

Influences on measurement of ultrafine Particles

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Influence of Sampling Conditions, Engine Load and Fuel Quality on Measurement of Ultrafine Particles from a Modern Diesel Vehicle - Parameter Variation Measurement Results -

Influences on measurement of ultrafine Particles

Presentation overview

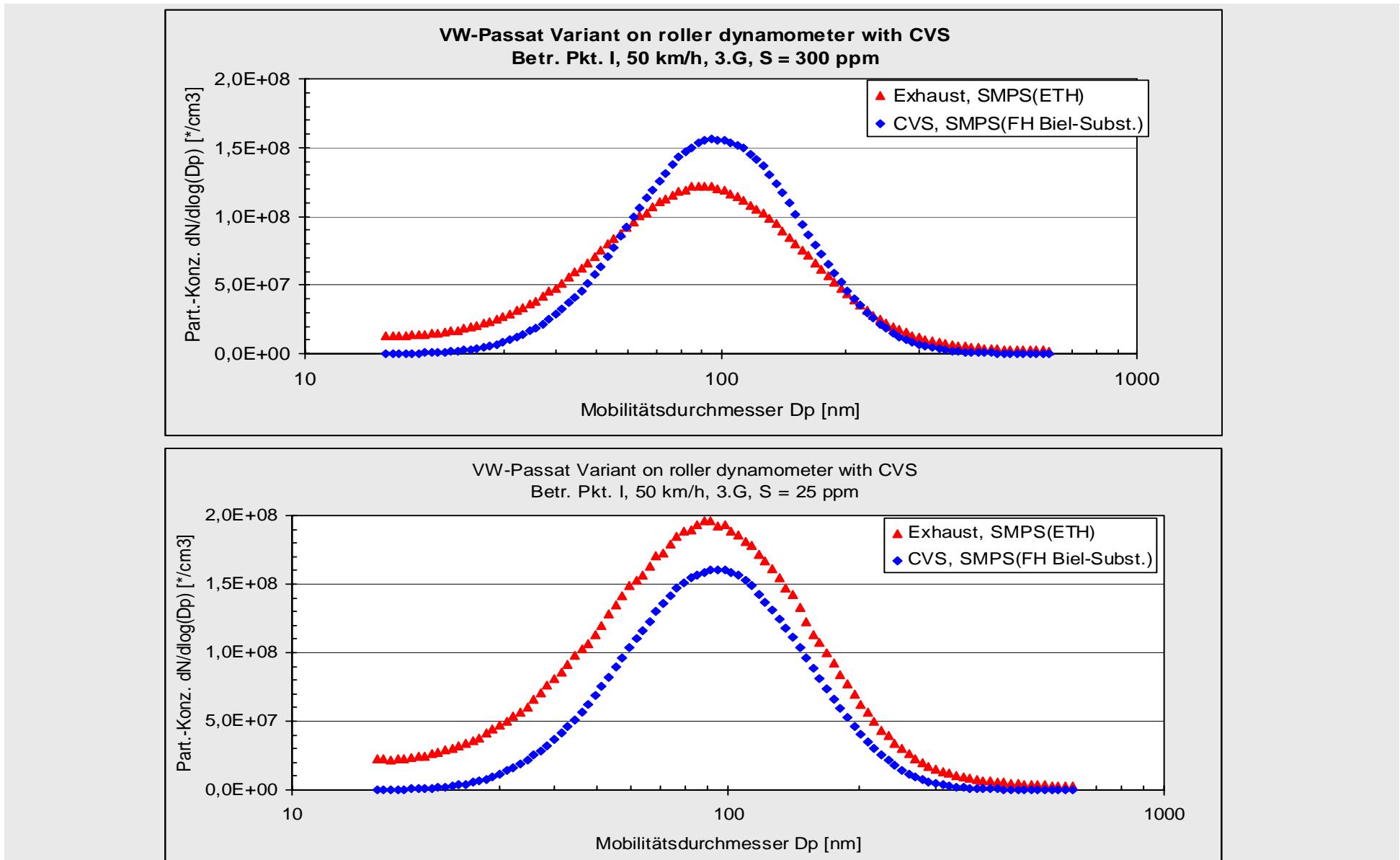
- 1. Load and fuel sulphur content influences on particle NSD and PM**
- 2. What causes the nucleation particle mode, how are measurement conditions that provoke / avoid nucleation**
- 3. Comparison of mobility size to aerodynamic size classification**
- 4. Comparison of SMPS's used during the investigation**
- 5. Summary / conclusions**

