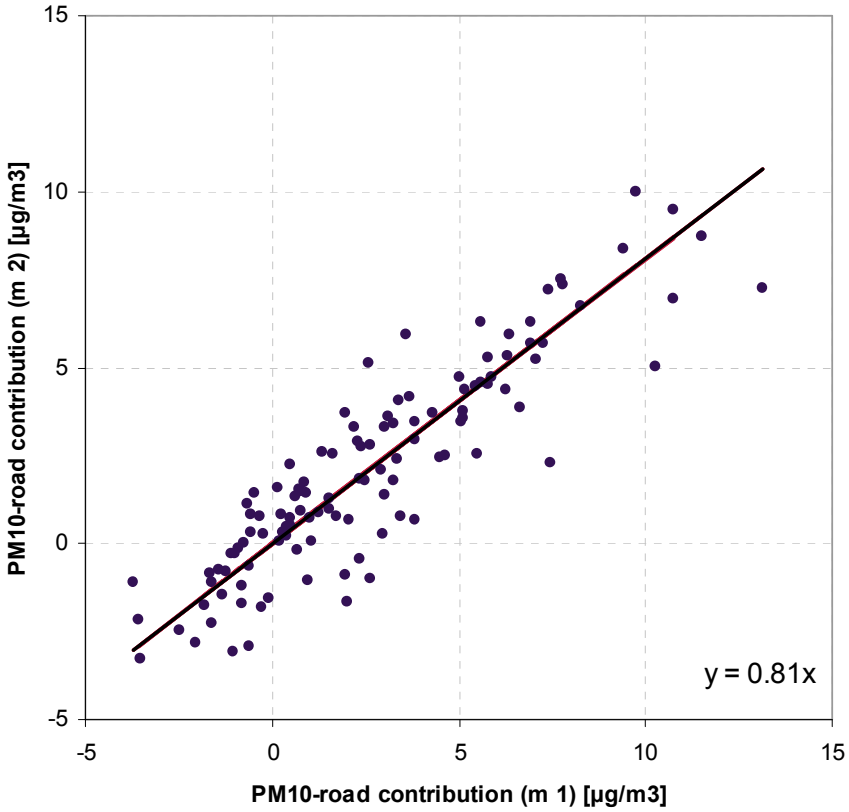


Resuspension suppression by $CaCl_2$ spraying, test on motorway A73



Results $CaCl_2$ test on A73 motorway

- $CaCl_2$ section and reference section <48h after spraying (values corrected for background)
- $CaCl_2$ effect over 48 h period about 20% (24h period about 30%)



Conclusions effect of road surface on PM_{10}

1. Significant effects in studied “full size” cases are hard to determine since:
   - local road traffic contributes only about 25% to overall PM_{10} concentration
   - road surface effect is a small portion of that fraction
   - continuous PM_{10} measurements exhibit relatively low accuracy

Conclusions effect of road surface on PM_{10}

2. Clear effect in full size testing found only for $CaCl_2$ spraying

3. Clear effects found in simulated cases:
   - tyre wear on specific road surfaces (e.g. ModieSlab has half the tyre wear as PAC)
   - rolling resistance differs typically 30% peak-peak, leading to an estimated exhaust emission effect of 15%. Some low resistance roads are also found to exhibit low tyre wear

Additional findings on effect of road surface on PM_{10}

4. Strong indications that porous surfaces have positive effects due to buffering of fine dust particles. However no decisive evidence found

5. Studied data from other sources disagree strongly on the road wear contribution. We found no explanation for the different views

Recommendation

Apart from specific topics already discussed a general finding of the study is that the road surface is a directly adjustable part of the total mobility system

We recommend to develop an integral approach of the effect of the road surface on the safety, sustainability and environmental quality of road traffic and to further explore the potentials for future improvements

Thank you for your attention