Nanoparticle Emissions of GDI Car with Increased Lube Oil Consumption, Potentials of GPF.

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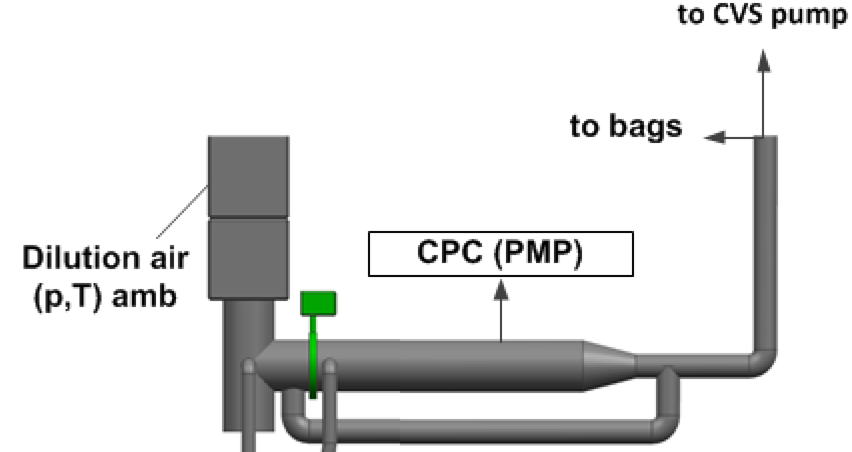
TEST VEHICLE

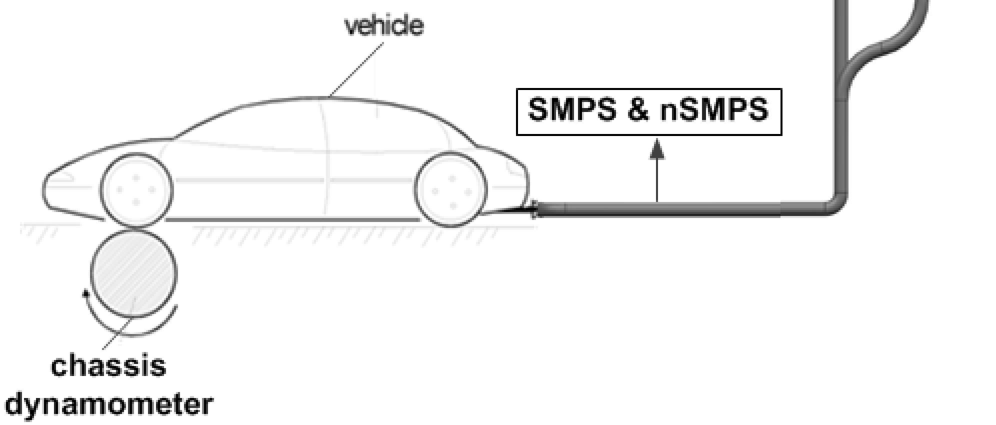
Model and year	Seat Leon 1.4 TSI ST/ 2015
Type of engine	CZEA
Number and arrangement of cylinders	4 / in line
Displacement	1395 cm^3
Power	110 kW @ 6000 min^{-1}
Torque	250 Nm @ 1500 min^{-1}
Injection	Gasoline / DI
Turbocharging	Yes
Curb weight	1287 kg
Gross vehicle weight	1830 kg
Drive wheel	Front-wheel drive
Gearbox	m6
First registration / mileage	13.11.2014 / 27880 km
Exhaust standard	EURO 6b
Exhaust aftertreatment system	O_2-Sonde, TWC

Lube oils

Property	**"L" Profile R-XL SAE 5W730 #133302**	**"H" TOPAZ SAE 5W730 #115151**	
Viscosity kin 40°C	68.5	69.7	mm^2/s
Viscosity kin 100°C	11.96	11.90	mm^2/s
Viscosity index	172.5	168.0	(--)
Density 20°C	852.4	855.0	kg/m^3
Pourpoint	-33	-39	°C
Flamepoint	≥ 200	≥ 200	°C
Total Base Number TBN	7.4	10.2	mg KOH/g
Sulfur ashes	400	1200	mg/kg
Sulfur	1770	3376	mg/kg
Mg	21	66	mg/kg
Zn	517	1117	mg/kg
Ca	1219	3106	mg/kg
P	458	926	mg/kg
Sum S to P	3985	8591	mg/kg