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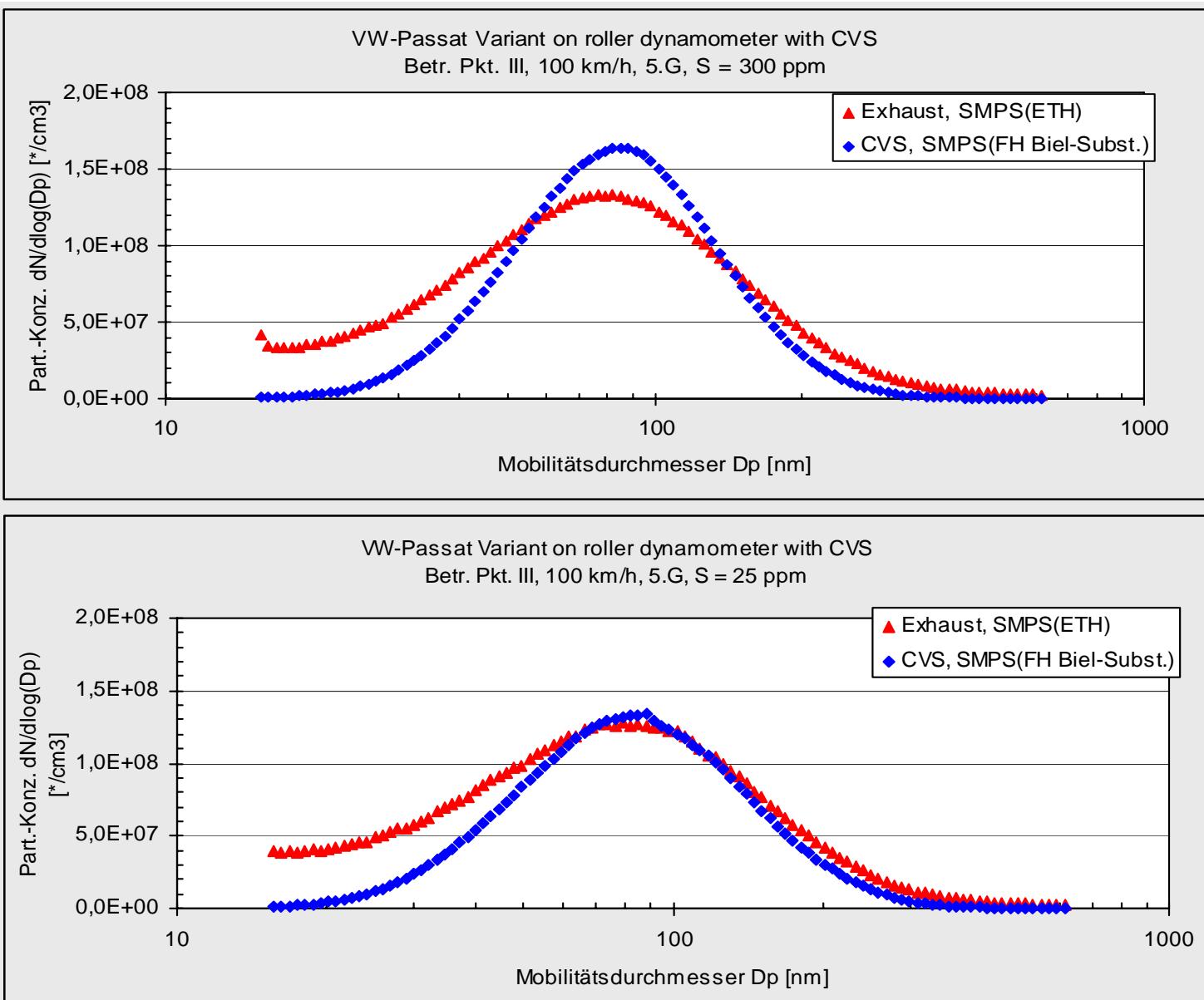
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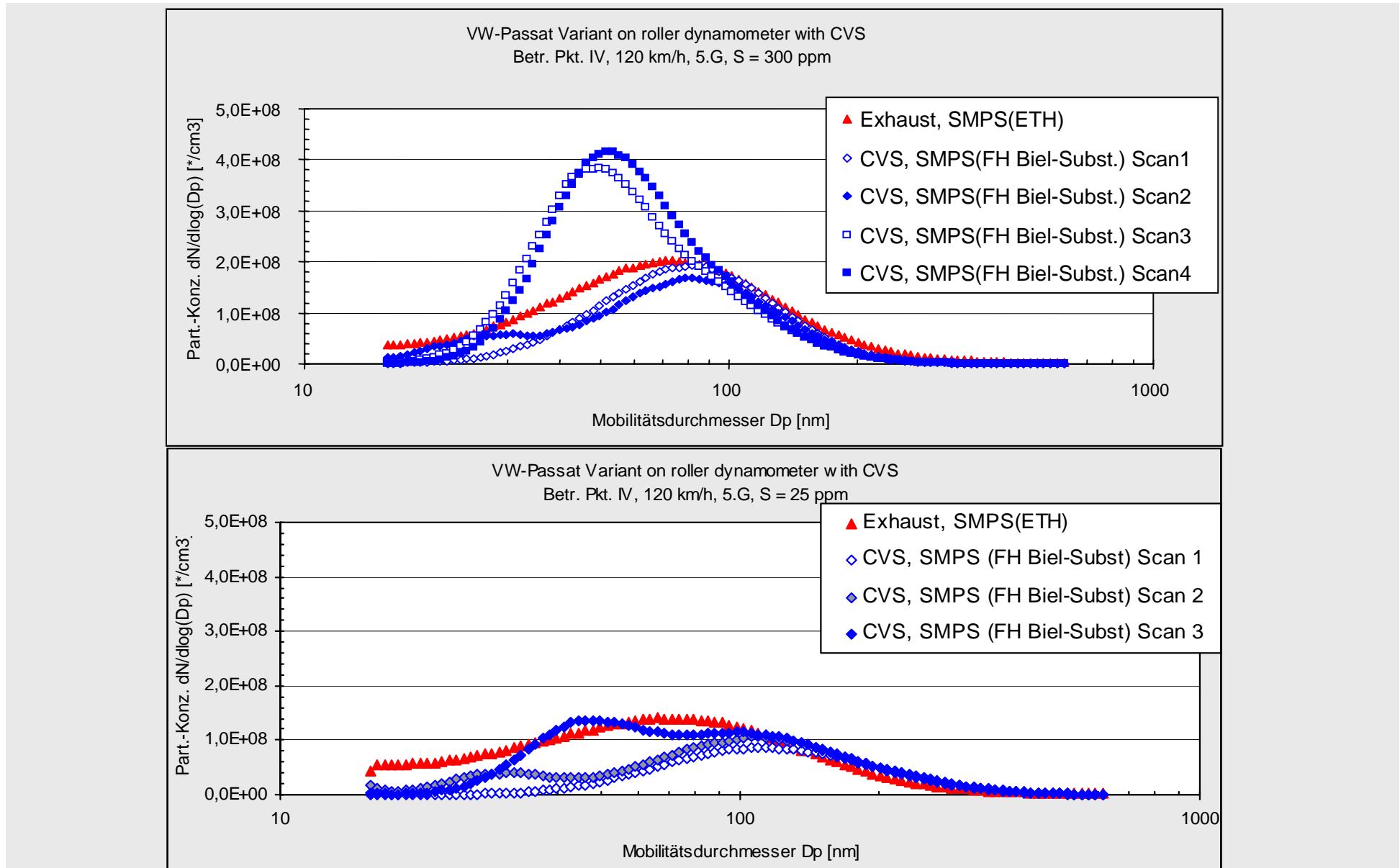
Influences of load and fuel sulphur contend on NSD and PM



