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Nanoparticles Research on four Gasoline Cars

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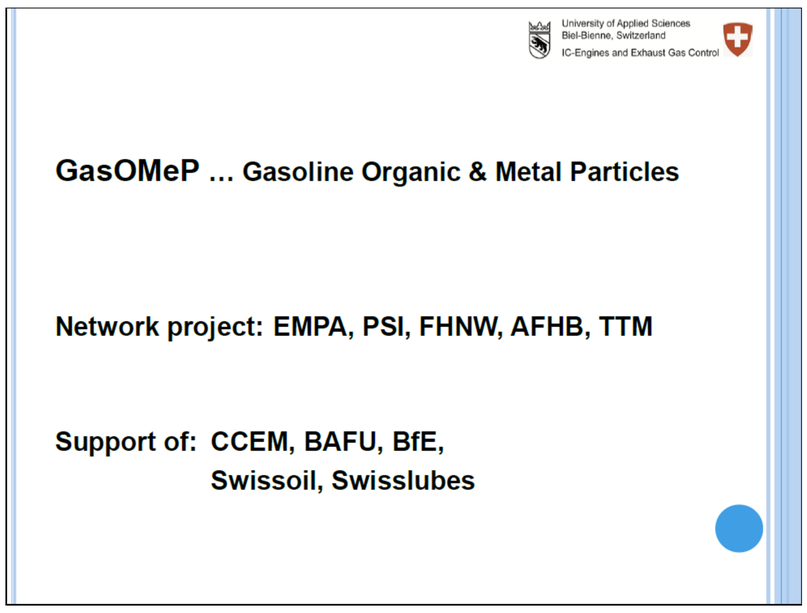
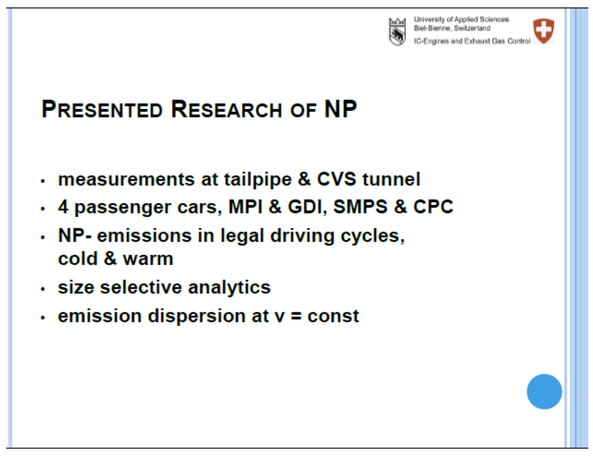




Abstract

In the project GasOMeP (Gasoline Organic & Metal Particulates) metal-nanoparticles (including sub 20nm) from gasoline cars are investigated for different engine technologies.

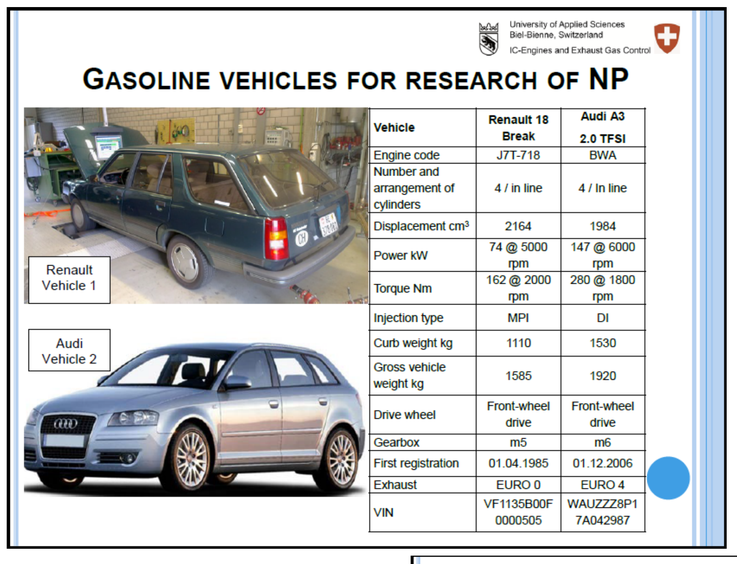
In the present paper some results of investigations of nanoparticles from four gasoline cars – an older one with MPI and three never with DI – are represented. The measurements were performed at vehicle tailpipe and in CVS-tunnel.