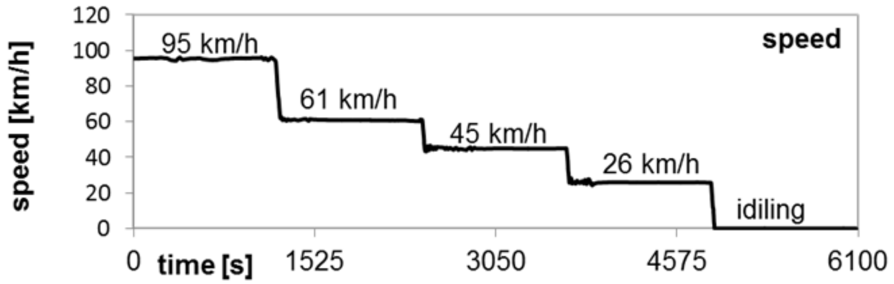
Chassis Dynamometer at AFHB



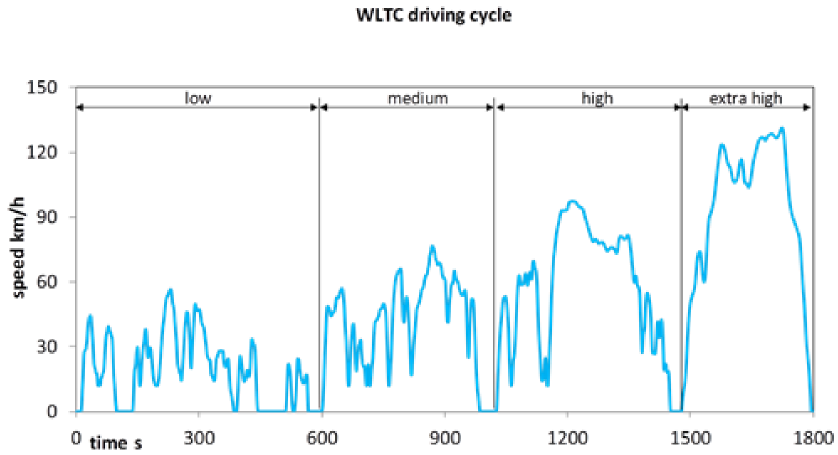


Test cycles

SSC Steady State Cycle



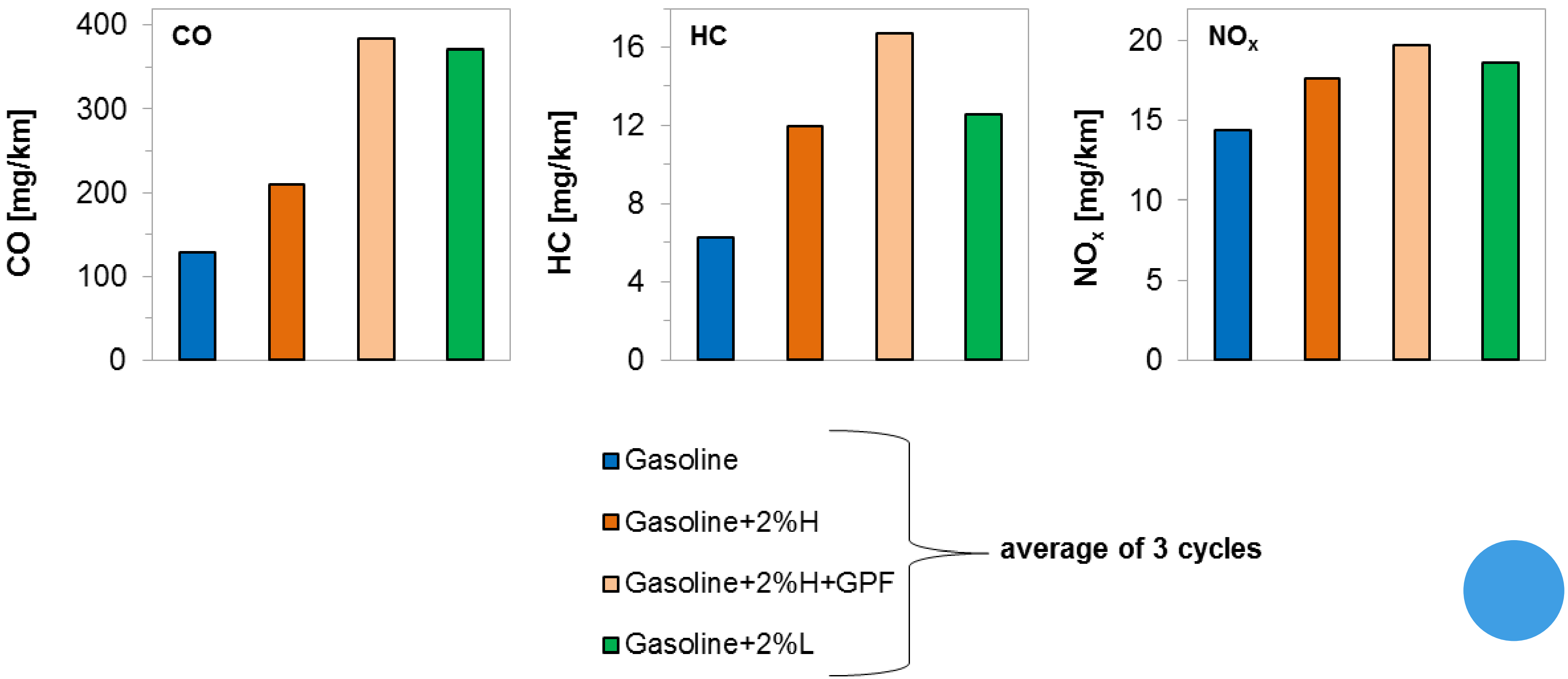
WLTC driving cycle



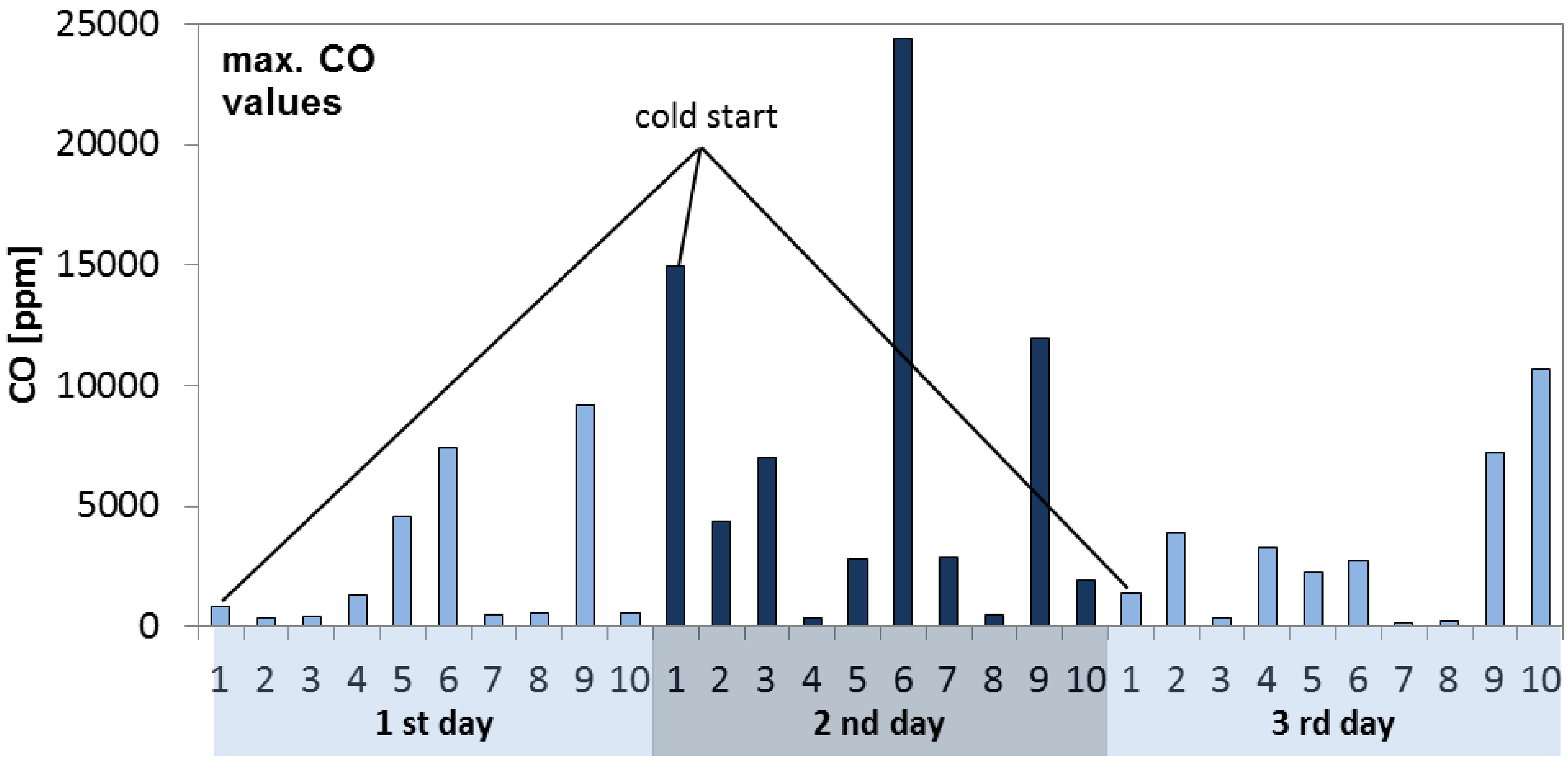
Test Series

- state of origin (gasoline, 3WC)
- addition of 2% lube oil “H” (Topaz) to fuel
- addition of 2% lube oil “H” (Topaz) to fuel + GPF
- addition of 2% lube oil “L” (profile) to fuel.

Limited Gaseous Exhaust Emissions in WLTC Warm.



Chronological Comparison of CO Peaks During 30 WLTC Driving Cycles. Fuel: gasoline + 2% oil H; with GPF