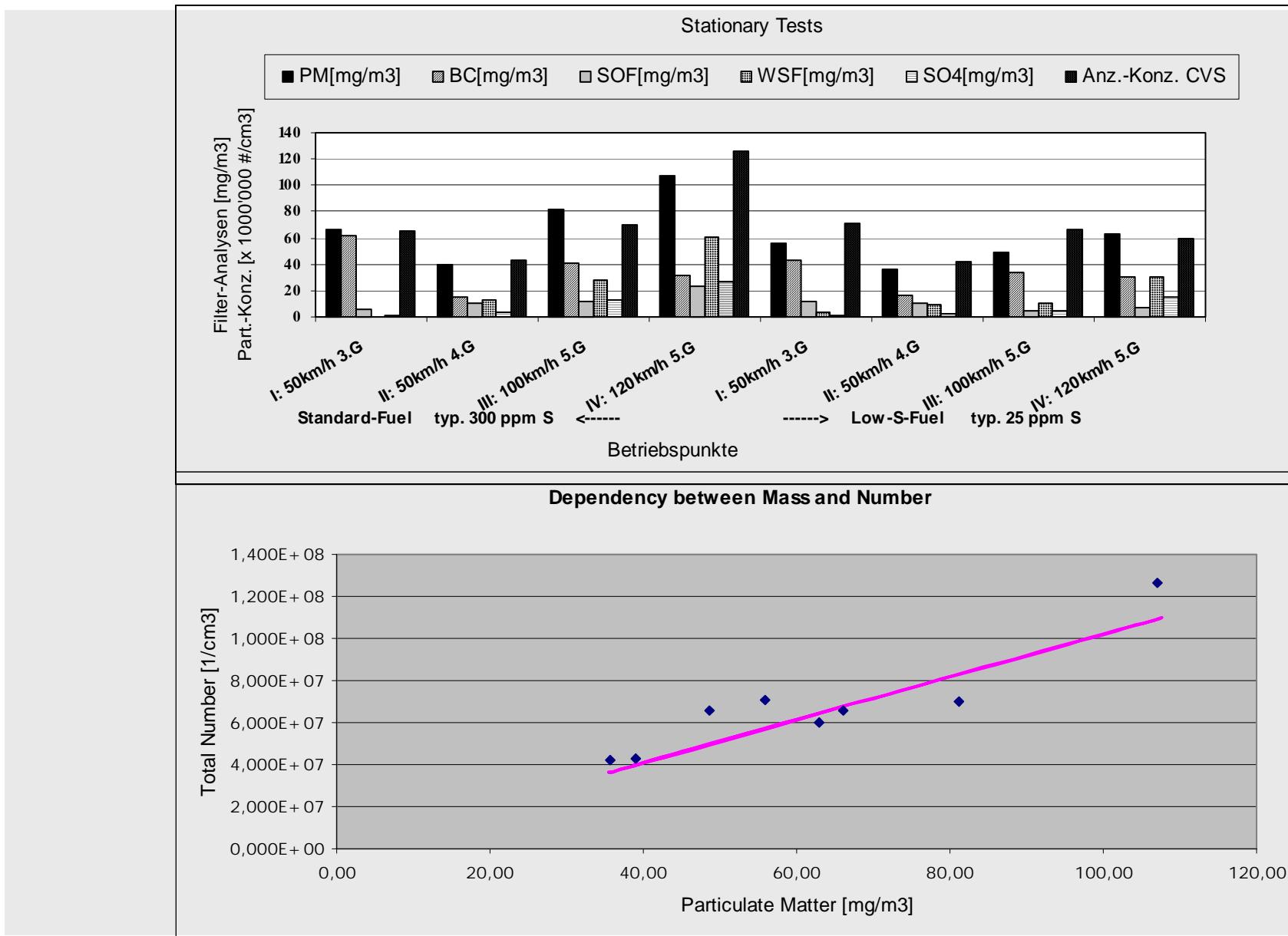
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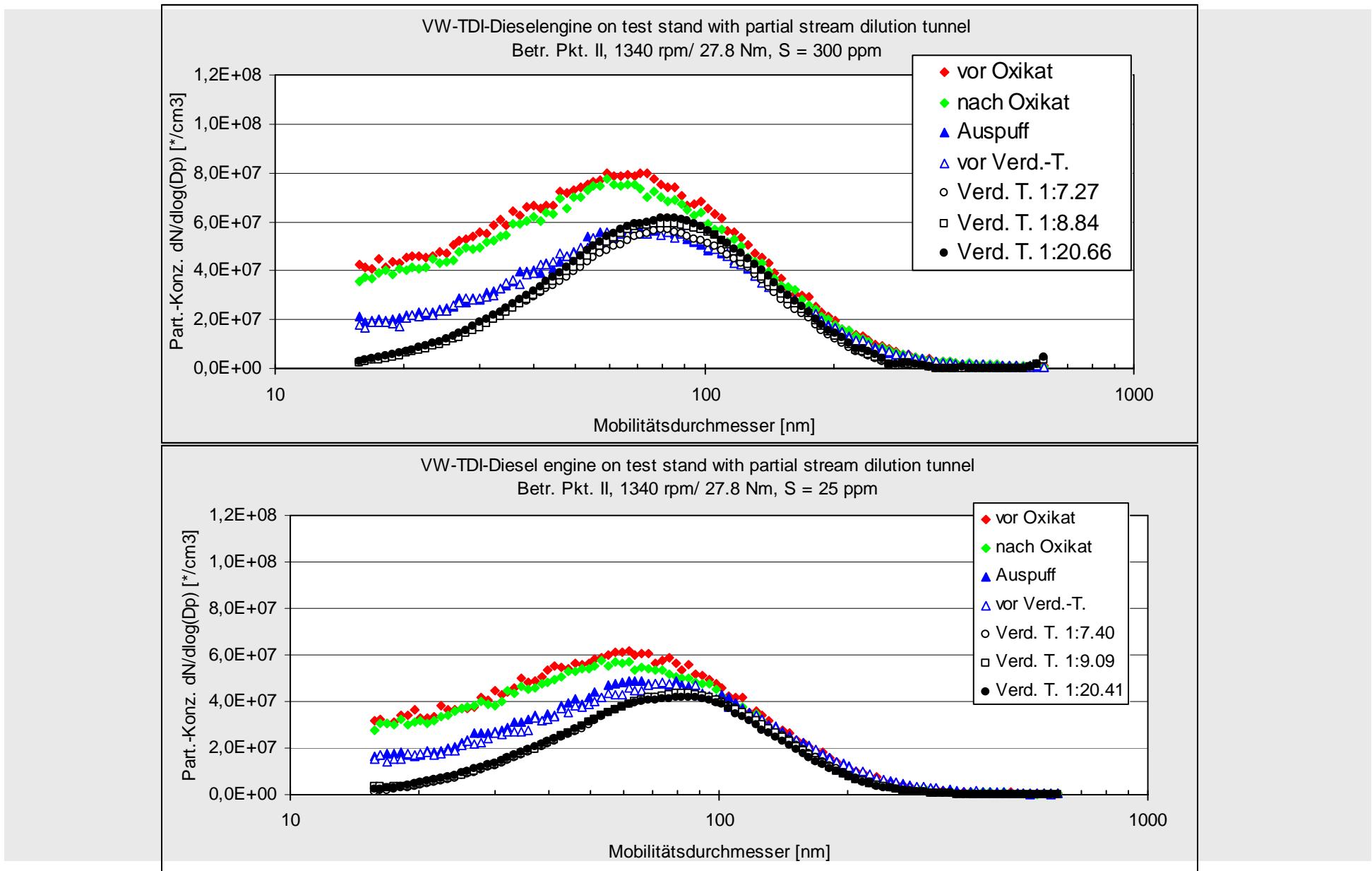


