Size Distribution of Particles from a Diesel Direct-Fired Heater

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Background
* Diesel direct-fired heaters (DFHs) are generally used as an independent heat source not only in the automotive industry.
* Independent heat sources will become more and more necessary with increasing efficiency of combustion engines and deployment of electric drives to heat the passenger compartment.
* There are currently no particulate matter (PM) emission limits for DFHs.
* Especially little is known about particle size distribution in exhaust emissions of DFHs.

Goal
To conduct a preliminary characterization of PM emitted by a typical production DFH during various operating regimes.

Approach

- A sample of PM from DFH exhaust was diluted by a rotating disc microdiluter (MD-19, Matter Aerosol) and fed into a particle classifier and spectrometer (Engine Exhaust Particle Sizer (EEPS), TSI).

- Measurements were taken in regimes:
  -- start-up of the DFH (ambient temperature approx. 20°C),
  -- minimal power output regime (P0),
  -- maximal power output regime (P9),
  -- switching-off the DFH.

- Moreover, two different types of glow plugs were applied in order to determine the effect of glow plug on PM concentrations.

Conclusions
* Particle size distributions from DFH have one or two peaks mostly in the tens of nm range, not dissimilar from diesel engine exhaust.
* Nanoparticles (< 100 nm) have been found in DFH exhaust in concentrations of \(10^6 \div 10^7 \text{#/cm}^3\) during stabilized operation and up to \(10^9 \text{#/cm}^3\) during start-up and switching-off.
* During stabilized operation, nanoparticles concentrations decreased with increasing power level (which increases temperature in combustion chamber), see Graph 6.
* Particle emissions during start-up and warm-up were affected by the type of the glow plug used.