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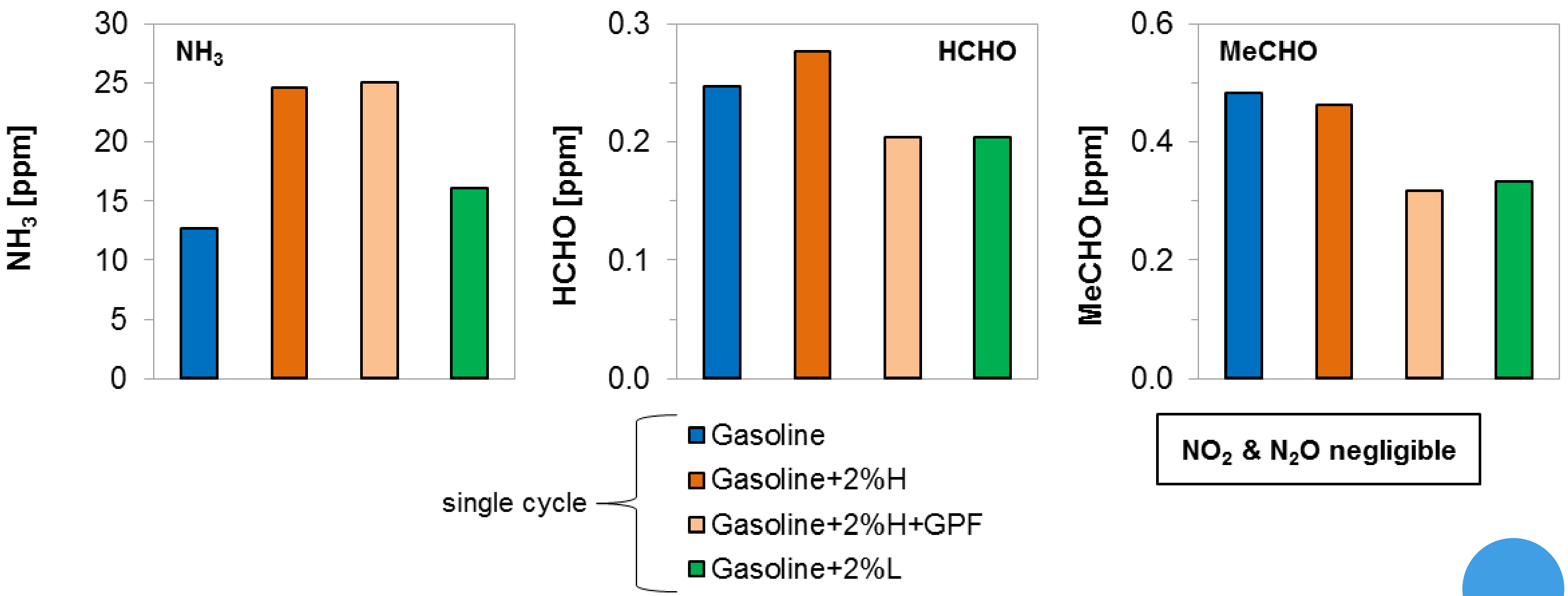
Non-legislated Gaseous Emissions in WLTC Warm.



NO_2 & N_2O negligible

