A laboratory evaluation of four commercial particle sizers under several aerosol types

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Epidemiological studies have consistently shown an association between particulate air pollution and respiratory disease (Seaton et al., 1995). Therefore, aerosol monitoring has an important role in determining possible exposure events and eventual health risks related to hazardous particle inhalation.

Optical particle counters (OPC) and time-of-flight particle sizers are often used for determining size resolved particulate mass concentration for ambient and workplace measurements. As particle sizers are usually calibrated to accurately measure polystyrene latex (PSL) test particles, more information is needed regarding their ability to sample oil mist or ambient aerosols. Sampling of aerosols with different optical properties and densities compared to PSL particles can lead to errors in particle sizing and particle mass calculation.

The goal of this study was to evaluate the performance of four commercial particle sizers for oil mist, PSL and ambient aerosols. Sizing as well as counting efficiency was evaluated for several aerosol particle diameters and number concentrations. The particle sizers evaluated in this study were: a Palas Welas 3000 optical aerosol spectrometer, Grimm 1.108 and 1.109 optical portable aerosol spectrometers (PAS) and a TSI 3321 time-of-flight aerodynamic particle sizer (APS).

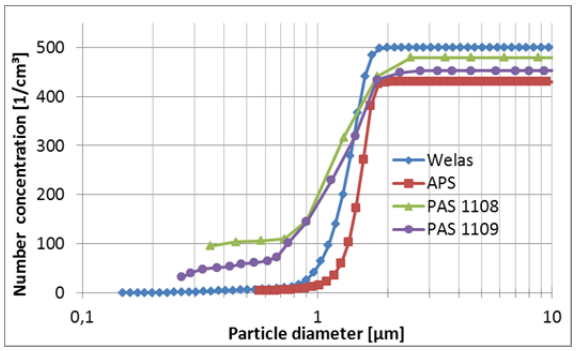

Figure 1. Summed particle number concentration of 4 particle sizers for hexadecane aerosol

An experimental facility was set up in order to test the performance of the four selected commercial particle sizers. The experimental facility is comprised of an aerosol generator, a dilution and mixing unit, a flow tube to allow the aerosol to stabilise and a TSI 3708 flow splitter to provide a representative sample for every particle sizer. Two different aerosol generators were used during the measurements. Hexadecane and octadecane particles were generated using a Topas SLG 270 condensation generator, while certified PSL particle standards were generated with a Topas ATM 220 nebuliser.

The results show that the tested devices often show different results, depending on aerosol type, particle size and number concentration. Significant differences were observed for ambient aerosol (Fig. 3), mainly due to the very different efficiency of the spectrometers to count particles smaller than 0,5 µm.

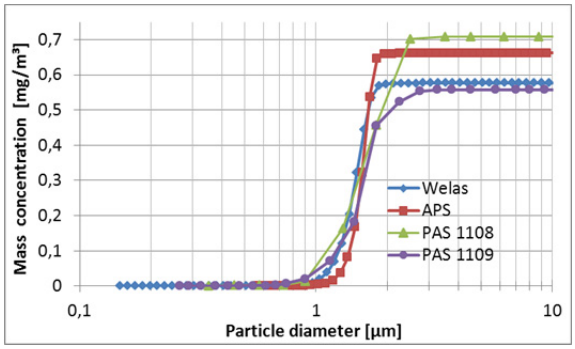

Figure 2. Summed particle mass concentration of 4 particle sizers for hexadecane aerosol

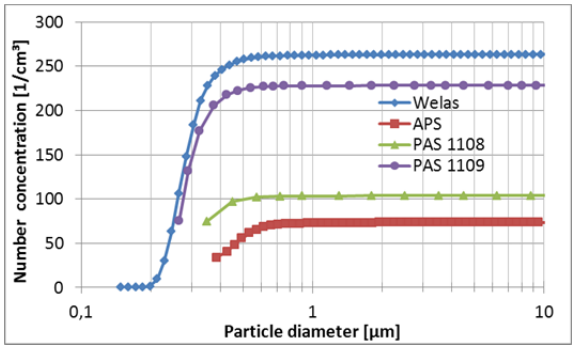

Figure 3. Summed particle number concentration of 4 particle sizers for ambient aerosol

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The health effects of organic compounds in aerosols are currently investigated in the framework of the Helmholtz Virtual Institute of Complex Molecular Systems in Environmental Health, HICE (www.hice-vi.eu).

Seaton, A., D. Godden, et al. (1995). "Particulate air pollution and acute health effects." The Lancet **345**(8943): 176-178.