

SOME REMARKS ABOUT THE NUCLEATION MODE IN DIESEL EXHAUST

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Introduction

Diesel engine exhaust particulate matter (DPM) pose a potential threat to public health. Tightened regulations have caused a great reduction of DPM emissions because much effort has been taken into the development of new diesel engines and exhaust gas after treatment systems.

Background

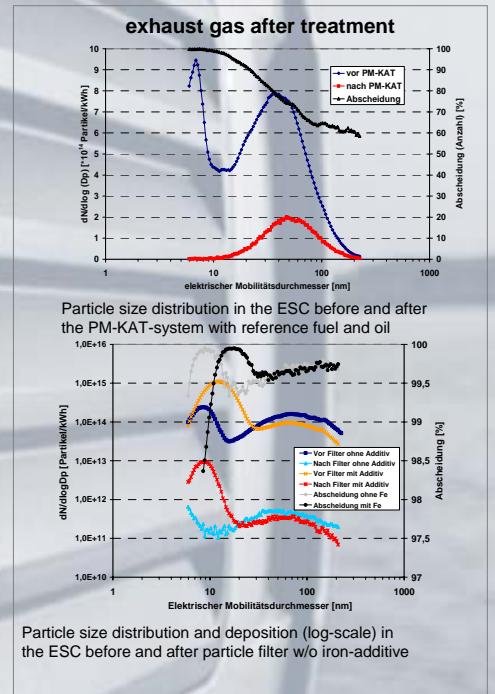
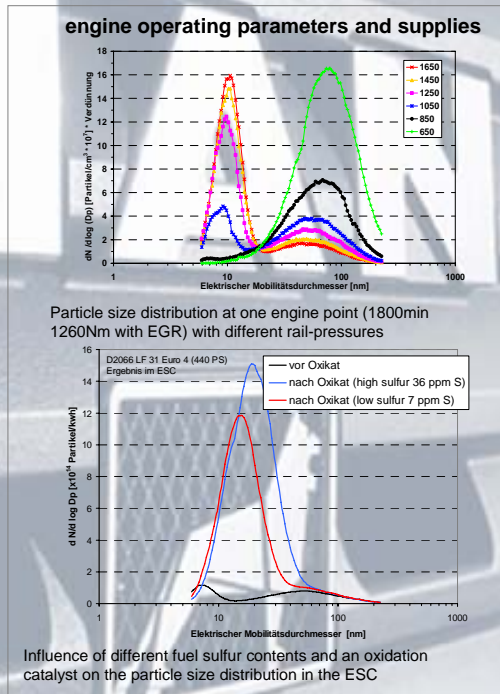
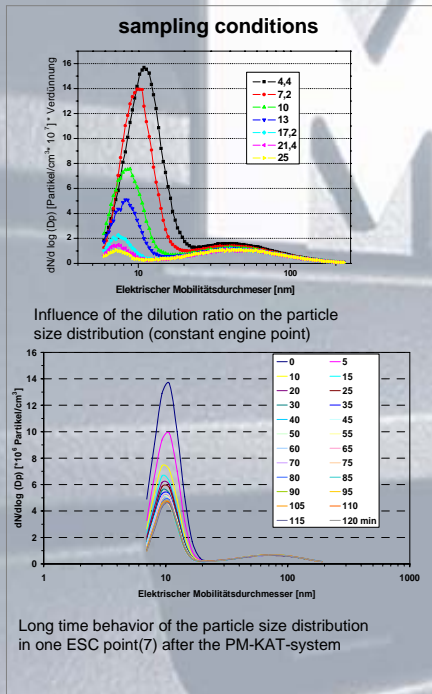
While determining the particle size distribution in the exhaust of modern heavy-duty vehicles with an SMPS (Scanning mobility particle sizer), often two modes appear: The nucleation mode in the area around 10 nm, which consists before or without oxidation catalysts usually of un- and/or partly burnt hydrocarbons (from fuel and engine oil). As well as the accumulation mode in the area between 40 and 80 nm, the actual soot mode. The nucleation mode is strongly influenced by the type of sampling, especially by the dilution. When falling below a certain dilution ratio, the hydrocarbons can nucleate homogeneous. In addition ash particles, which came from the engine oil, can serve as condensation particles. The toxicological effect in the lung may differ based on the different composition and solubility of that of the soot mode. Both modes should separate valued become therefore with respect to their toxicological effect [1-5].

Experimental: SMPS Measurements in Diesel Exhaust

For Particle Size Measurements in Diesel Exhaust of Heavy Duty engines on a test bench a SMPS System (TSI 3936, LDMA) has been used. The dilution was carried out with an micro tunnel (partial flow dilution system (NOVA Microtrol 5) according to the legal regulation.

Results: Particle Size Distribution Measurements

The nucleation mode is influenced by:

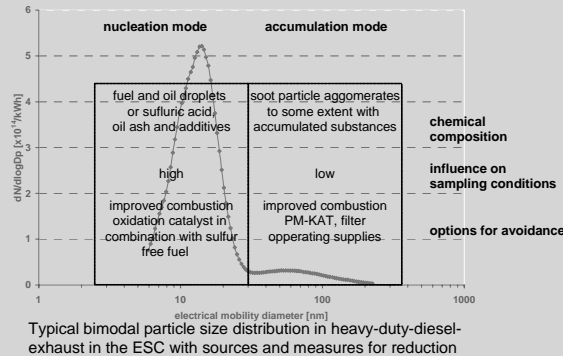


Discussion and Conclusions

The different factors influencing the nucleation mode can be summarized in the following figure. There you can clearly see the strong influence of the nucleation mode by the sampling conditions, the engine operating parameters and exhaust gas after treatment devices.

It exists endeavor to establish a new additional emission limit of sides of the EU for the diesel exhaust. Next to the well known and in the last years drastically tightened particle mass limit, the establishment of a particle number limit is presently in the discussion. There are many open questions?

- Is there a correlation between mass and number
- Is there a correlation between health effects and number



What about the nucleation mode particles

- What about sampling artifacts (i. e. ash)
- What about the chemical composition of both modes

So it is questionable which relevant information this additional particle number limit will bring.

For the determination of this new particle number limit, a costly particle sampling and treatment is necessary to separate the solid from the volatile particles.

This is far from real world conditions.

Literature

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