

# Size Distribution of Particles from a Diesel Direct-Fired Heater



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## Background

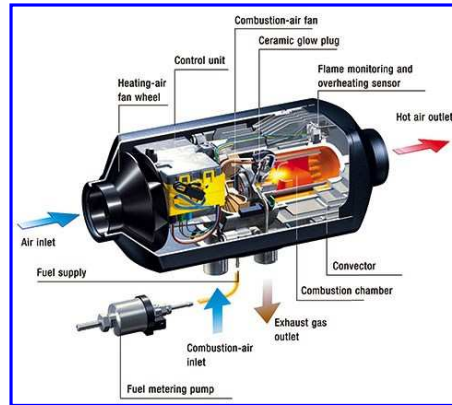
- \* Diesel direct-fired heaters (DFHs) are generally used as an independent heat source not only in the automotive industry.
- \* Independent heat sources will become more and more necessary with increasing efficiency of combustion engines and deployment of electric drives to heat the passenger compartment.
- \* 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

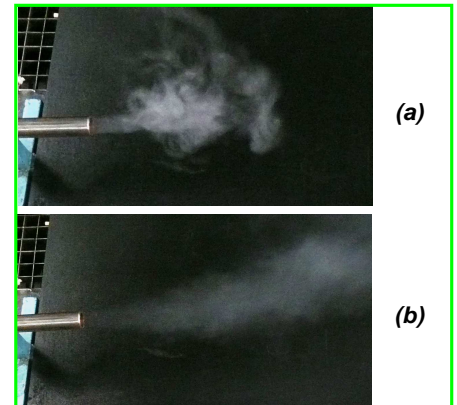
To conduct a preliminary characterization of PM emitted by a typical production DFH during various operating regimes.

## Approach

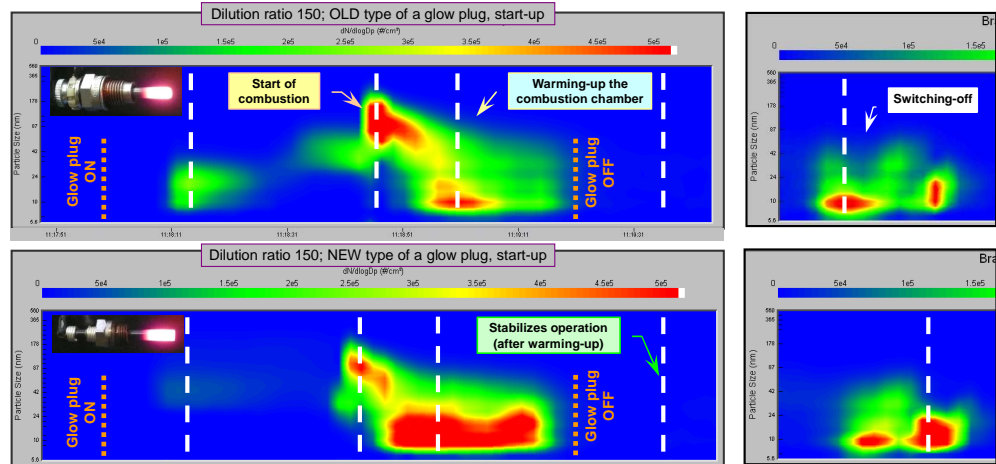
- ➔ A sample of PM from DFH exhaust was diluted by a rotating disc microdiluter (MD-19, Matter Aerosol) and fed into a particle classifier and spectrometer (Engine Exhaust Particle Sizer (EEPS), TSI).
- ➔ Measurements were taken in regimes:
  - start-up of the DFH (ambient temperature approx. 20°C),
  - 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.



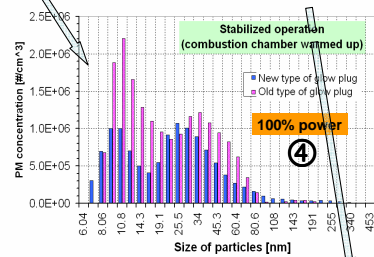
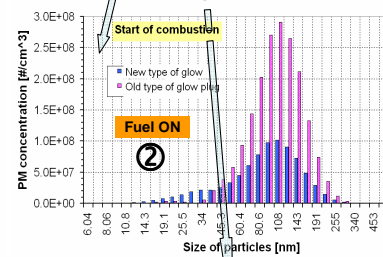
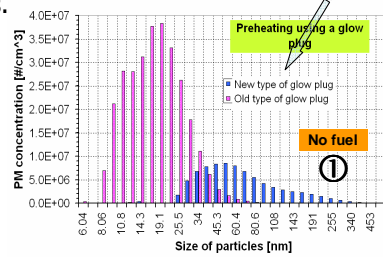
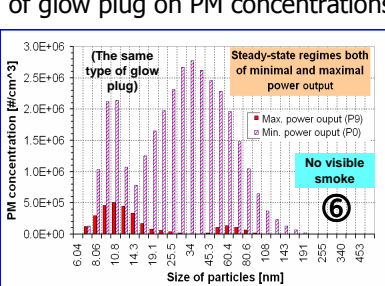
Look inside a conventional diesel DFH with a low-pressure fuel system (<http://www.eberspaecher.com>)



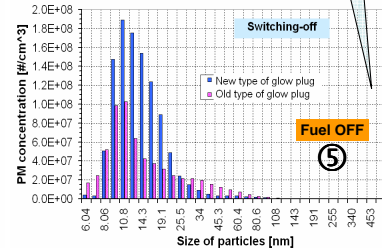
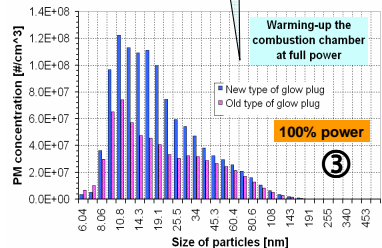
White smoke emissions during the both (a): start-up and (b): switching-off regimes



PM measurements during both start-up and switching-off regimes with two types of glow plugs



Size-distribution of undiluted PM



## 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.

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