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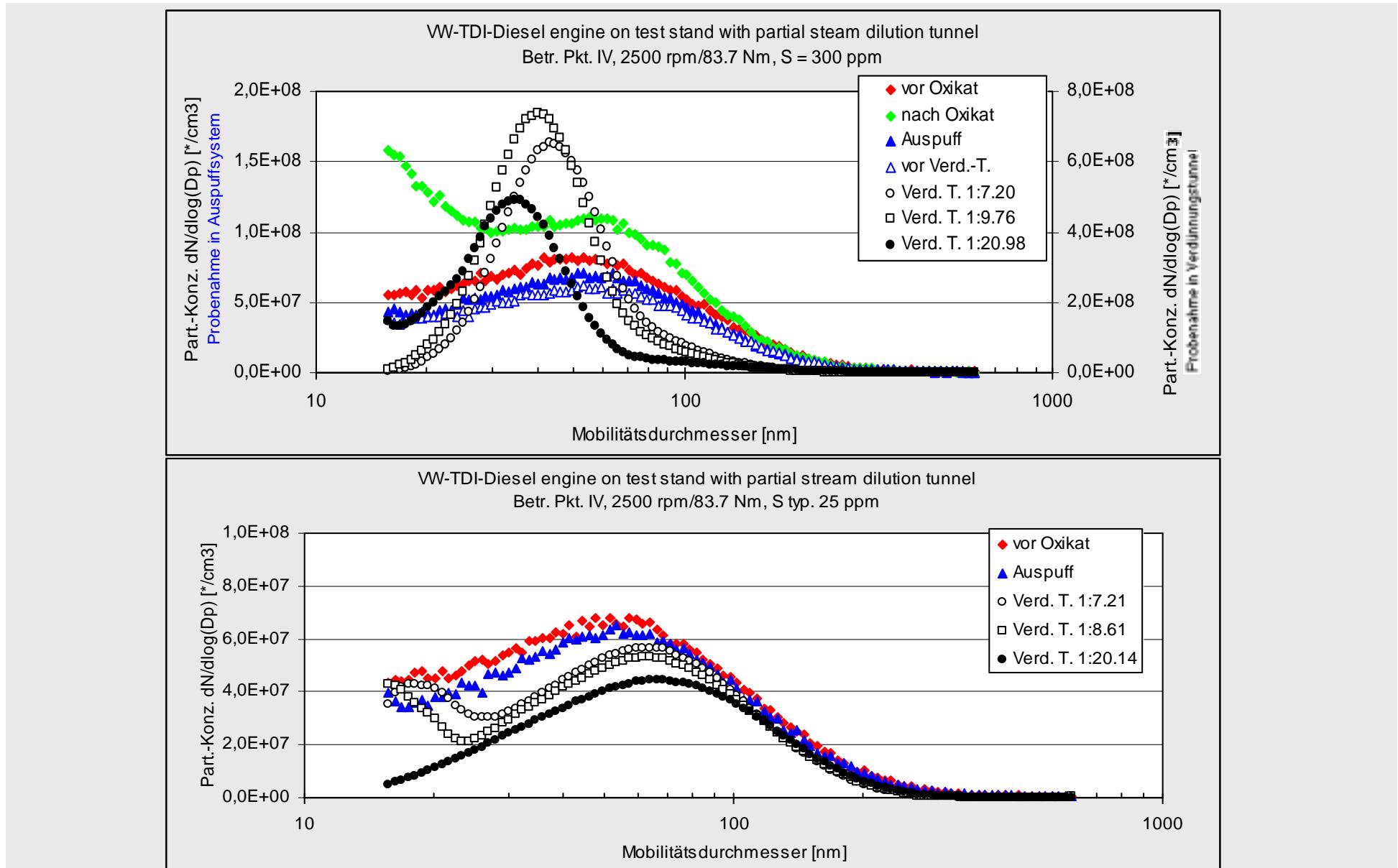
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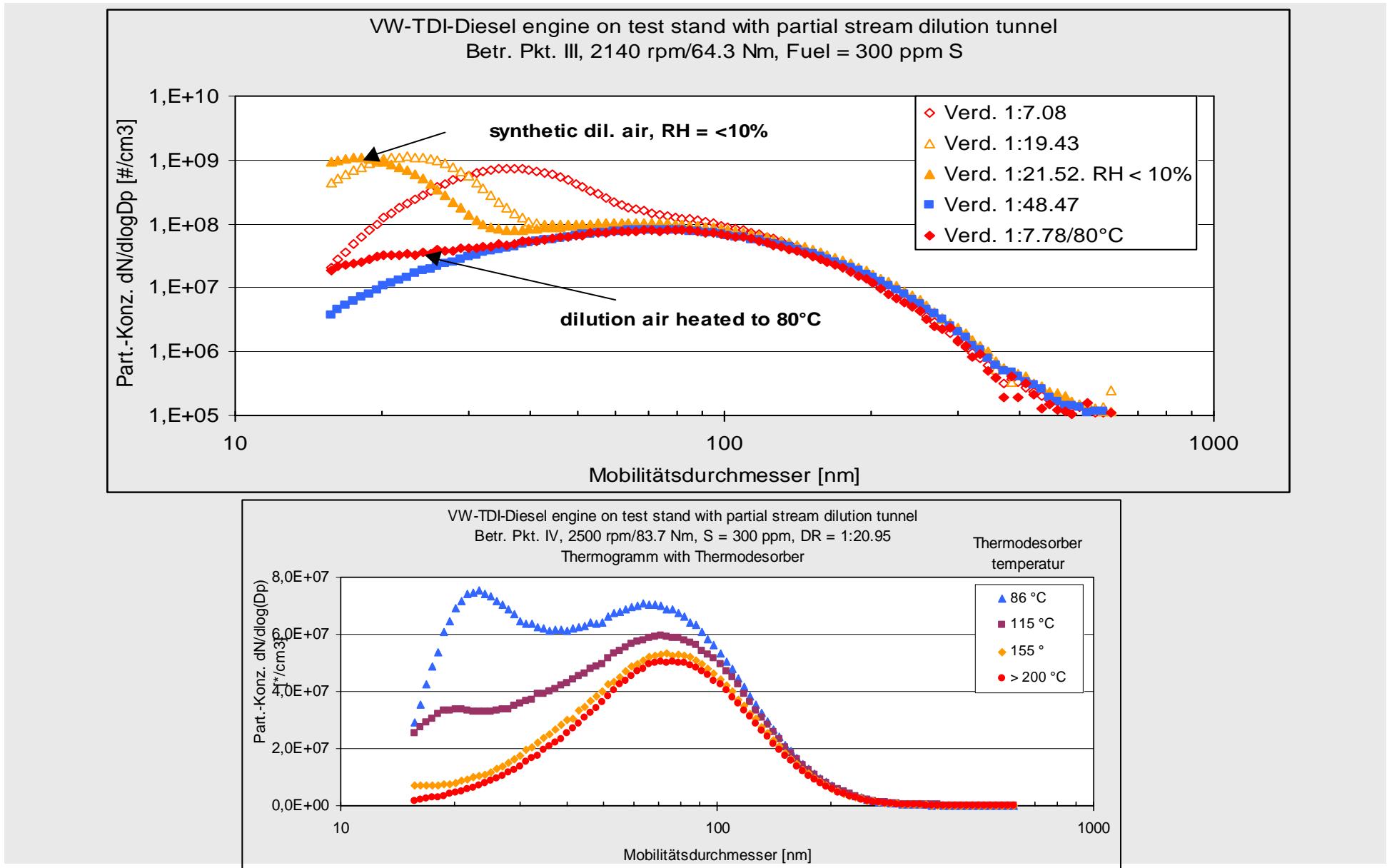
NSD measurements along the tail pipe; influence of dilution ratio



