Particle Number Reduction of GDI-Cars with GPF’s

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Abstract

The nanoparticles (NP) count concentrations are limited in EU for Diesel passenger cars since 2013 and for gasoline cars with direct injection (GDI) since 2014. The limit for GDI was temporarily extended to 6 x 10^{12} #/km (regulation No. 459/2012/EU). Nuclei of metals as well as organics are suspected to significantly contribute especially to the ultrafine particle size fractions, and thus to the particle number concentration. The invisible nanoparticles (NP) from combustion processes penetrate easily into the human body through the respiratory and olfactory pathways and carry numerous harmful health effects potential.

In the project GasOMeP (Gasoline Organic & Metal Particulates) metal-nanoparticles (including sub 20nm) from gasoline cars are investigated for different engine technologies. In the present paper some results of investigations of nanoparticles from five DI gasoline cars are represented. The measurements were performed at vehicle tailpipe and in CVS-tunnel. Moreover, five variants of “vehicle – GPF” were investigated. The PN-emission level of the investigated GDI cars in WLTC without GPF is in the same range of magnitude very near to the actual limit value of 6.0 x 10^{12} #/km. With the GPF’s with better filtration quality, it is possible to lower the emissions below the future limit value of 6.0 x 10^{11} #/km.

There is no visible nuclei mode and the ultrafine particle concentrations below 10nm are insignificant. Some of the vehicles show at constant speed operation a periodical fluctuation of the NP-emissions, as an effect of the electronic control.

Results at steady state operation SSC

Results at Transient operation WLTC

Conclusions

• the PN-emission level of the investigated GDI cars in WLTC without GPF is in the same range of magnitude very near to the actual limit value of 6.0 x 10^{12} #/km
• with the GPF’s with better filtration quality it is possible to lower the emissions below the future limit value of 6.0 x 10^{11} #/km
• the filtration efficiency of GPF can attain 99% but it can also be optimized to lower values – in this respect the requirement of “best available technology for health protection” should be considered

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