Intercomparison of SMPS with CAST particles

Jürg Schlatter, Swiss Federal Office of Metrology and Accreditation, metas
Lindenweg 50, CH-3003 Bern-Wabern, Switzerland

ETH-Conference on Combustion Generated Particles 18th to 20th August 2003

The Scanning Mobility Particle Sizer (SMPS) consisting of a Differential Mobility Analyser (DMA) and a Condensation Particle Counter (CPC) is a well established system for the measurement of exhaust particle size distributions. In March 2003 three SMPS's (TSI 3081) were compared with an aerosol from a Combustion Aerosol StAndard (CAST) at METAS. The goal of the intercomparison was the quantification of the deviations, when the instruments were operated by the owner. The combustion aerosols had median mobility diameters between 30 nm and 190 nm and number concentrations between 106 cm−3 and 6 ⋅ 107 cm−3.

The instruments were placed in a climatised laboratory at METAS. All instruments were supplied with the same aerosol at the same time (see figures 1 and 2). The measurements followed the scheme in Figure 2: The flame in the CAST was stabilised and four different concentrations with the identical particle size were produced without changing the flame.

The raw data were analysed with the Software SMPS 3.210 and the number density distributions (example in figure 4) in an Excel-Table (fit of logarithmic normal distribution, calculation of mean, mode and number concentration).

The intercomparison demonstrates the conformity of the measurement results for the particle diameter within the uncertainty of the METAS standard (Uc of 7 nm to 11 nm) (figure 5). For the number concentration the measurement results derive over 50 %. This value exceeds the uncertainty of the METAS standard (Uc of 8 % to 18 %) and shows therefore a significant deviation (figure 6). The main contribution to the deviation ensues from the calibration and adjustment of the flows in the DMA and the CPC.

The intercomparison shows, that the calibration of particle measurement instruments is indispensable, because deviations can only be discovered and quantified in a comparison with standards.