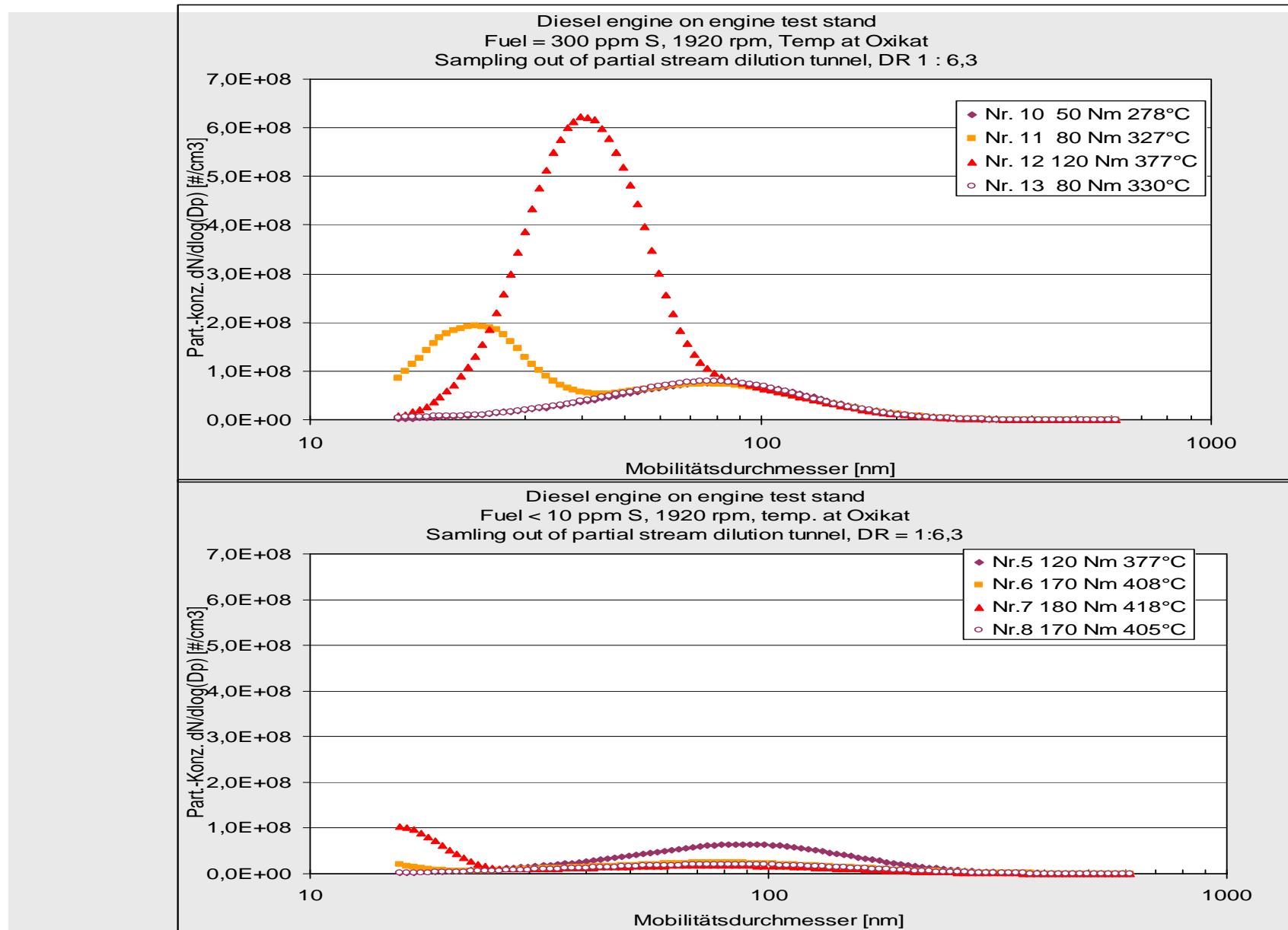
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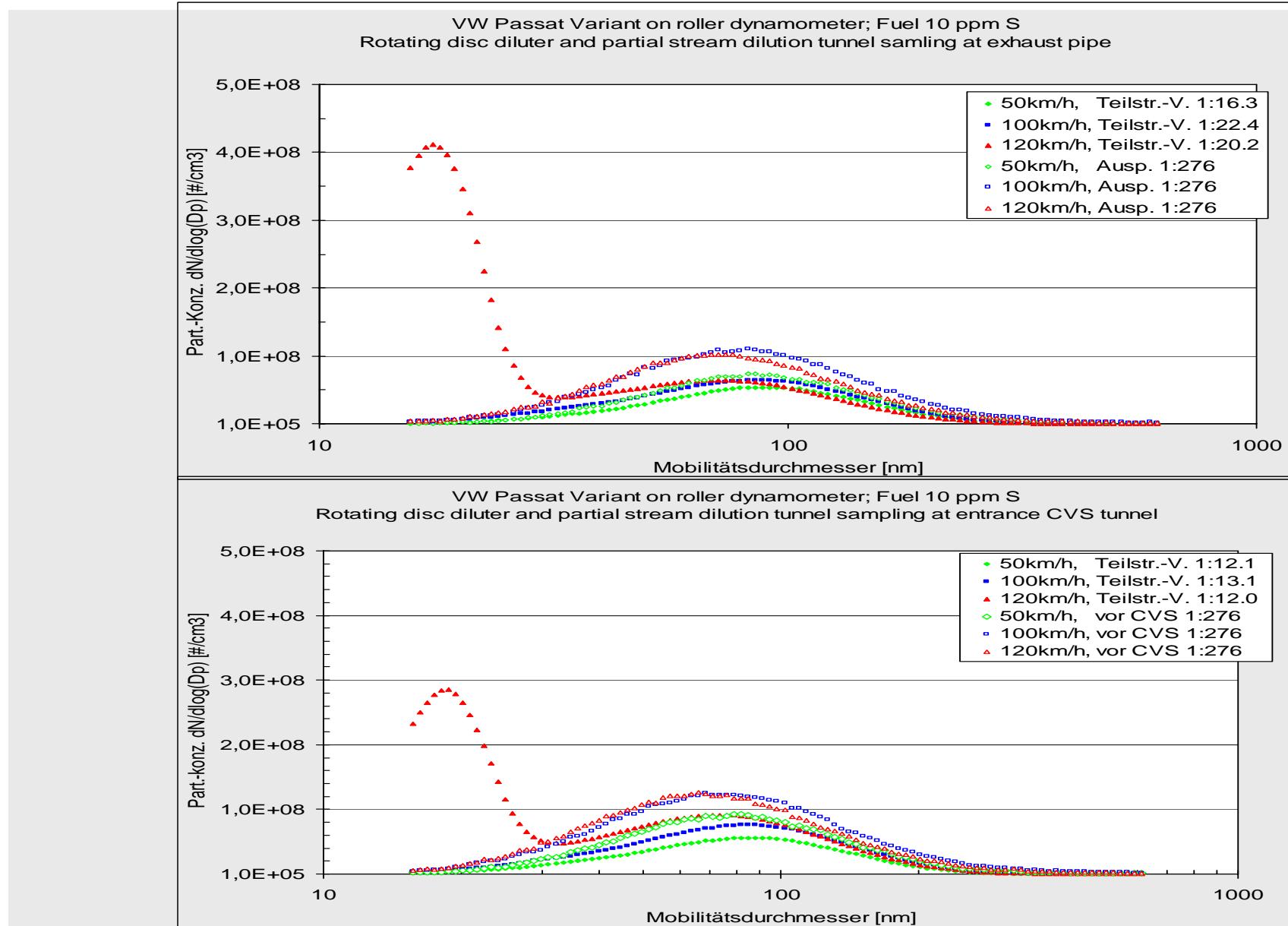
Influence of dilution ratio, dilution air humidity and temperature