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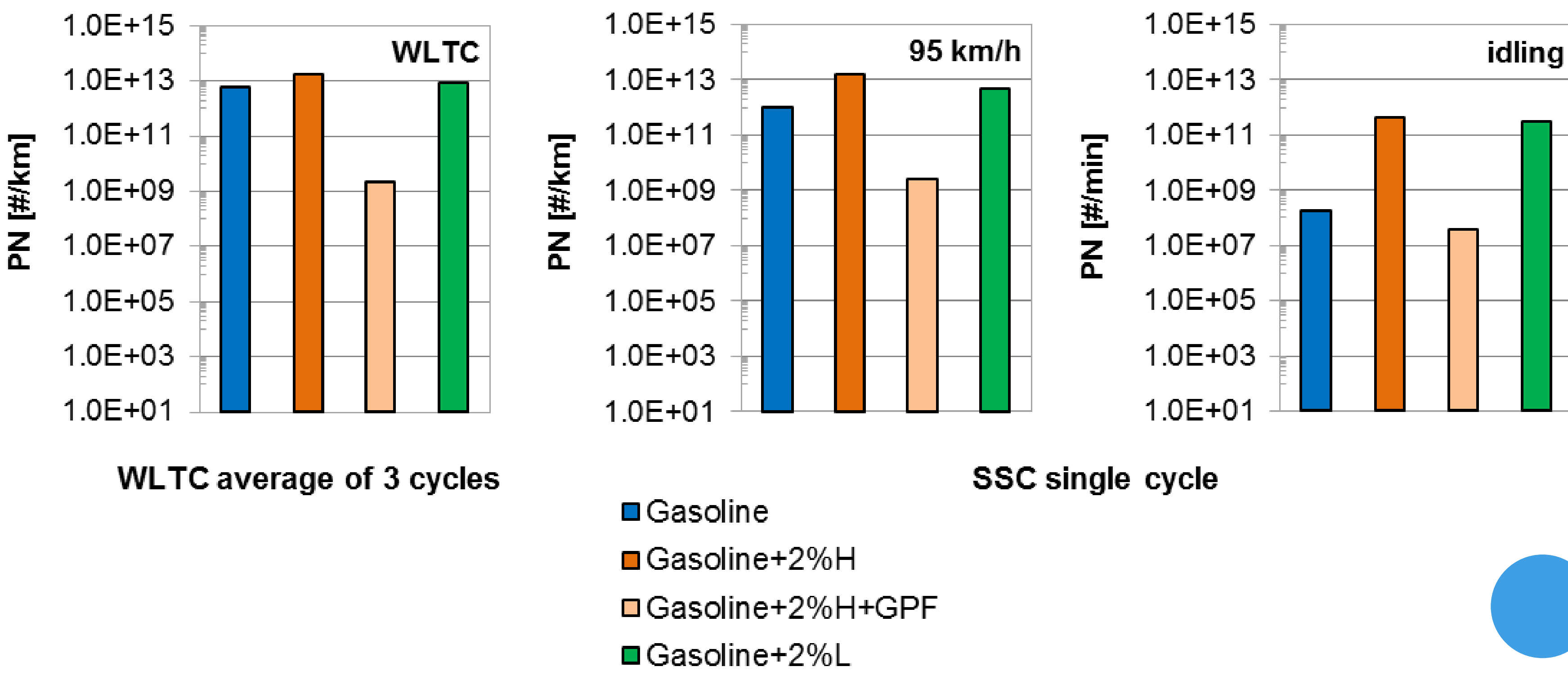
PN Emissions During WLTC Warm and SSC Driving Cycles Warm.



