Chemical Assessment of genotoxic emissions from gasoline direct injection vehicles

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Gasoline Direct Injection vehicles (GDI) are quickly replacing traditional gasoline port-fuel injection (PFI) technology. They are claimed to have lower fuel consumption and CO_2 emissions. In the next years to come, we will be increasingly exposed to GDI vehicle exhausts with yet unknown consequences. It is expected that more than 50 million GDI vehicles operate on our roads in 2020 resulting in an important impact on urban air quality and human health.

PAHs, a group of genotoxic compounds released from new gasoline direct injection (GDI) vehicle exhausts are formed and released together with soot nanoparticles, supporting the T*rojan Horse effect*[1]. This nanoparticles (<100 nm) penetrate the alveolar region involving a severe health risk. A multistep analytical procedure was designed to determine PAHs in these exhaust. Average mean particle concentrations of 7 GDI vehicles tested exceeded the current Euro-6 particle number (PN) limit of 6 x 10^{11}particles/km. On average, GDI vehicles emit up to 17-fold more genotoxic PAHs than a tested bench mark diesel vehicle with DPF. Best available technologies are required to reduce these emissions. Four prototype gasoline particle filters showed potential to reduce these emissions, even though, above the levels of a diesel vehicle with particle filter. On average, a 4-7-fold decrease on emissions was observed for PN and 2-5 fold decrease for genotoxic PAHs. However, one out of four filters had the poorest filtration efficiency, even showing an increase on emissions[2]. Bioethanol-gasoline blends have also shown potential to reducing emissions[3].

[1] Muñoz, M.; Haag, R.; Honegger, P.; Zeyer, K.; Mohn, J.; Comte, P.; Czerwinsk, J.; Heeb, N. V., Co-formation and co-release of genotoxic PAHs, alkyl-PAHs and soot nanoparticles from gasoline direct injection vehicles. *Atmos. Environm.* **2018,** *178*, 242-254.

[2] Muñoz, M.; Haag, R.; Zeyer, K.; Mohn, J.; Comte, P.; Czerwinski, J.; Heeb, N. V., Effects of four prototype gasoline particle filters (GPFs) on nanoparticle and genotoxic PAH emissions of a gasoline direct injection (GDI) vehicle. *Environ. Sci. Technol.* **2018**.

[3] Muñoz, M.; Heeb, N. V.; Haag, R.; Honegger, P.; Zeyer, K.; Mohn, J.; Comte, P.; Czerwinski, J., Bioethanol Blending Reduces Nanoparticle, PAH, and Alkyl- and Nitro-PAH Emissions and the Genotoxic Potential of Exhaust from a Gasoline Direct Injection Flex-Fuel Vehicle. *Environ. Sci. Technol.* **2016,** *50*, (21), 11853-11861.