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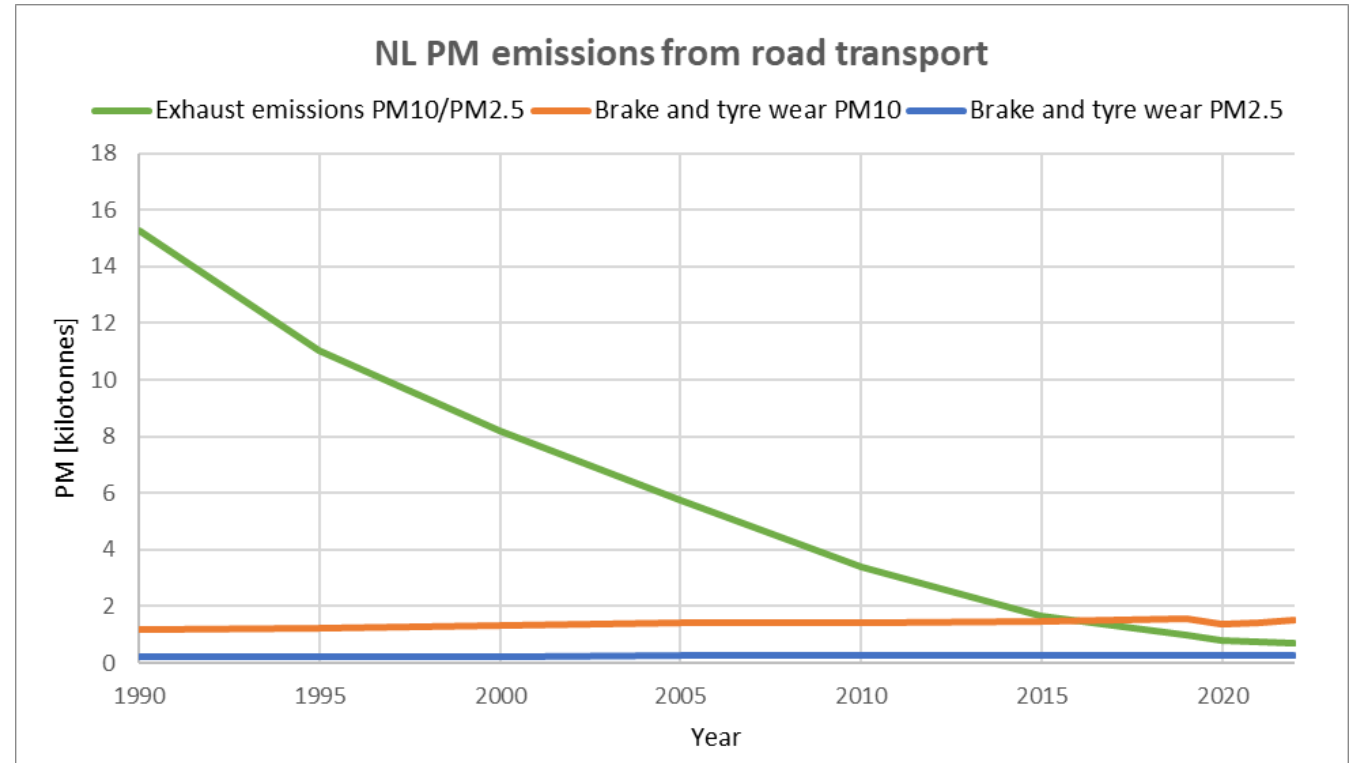
Informal Document GRPE-90-30
90th GRPE, 9th of January – 12th of January, 2024,
agenda item 7

HEALTH EFFECTS OF BRAKE WEAR PARTICLE EMISSIONS GRPE 90 – JANUARY 2024

PRESENTER T. FRATEUR

› THE NON-EXHAUST EMISSIONS PROBLEM

- › Particle mass emissions of brake and tyre wear have overtaken those originating from exhausts.¹
- › Current steps towards addressing the problem of non-exhaust emissions in legislation are very much welcomed.
- › Future steps could improve regulation effectiveness in reducing emission impact on environment and human health.

