

Size Distribution of Particles from a Diesel Direct-Fired Heater



Ľubomír Miklánek¹, Michal Vojtíšek-Lom^{1,2}

1: Josef Bozek Vehicle Centre for Sustainable Mobility, Czech Technical University in Prague,
 2: Institute for Automobile, Combustion Engine and Railway Engineering, Czech Technical University in Prague
 Contact: lubomir.miklanek@fs.cvut.cz, tel. (+420) 224 351 855, (+420) 246 003 709;
 michal.vojtisek@fs.cvut.cz, tel. (+420) 774 262 854



Technology Agency of the Czech Republic



Centers of Competence

Background

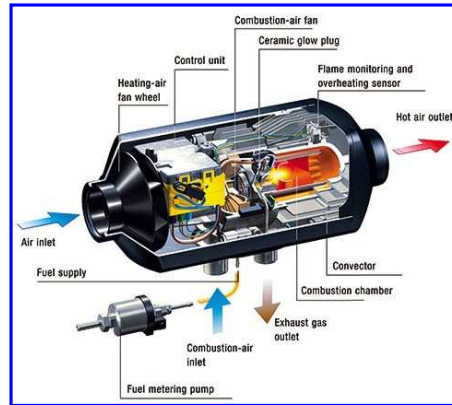
- * Diesel direct-fired heaters (DFHs) are generally used as an independent heat source not only in the automotive industry.
- * Independent heat sources will become more and more necessary with increasing efficiency of combustion engines and deployment of electric drives to heat the passenger compartment.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

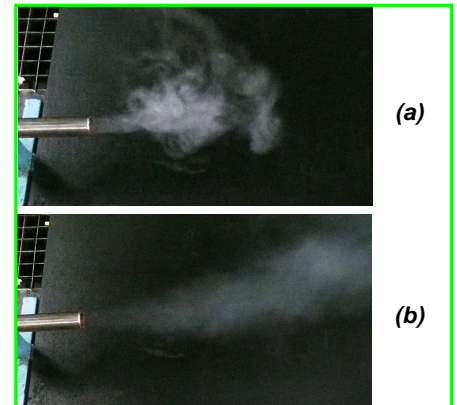
To conduct a preliminary characterization of PM emitted by a typical production DFH during various operating regimes.

Approach

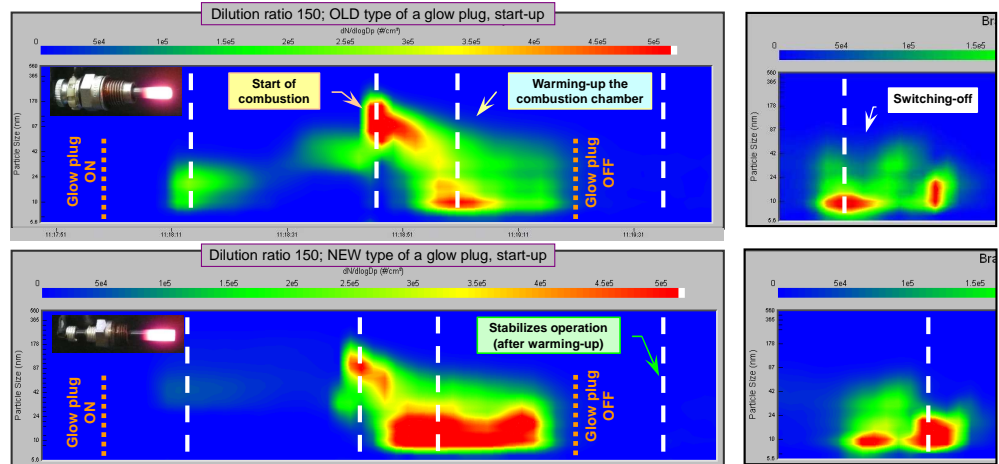
- ➔ A sample of PM from DFH exhaust was diluted by a rotating disc microdiluter (MD-19, Matter Aerosol) and fed into a particle classifier and spectrometer (Engine Exhaust Particle Sizer (EEPS), TSI).
- ➔ Measurements were taken in regimes:
 - start-up of the DFH (ambient temperature approx. 20°C),
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



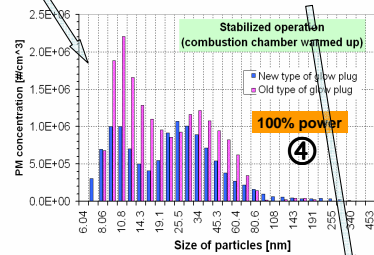
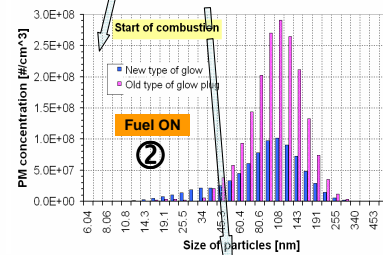
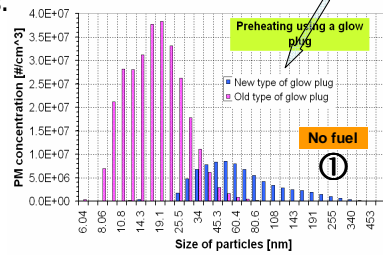
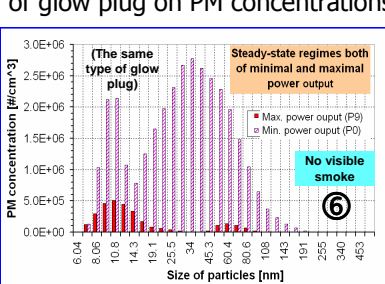
Look inside a conventional diesel DFH with a low-pressure fuel system (<http://www.eberspaecher.com>)



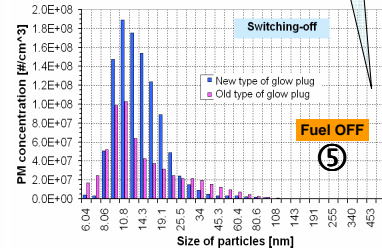
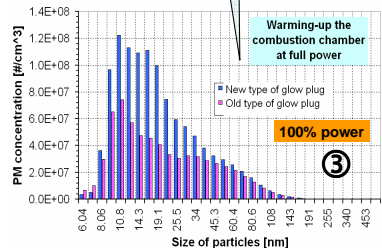
White smoke emissions during the both (a): start-up and (b): switching-off regimes



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 #/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.

Acknowledgments:

Work sponsored by:

- the Czech Science Foundation Grant no. 13-01438S (BIOTOX).
- the EU Regional Development Fund in OP R&D for Innovations (OP VaVpI) and Ministry for Education, Czech Republic, project # CZ.1.05/2.1.00/03.0125 Acquisition of Technology for Vehicle Center of Sustainable Mobility.
- the Technological Agency, Czech Republic, programme Centres of Competence, project # TE01020020 Josef Bozek Competence Centre for Automotive Industry.
- the BRANO GROUP, a.s., provider of the independent air-heating system.
- the salary of the first author was funded by EU-EBRD program, project CZ.1.07/2.3.00/30.0034, Support of Research Teams at Czech Technical University in Prague.

