A study on SVOC aerosol evaporation and its possible implications on workplace sampling

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Aerosols of Semi-Volatile Organic Compound (SVOC) origin represent a big challenge to industrial hygienists due to toxicological and sampling issues. Especially problematic is the sampling of hazardous semi-volatiles that appear in both particulate and gaseous phases in the workplace (oil mists, PAHs, alkanolamines, inorganic acids, etc) (Breuer 1999). More attention has to be given to these dynamic aerosol systems as the particle-vapour distribution is considerably depending on the sampling conditions. Thus the real-phase distribution can be shifted by evaporating particles or condensing vapour.

Due to the fact that *off-line* filter-adsorber sampling setup can induce artefacts when measuring SVOC aerosols, we investigated a new *on-line* alternative to filter sampling that can accurately distinguish between vapour and particle mass.

The *on-line* approach to analyse SVOC aerosols was to account for the total mass (TM) with a Flame Ionization Detector (FID) coupled with a heated transfer line. The particle mass (PM) was calculated from the particle diameter measured using an optical white light particle sizer, while the vapour mass (VM) was calculated as the difference between the measured total and particulate mass (VM=TM-PM).

In order to study SVOC particle evaporation an experimental apparatus comprising of a Sinclair-La Mer aerosol generator, a flow tube and the above mentioned aerosol sampling system was set up inside a temperature controlled chamber. Several n-alkane (C_{14} to C_{20}) monodisperse aerosols were generated with various particle diameters, diluted with particle free nitrogen and monitored for particle evaporation losses.

Fig. 1 shows 1, 1.5 and 2 µm hexadecane particles evaporation in the flow tube. Continuous lines represent the initial particle size distribution (PSD), while the dotted lines represent the PSD after additional 3 seconds of residence time. The experimental data were also compared to a diffusion based theoretical computational model. The experimental and model data were found to be in a good agreement for the flow tube experiments (results will be shown in the presentation).

Comparisons between the developed *on-line* method and the *off-line* filter-adsorber sampling method were done for n-alkanes of different volatilities and particle mass loads. The *off-line* samplers comprise of a glass fibre filter for the separation of the particle phase and XAD2 adsorber for the quantification of the remaining vapours.

Our results confirm that the *off-line* method can be biased for SVOC aerosol measurement. The only comparable result that is independent of sampling method is for TM. The *off-line* method systematically returns lower PM and higher VM values (Fig. 2), a clear indication for particle evaporation. This effect is also expected to influence the workplace risk assessment, with the particle-vapour distribution being influenced by the sampling conditions. The amount of evaporated aerosol is difficult to predict as it is influenced by several parameters like gas phase saturation, droplet diameter, substance volatility and sampling temperature.

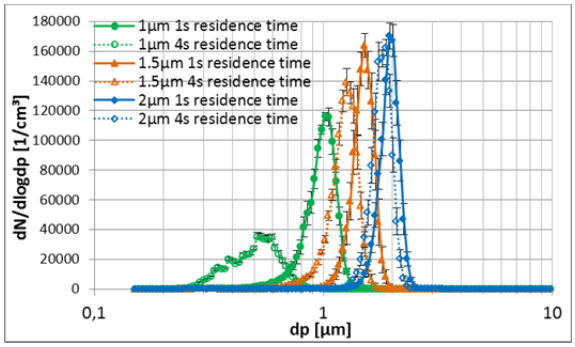

Figure 1. Evaporation of hexadecane particles

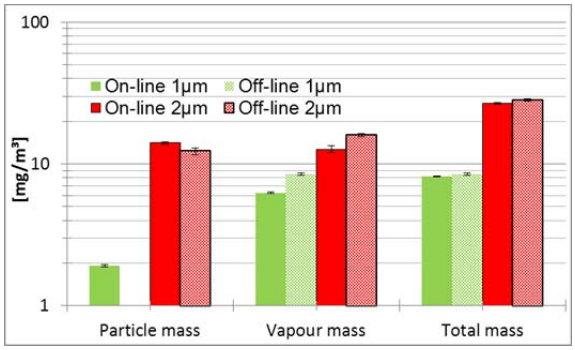

Figure 2. Comparison between *on-line* and *off-line* measurements for hexadecane 1 and 2 µm data.

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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).

Breuer, D. (1999). "Measurement of vapour–aerosol mixtures." J. Environ. Monit.(1): 299-305.