Oxidation catalyst temperature - formation of nucleation particles



Roller dynamometer transfer line - formation of nucleation particles

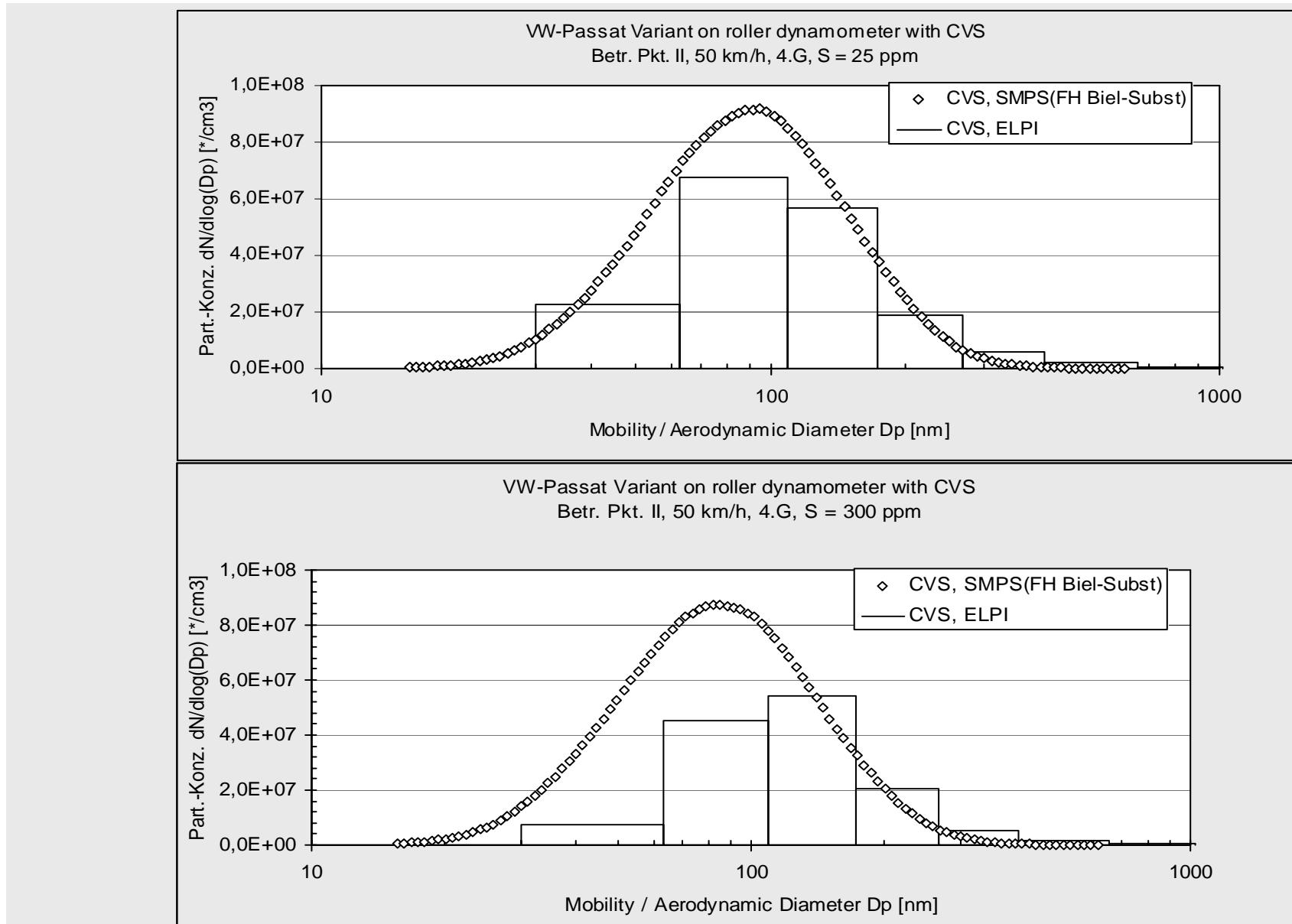


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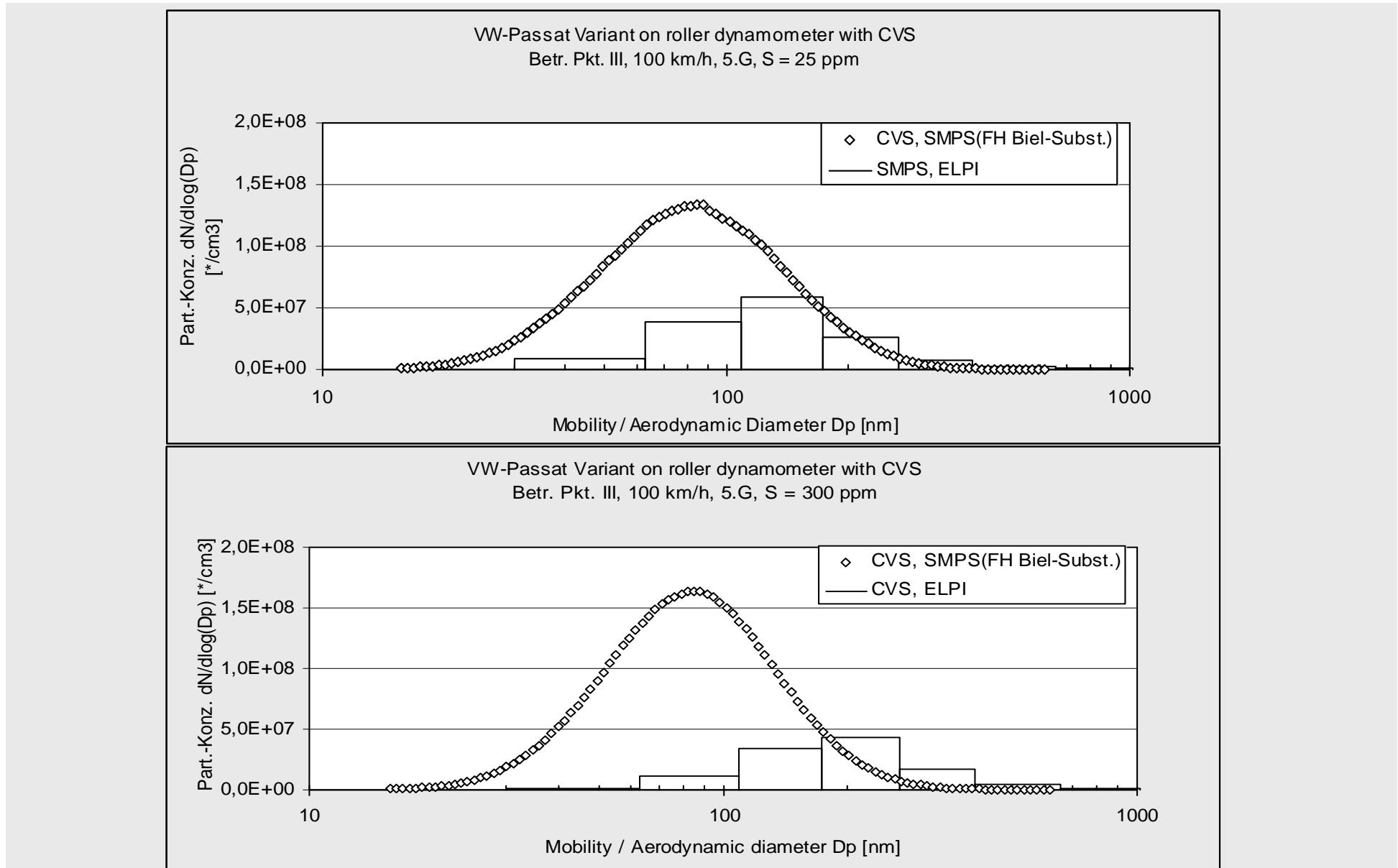
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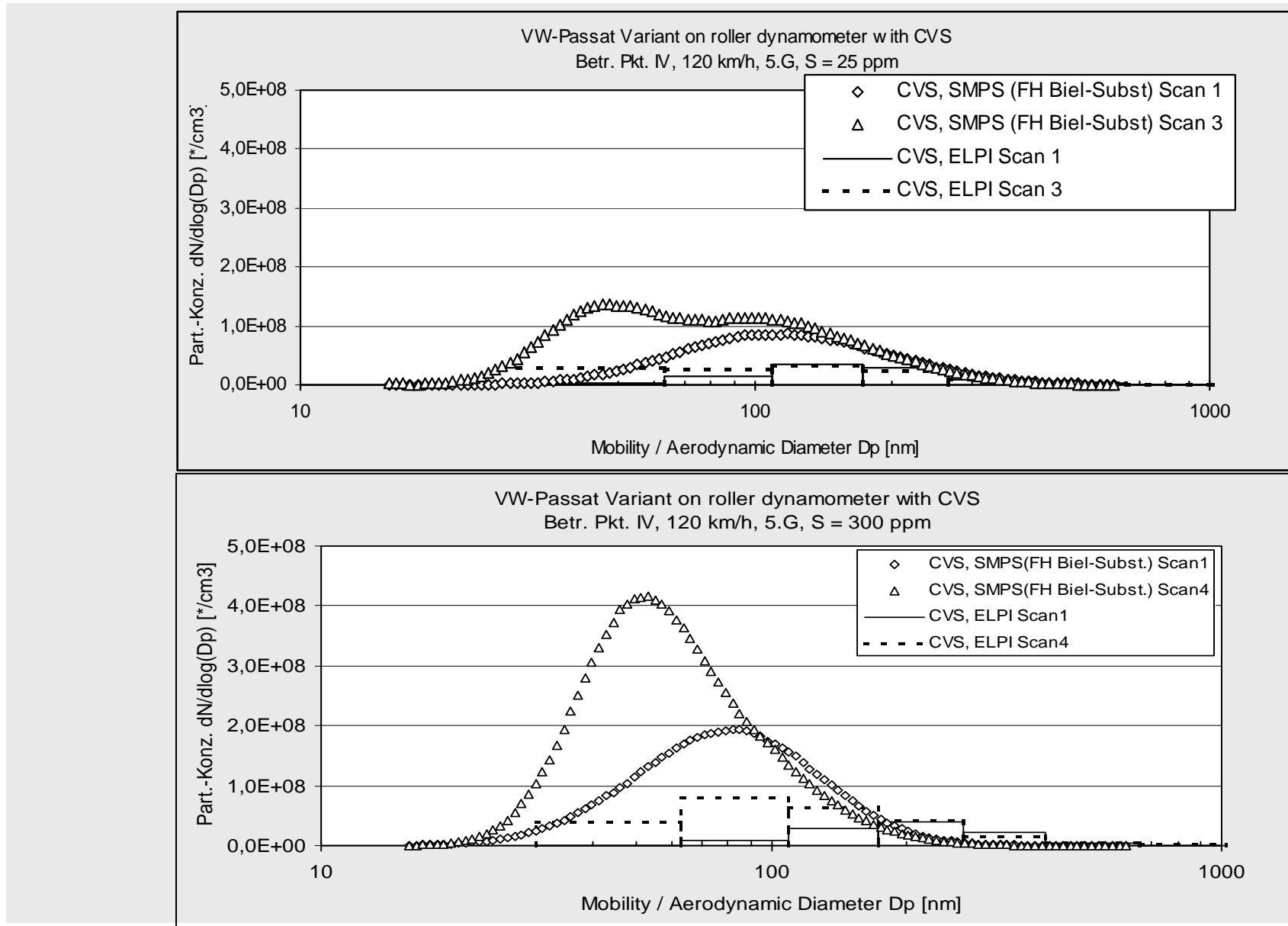
Comparison mobility to aerodynamic size classification