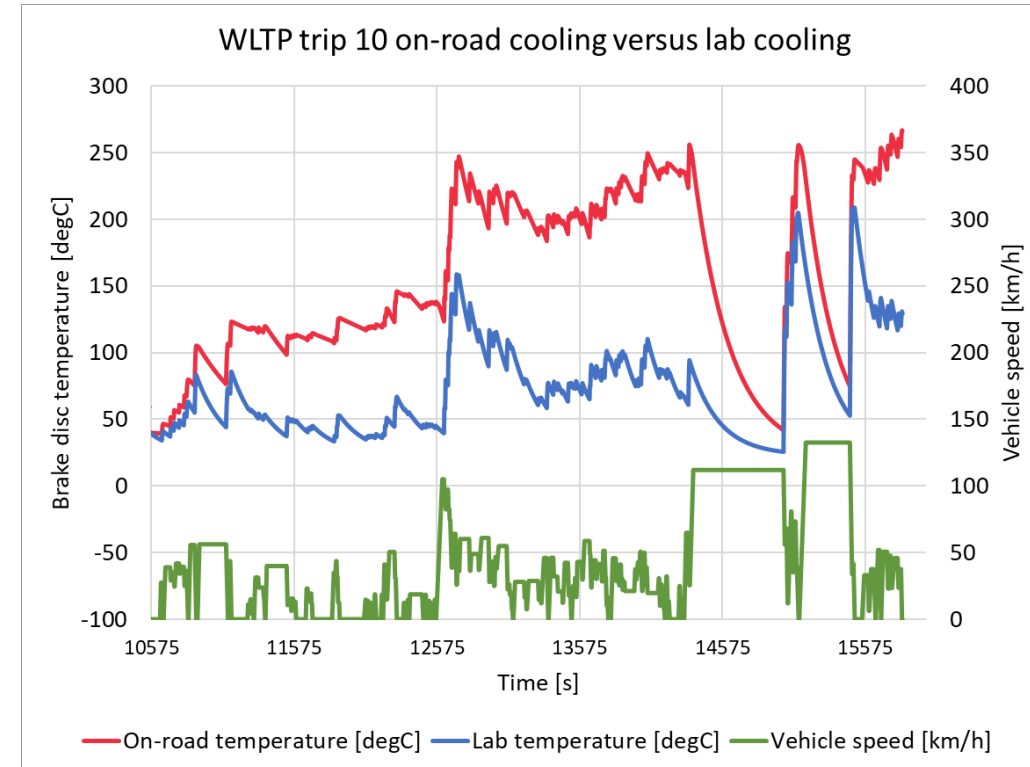


¹ www.emissieregistratie.nl

› BRAKING EMISSIONS

PARTICLE SIZE AND MATERIAL

- › Brake temperature directly affects PM emissions and their particle composition during braking events^{1,2}
 - › Above critical temperatures of 165-190 degC¹ ultra fine particles are emitted (<100 nm) .
- › Brake temperature typically remains below the critical point during the WLTP brake cycle to enable reproducibility in the cycle.
 - › Real world conditions resulting in UFP emissions are overlooked.
- › Local regulation influences material selection for brake lining
 - › In EU only asbestos is noted as forbidden material³
 - › US CA has additional regulated materials⁴



¹ Alemani et al., 2016. A study on emission of airborne wear particles from car brake friction pairs. SAE International Journal of Materials and Manufacturing

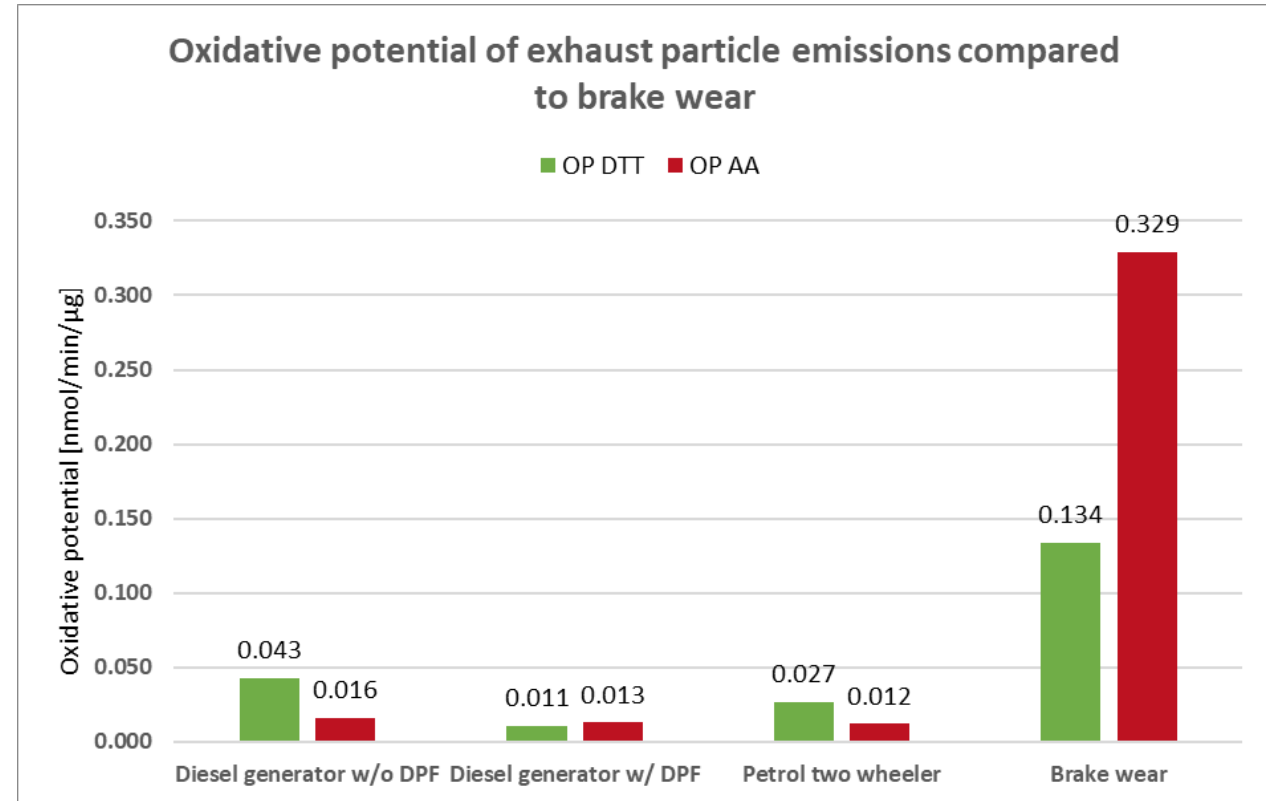
² Nosko et al., 2017. Emission of 1.3–10 nm airborne particles from brake materials. Aerosol Science and Technology

