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Non-Exhaust Emissions – Paradigm Shift to Wear Particles in Traffic

A decade ago, non-exhaust emissions were of little importance in the field of emissions. Today, they dominate the field of research into emissions in the transport sector.

Exhaust emissions from motor vehicles have been significantly reduced thanks to ever-stricter limits and more realistic test procedures in the exhaust emission standards. In combination with the increase in kilometers driven and the average vehicle weight, the proportion of tire and road wear particle emissions is increasing in terms of both particle mass and number. As a result of the electrification of drive systems and the potential to recover braking energy electrically, brake wear emissions are decreasing. In Measurements and simulation of tire and brake wear [1], a

reduction in the proportion of exhaust PM from 20 % to 2 % was calculated for road traffic from 2020 to 2050, along with a simultaneous increase in non-exhaust emissions. Overall, PM emissions from road traffic will therefore only decrease by around 20 %. As stricter air quality limit values must be complied with throughout the EU from 2030, these low reduction rates could lead to exceeded values at air quality measuring stations close to traffic. The proportion of tire and road wear particles could already be around 60 % by 2030, with a rising trend.



Figure 1: Development of PM10 levels caused by traffic for light (LDV) and heavy-duty vehicles (HDV) from 1990 to 2050. [1]

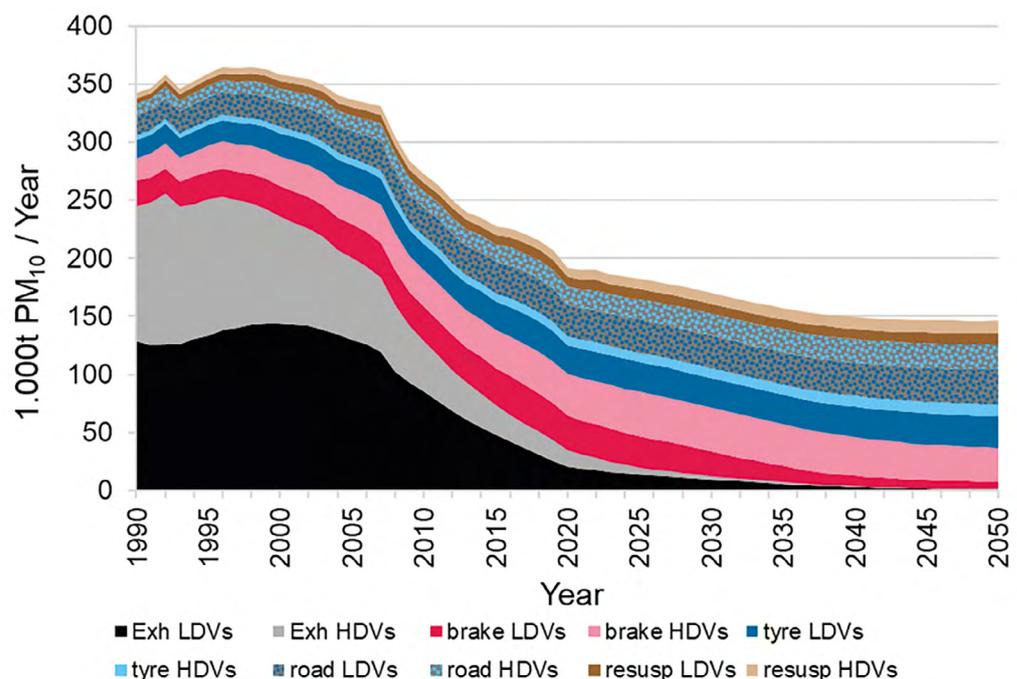




Figure 2: Truck tires on a truck chassis dynamometer for the measurement of tire wear particles.



Figure 3: Component test bench for the measurement of tire wear particles on an outer drum test bench.



Figure 4: Component test bench for the measurement of railway brake wear particles.

In addition to the risk of exceeding future air quality limits, current trends also show that general particulate pollution is hardly decreasing [2]. In addition to the contribution of all non-exhaust particles to air quality pollution with significant negative health effects, tire wear contributes significantly to the release of microplastics. It is estimated to account for 450,000 tons in the EU alone in 2019 [3]. High wear on components also leads to higher costs for vehicle owners due to replacements.

Under the new Regulation (EU) 2024/1257 (“Euro-7”), emissions from brake and tire wear are regulated for the first time. Technical regulation in the area of brakes is carried out via the UN Global Technical Regulation No. 24 (UN GTR No. 24),

which measures and limits brake wear on a special component test bench. Here, the released brake wear particles are recorded directly in order to control the exposure to brake dust. For tires, on the other hand, the UN Global Technical Regulation No. 117 (UNR117) describes the test method for determining the relevant total tire wear. As no method exists to date for the representative measurement of airborne particles (PN, PM2.5, PM10) for tire wear, UNR117 only weighs the total tire wear after convoy driving on the road. Total tire wear and therefore microplastic emissions are well regulated, but ultrafine particles (UFP) due to tires, which pose health risks to humans and animals, are not measured. As a result, there is a significant risk that while tires are being

developed to reduce worn mass, this may be accompanied by an increase in UFP or the use of more environmentally harmful components.

Graz University of Technology has initiated the lead project “NExT (Non Exhaust Emission Topics)” on this relatively new research topic. In NExT, the Institutes of Electrical Measurement and Sensor Systems (EMS), of Electron Microscopy and Nanoanalysis (FELMI), of Thermodynamics and Sustainable Propulsion Systems (ITnA), of Automotive Engineering (FTG) and for Structural Durability and Railway Technology (BST) are working together on current issues such as how these airborne emissions can be reliably measured and quantified under real driving





conditions, what role different materials, driving styles and road conditions play in their formation or how ultrafine particles can be precisely recorded and analyzed. Not only is road traffic being scrutinized, but also rail traffic, which makes a significant contribution to non-exhaust emissions. In addition to NeXT, the institutes are also working on a number of national and international research projects on non-exhaust emissions. We use our test benches for various vehicle categories and components to investigate the gen-

eration and characteristics of emissions under controlled conditions. The aim is to further develop the measurement methods and simulation models in order to make more accurate predictions about emissions and their effects as well as to validate them under real-life conditions.

With these comprehensive investigations and our combined expertise, we want to make a decisive contribution to reducing non-exhaust emissions and thus improve air quality and health in the long term. ●



Lead project consortium.

REFERENCES

- [1] E. E. Ketan, S. Hausberger und L. Landl, „Measurements and simulation of tyre wear emissions from road traffic,“ Prague, 2024.
- [2] Umweltbundesamt Gesellschaft, “www.umweltbundesamt.at,” [Online]. Available: <https://www.umweltbundesamt.at/umweltthemen/luft/luftschadstoffe/staub/pm10>. [Zugriff am 20 02 2025].
- [3] European Commission, “Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on preventing plastic pellet losses to reduce microplastic pollution,” 2023. [Online]. Available: [https://ec.europa.eu/transparency/documents-register/detail?ref=SWD\(2023\)332&lang=en](https://ec.europa.eu/transparency/documents-register/detail?ref=SWD(2023)332&lang=en). [Zugriff am 27 January 2025].