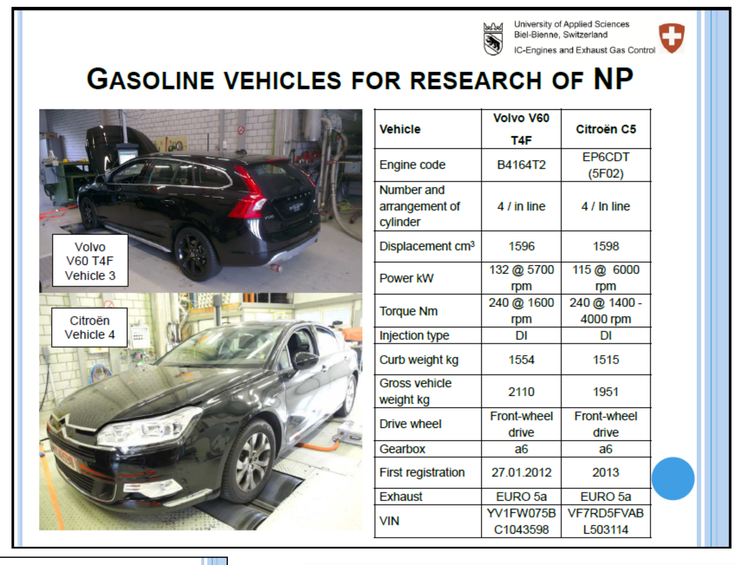
The results show that the older vehicle with MPI emits high particle count concentrations. The size distributions of this vehicle are decisively bimodal with high numbers in nuclei mode.

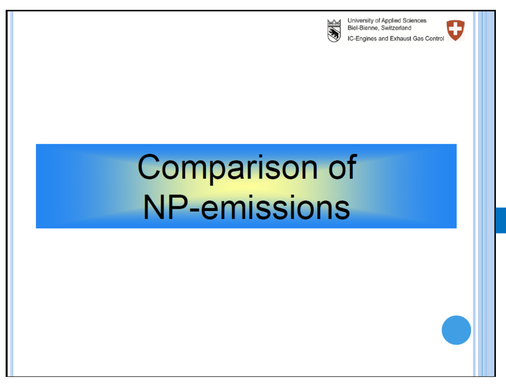
The emissions of the newer vehicles with DI show sometimes no typical uniform shape of particle size distributions and are at lower level, than for the older vehicle. There is no visible nuclei mode and the ultrafine particle concentrations below 10nm are insignificant.

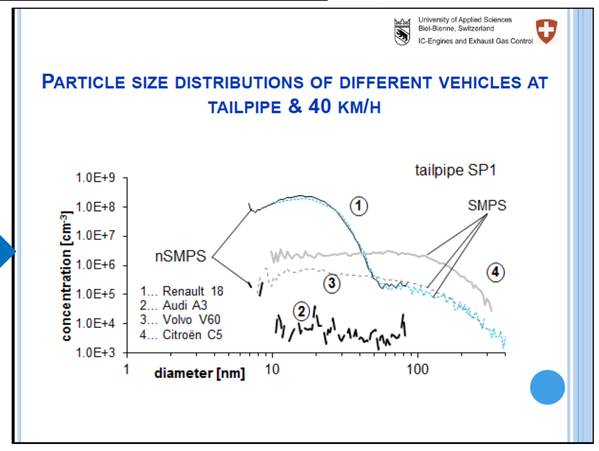
A size-selective analysis of the composition of NP's in NEDC revealed an increased amount of Na, Mg, Ca & Zn in the lowest size range, below 100nm.

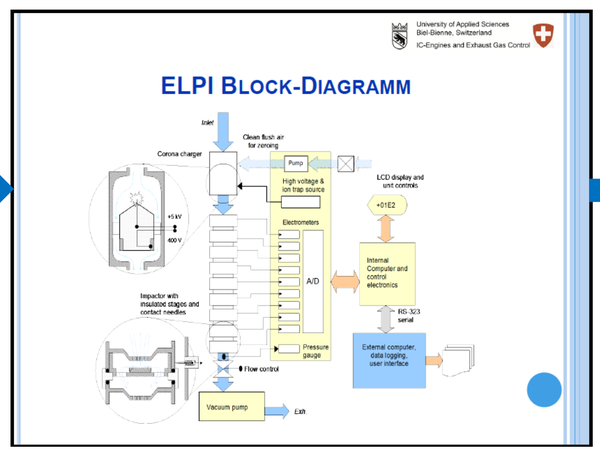
Some of the newer, low-emitting vehicles show at constant speed operation a periodical fluctuation of the NP-emissions.
Increased NP-emissions at cold start were confirmed.