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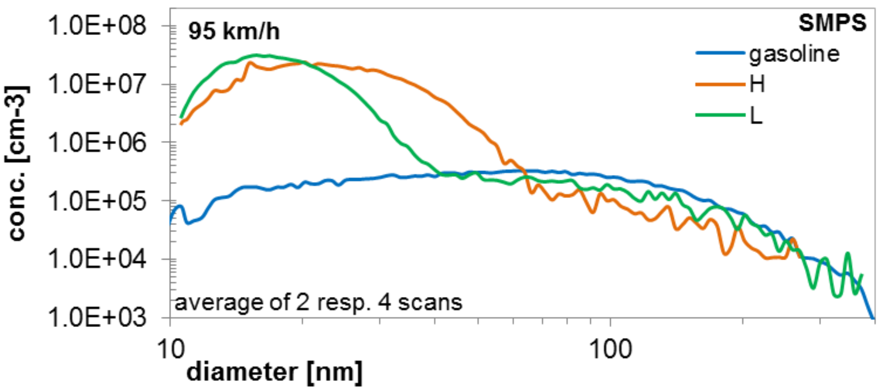
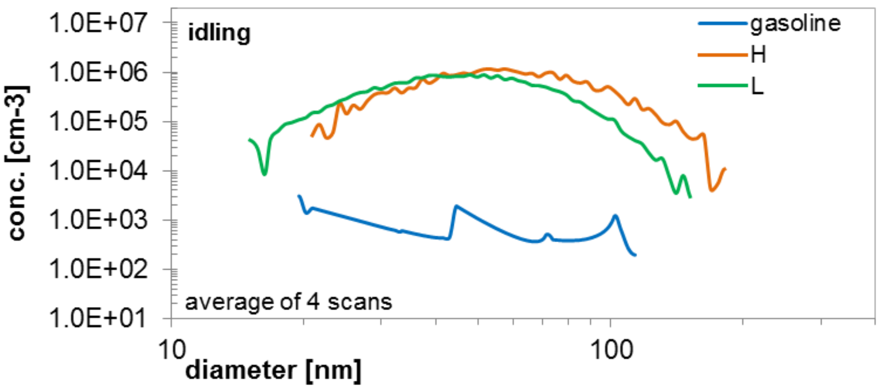
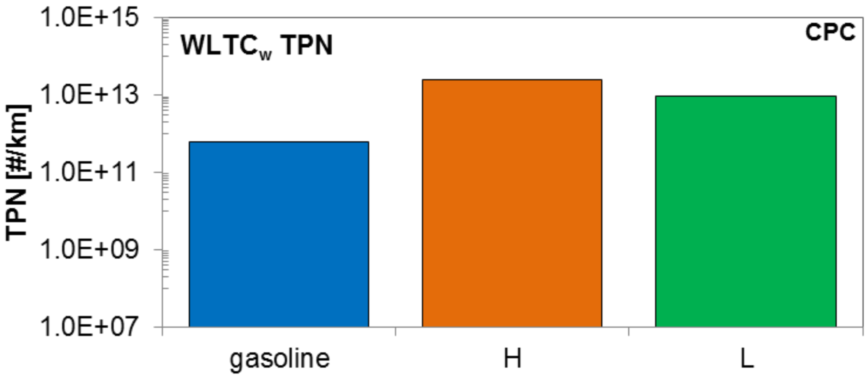
Effect of increased lube consumption fuel: gasoline & gas. + 2% oil