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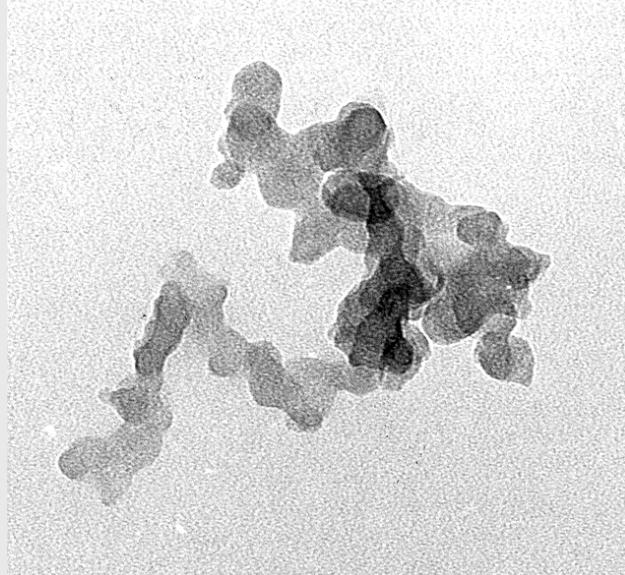


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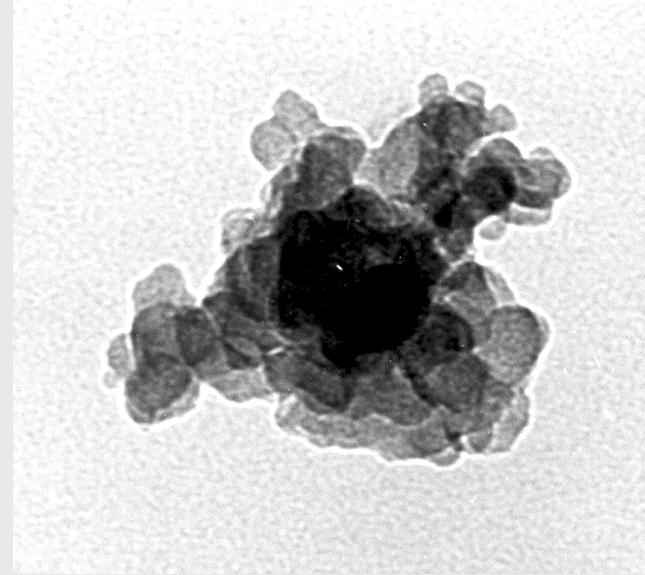
Transmission electron microscope (TEM) analysis show Morphology changes

Source: Dr. w. Koch et al, Fraunhofer-Insitut of Toxicology and Aerosol Research, Hannover

