HEALTH EFFECTS OF BRAKE WEAR PARTICLE EMISSIONS

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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
Brake temperature directly affects PM emissions and their particle composition during braking events. Above critical temperatures of 165-190 degC, 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 material. US CA has additional regulated materials.

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
Particle matter size and material affects human health

- Exposure to Ultrafine particles cause greater inflammatory response than fine particles per given mass and negatively impacts the cardiovascular and respiratory system.

- Oxidative potential is considered a relevant health impact indicator.

- 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.

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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
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