H «high», L… «low» metals & ashes in lube oil







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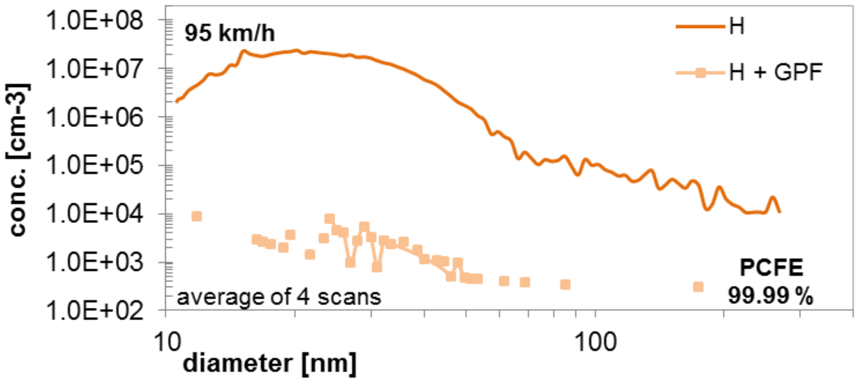
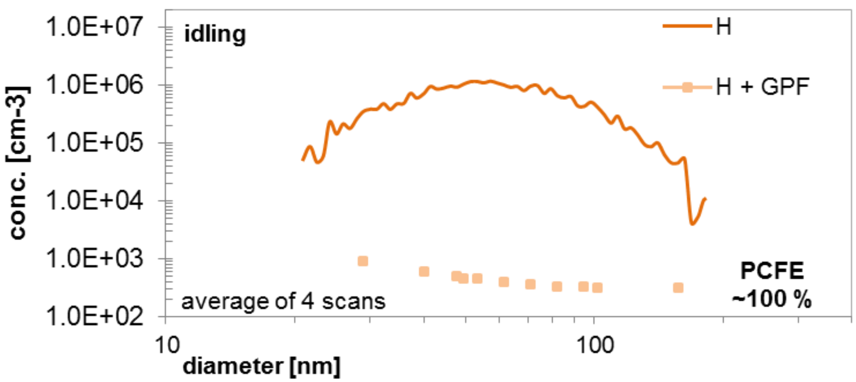
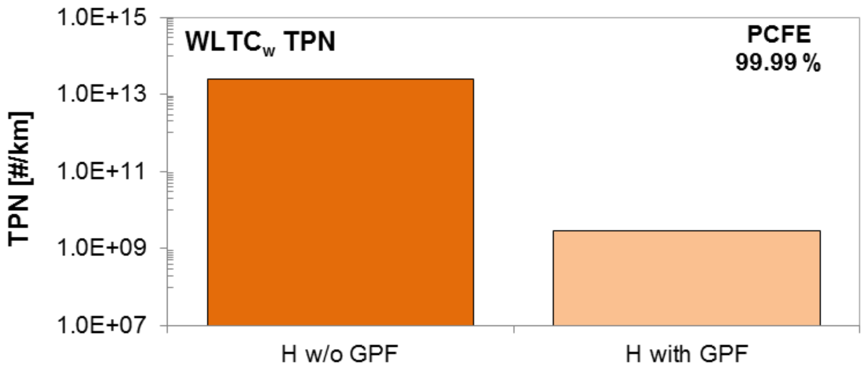
Effect of GPF with Increased Lube Oil Consumption