Diesel particle at low load



Diesel particle at high load



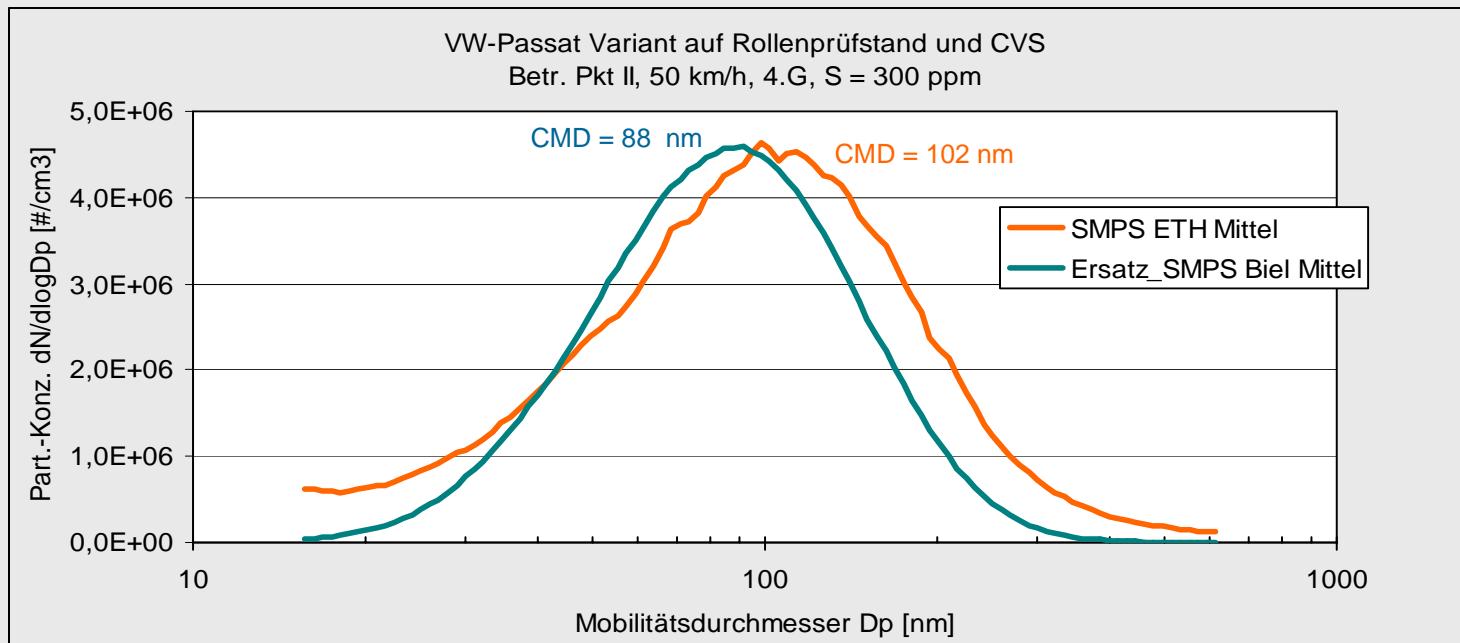
The relationship between aerodynamic and mobility diameter depends strongly on the fractal dimension of the agglomerate

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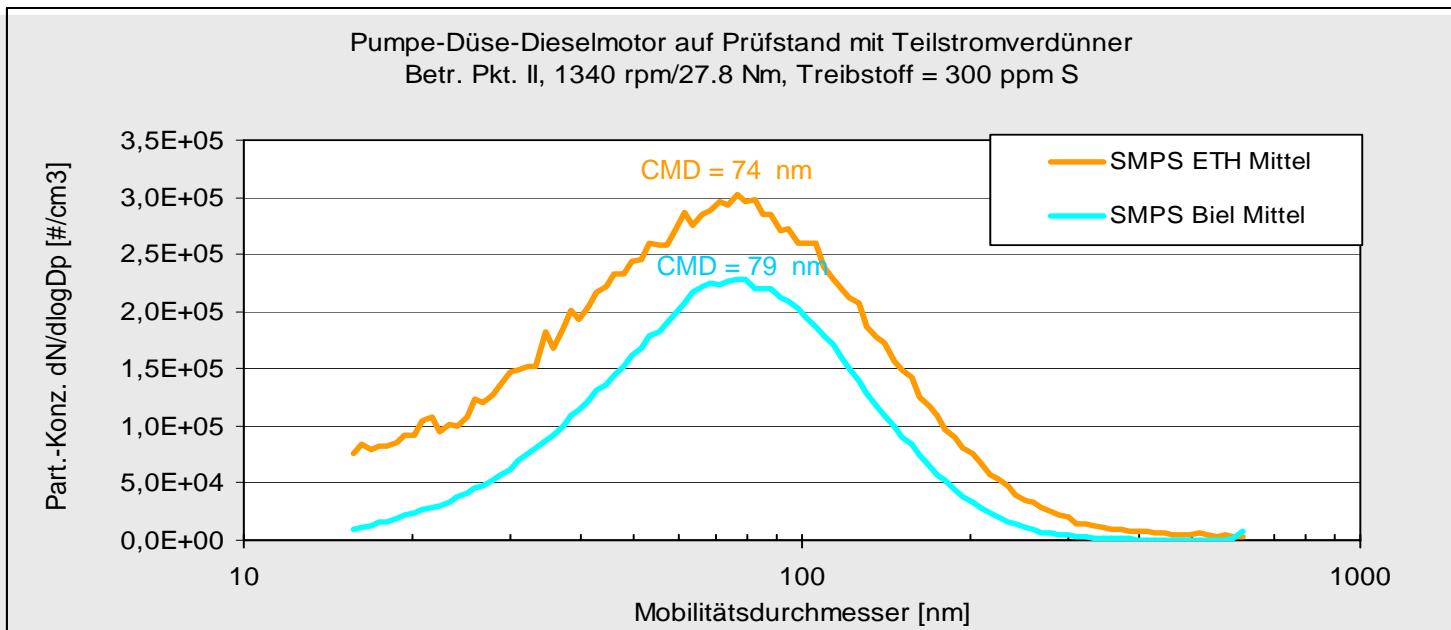
Comparison of SMPS-ETH and SMPS-FH Biel substitute (TSI)*



	Anzahl-K. [#/ cm^3]			Peak-Höhe [#/ cm^3]		
	SMPS ETH	SMPS Biel	Verh. ETH/Biel	SMPS ETH	SMPS Biel	Verh. ETH/Biel
Scan 1	3,30E+06	2,77E+06	1,19	4,92E+06	4,87E+06	1,01
Scan 2	3,13E+06	2,59E+06	1,21	4,48E+06	4,69E+06	0,96
Scan 3	3,06E+06	2,44E+06	1,25	4,60E+06	4,23E+06	1,09
Mittel	3,16E+06	2,60E+06	1,22	4,67E+06	4,60E+06	1,02

*Original instrument was for repair at TSI

Comparison of SMPS-ETH and original SMPS-FH Biel*



	Anzahl-K. [#/cm ³]			Peak-Höhe [#/cm ³]		
	SMPS ETH	SMPS Biel	Verh. ETH/Biel	SMPS ETH	SMPS Biel	Verh. ETH/Biel
Scan 1	2,099E+05	1,394E+05	1,51	3,108E+05	2,405E+05	1,29
Scan 2	2,166E+05	1,326E+05	1,63	3,083E+05	2,317E+05	1,33
Scan 3	2,181E+05	1,293E+05	1,69	3,157E+05	2,236E+05	1,41
Scan 4	2,165E+05	1,288E+05	1,68	3,060E+05	2,239E+05	1,37
Mittel	2,153E+05	1,325E+05	1,62	3,102E+05	2,299E+05	1,35

*Original instrument was for repair at TSI

Summary / conclusions

- ▶ Measuring NSD at higher load the formation of nucleation particles occurs, especially with high sulphur fuel
- ▶ Already little variation of CVS-DR has a strong effect on particle number and size (no reproducible measurements possible)
- ▶ Provoke nucleation: Low DR, cold humid dil-air, high sulphur fuel
- ▶ Avoid nucleation: High DR > 50, hot dil-air, sulphur free fuel
- ▶ Good correlation between PM and Total Number excluding nucleation effect
- ▶ Oxidation catalyst seems to be the main cause for nucleation particles
- ▶ “Memory effect” of exhaust line probable
- ▶ No significant nucleation particle effect observed from transfer line
- ▶ Relationship between aerodynamic and mobility diameter depends on particle morphology (density), morphology changes dependent on load and fuel quality
- ▶ High discrepancy in particle number and size comparing SMPS's - only good for relative measurements as long as no reliable standard exists

Acknowledgements

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