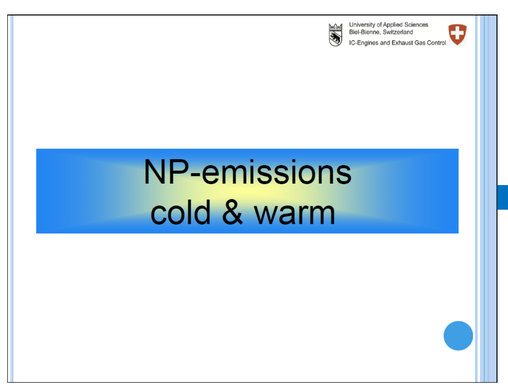


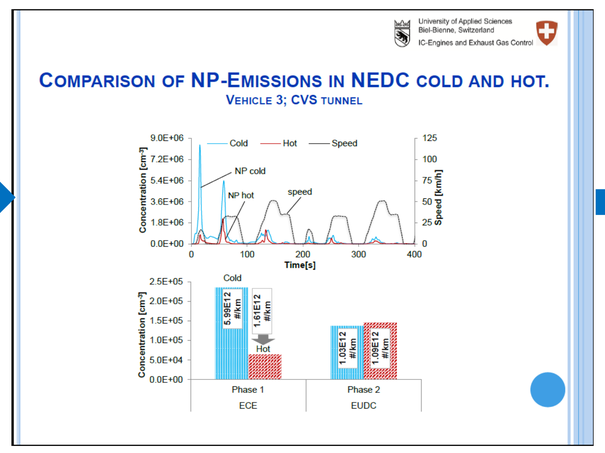


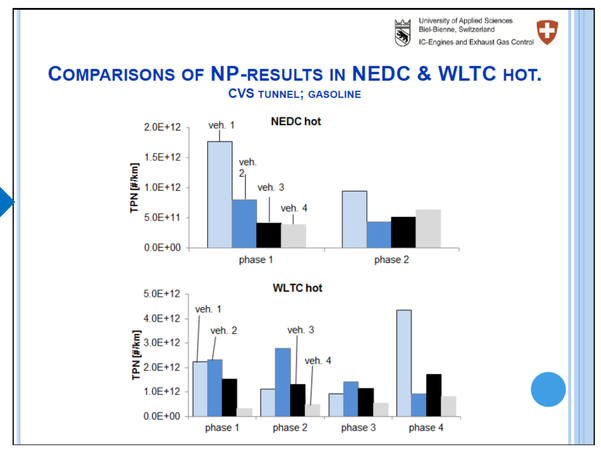


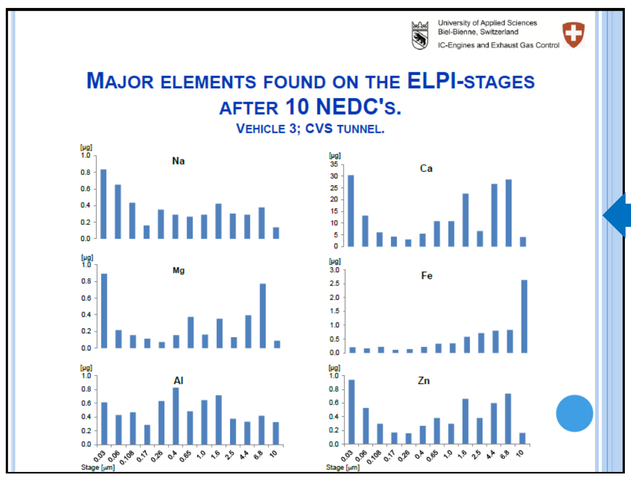


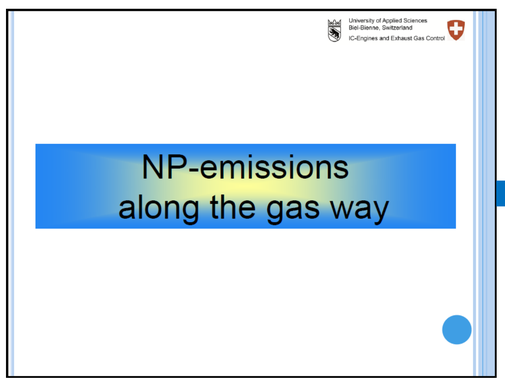


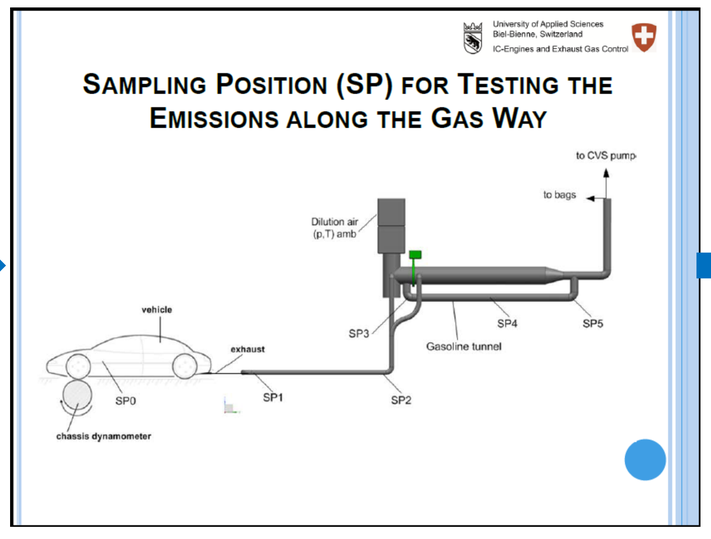


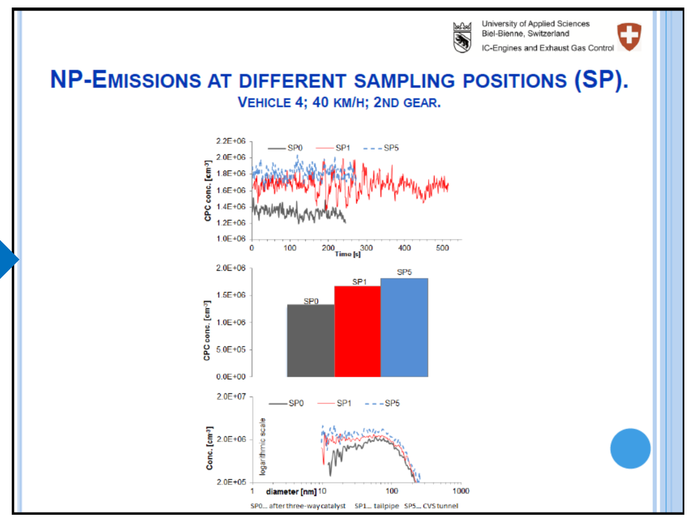












Conclusions

- the older model with MPI (vehicle 1) emits at the stationary part load operation up to 4 orders of magnitude more nanoparticles,
- for the low-emitting vehicle there are sporadic NP-emission peaks and no clear shape of particle size distribution,
- for the vehicles with DI (vehicle 2, 3 & 4) there is no increase of PC's in nuclei mode (below 10 nm) at the measured constant speeds,
- the NP emitted at cold start (20-25°C) of a NEDC, or WLTC are roughly 4 to 5 times higher than with the hot start,
- in the last phases of WLTC with higher accelerations, with higher speeds and more energy needed for accelerations, there is a highest level of NP-emissions,