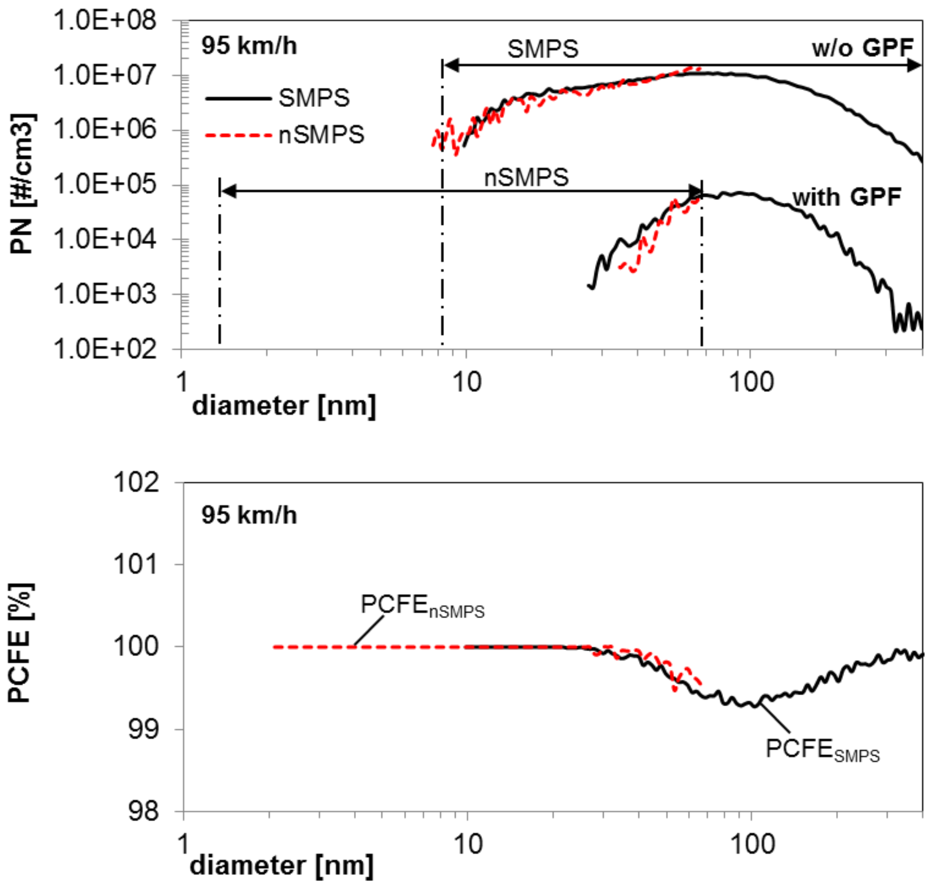
fuel: gasoline + 2% oil H; with & w/o GPF







Example of PSD's with SMPS & nSMPS and Particle Counts Filtration Efficiency (PCFE), GPF 1 at 95 km/h



Conclusions (1)

- the increased lube oil consumption increases emissions of CO and HC, it can have impact on Lambda regulation and contributes to increased NH_3-values
- with all fuels: gasoline, gasoline +"H" and gasoline +"L" there are no emissions of nitric dioxide NO_2, of nitrous oxide N_2O and negligible emissions (<1ppm) of aldehyde HCHO and of acetaldehyde MeOH

Conclusions (2)

- **with addition of lube oil to the fuel (simulating the increased lube oil consumption) there is an increase of PN-emissions by approximately 2 orders of magnitude**

- **an efficient GPF eliminates the nanoparticles and lowers PN by 4 orders of magnitude**


Thanks
for your
attention!