³ Regulation No 90 & 13-H of the Economic Commission for Europe of the United Nations (UN/ECE)

⁴ California Code of Regulations, Title 22, Division 4.5, Chapter 30: California Brake Friction Material Requirement

› BRAKING EMISSIONS HEALTH EFFECTS

- › Particle matter size and material affects human health
 - › Exposure to Ultrafine particles cause greater inflammatory response than fine particles per given mass¹ and negatively impacts the cardiovascular and respiratory system².
- › Oxidative potential is considered a relevant health impact indicator.³
 - › OP for brake wear is significantly higher than for diesel and petrol emission sources. (limited dataset)
 - › First indication that brake wear particles are more harmful to human health than exhaust particle sources



¹ Oberdörster, 2001. Pulmonary effects of inhaled ultrafine particles. Int Arch Occup Environ Health

² Health Council of the Netherlands, 2021. Risks of ultrafine particles in the outside air. The Hague: publication no. 2021/38.

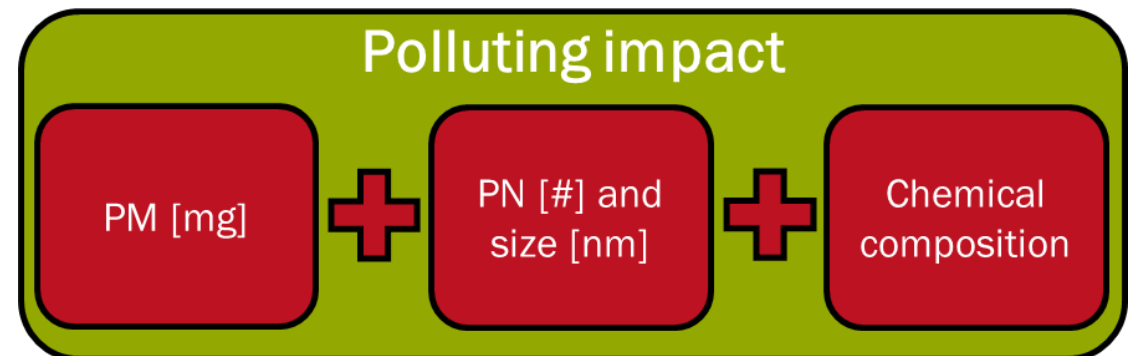
³ Ayres et al., 2008. Evaluating the toxicity of airborne particulate matter and nanoparticles by measuring oxidative stress potential—a workshop report and consensus statement.

Inhalation toxicology

DTT: dithiothreitol, AA: ascorbic acid

› CONCLUSIONS

- › Future steps should look further into the health impact of particle emissions. The following topics could be considered:
 - › Incorporate real-world, “outside of WLTP boundaries” conditions in non-tailpipe emission testing, similar to RDE for exhaust.
 - › Broadening the PM and expected PN emission limits with size distribution criteria to cover a wider range of indicators for health effects, e.g. ultra fine particles.
 - › Material selection for brake lining could be regulated to minimize or avoid harmful materials in wear susceptible parts.
 - › Ideally, brake wear emissions are evaluated on their total impact by means of PM, PN (incl. size distr.), material or health relevant indicator.



› RECOMMENDATION

- › The Netherlands invites GRPE to consider
 - › extending the mandate of the PMP IWG to investigate the environmental and health impact of brake wear emissions
 - › support of appropriate future steps for brake wear legislation
- › The Netherlands is willing to give (full) support to this process.



› **THANK YOU FOR
FOR YOUR ATTENTION**

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