- there is a good repeatability of the average emissions in the "warm" driving cycles,
- 10 NEDC's allow the accumulation of enough particles on the ELPI-stages, to enable the size-selective substance analysis,
- the most important substances found after 10 NEDC's in the 3 lowest stages (sizes: 0,03; 0,06; 0,108; µm) were: Na, Mg, Ca and Zn,
- there is an increase of particle counts along the gas way due to the increasing nuclei mode,
- due to the electronic regulation of the engine the NP-emission of some vehicles (here vehicle 3 & 4) are periodically fluctuating,
- comparing the NP-emissions of different vehicles with SMPS PSD's at constant operation gives only a limited information about the relationships of emissions measured with CPC in dynamic driving cycles.

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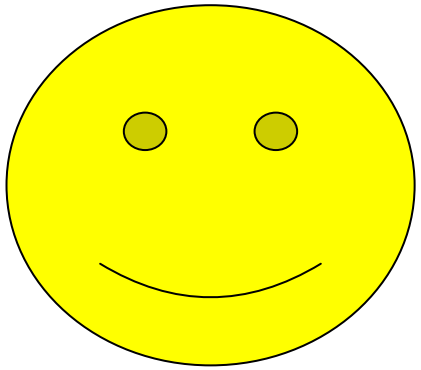

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