Design/performance test of a headset-mounted minisampler for inhalable dust

G. Lidén and J. Zábori

Department of Environmental Science and Analytical Chemistry,
Stockholm University, SE-10691 Stockholm, Sweden
Keywords: Occupational exposure, Inhalable dust, Personal sampling.
Presenting author email: Goran.Liden@aces.su.se

The determination of occupational exposure to airborne contaminants often requires a long sampling period (2-8h) to be collected in the breathing zone for subsequent chemical analysis. Usually the sampler is mounted at the collarbone or at the upper part of the chest. When working close to the source (handling it) strong concentration gradients are generated and one would get a smaller bias in the determined exposure if it was possible to sample close the workers mouth or nose. A minisampler for the inhalable aerosol fraction (CEN, 1993) was developed for the SKC *Face Level Sampling Headset* (SKC, 2016). Currently, only one small aerosol sampler is commercially available for this system, an open-face cassette for 13 mm filters originally intended for manganese (Lidén and Surakka, 2009). On the Face Level Sampling Headset, the sampler is mounted on a light beam and is located in the direct vicinity of the mouth/nose. The air flow is generated by a personal sampling pump.

CEN/TC137/WG3 and ISO/TC146/SC2/WG1 currently discuss whether to add a new sampling convention for the inhalable fraction for workplaces with calm air/low wind. These discussions are based on the results of Aitken *et al.* (1999) and Sleeth and Vincent (2011). The object was to optimize the sampling efficiency to be as close as possible to one of the proposed sampling conventions.

The sampler was designed with a circular tubular nozzle. In the original experimental design, the nozzle length was approx. 10 mm and the nozzle was attached to modified 13 mm Swinnex nylon filter holders (Millipore). The test followed EN13205 (CEN, 2014). In the initial experiment the collection efficiency was determined for eight aerodynamic particle sizes at two nozzle sizes and two flow rates per size. The test aerosols were generated from "monodisperse" aluminium oxide particles in the grade range F600 – E220 corresponding to aerodynamic sizes in the range 16 – 113 µm. The experiment was carried out in a calm air chamber with the general test setup similar to that of Kenny et al. (1999). The test aerosol was introduced from above and the reference concentration was determined with a pseudo iso-kinetic sampler. The amount of collected sample was determined by weighing in a climatized room.

Based on an evaluation of the experimental results, an optimized nozzle was designed with an inner diameter of 7.5 mm. The minisampler was optimized for a flow rate of 0.75 LPM. Two versions were tested, with a long (9 mm) and short nozzle (4 mm). Figure 1 shows the sampling efficiency of the two versions of the optimized minisampler for the inhalable fraction as well as the sampling convention for inhalable fraction.

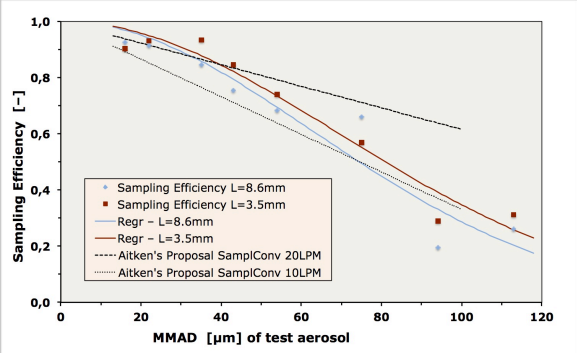

Figure 1. The experimentally determined sampling efficiency of the minisampler for the inhalable fraction and the sampling convention for inhalable fraction

It can be seen that the minisampler with the longer nozzle has a slightly lower sampling efficiency, on average 3.6% lower. These sedimentation losses are so small that they can be discarded. A short nozzle would also make the filter more exposed to air currents at the workplace that are not present in a clam air chamber.

This sampler could be an interesting choice if/when a sampling convention for calm air is defined.

This work was supported by the Swedish Work Environment Authority.

Aitken, RJ, Baldwin, PEJ, Beamont, GC, Kenny, LC, Maynard, AD (1999). *J. Aerosol Sci.* 30(5):613-626.

CEN (1993). *EN 481 Workplace atmospheres – Size fraction definitions for measurement of airborne particles*, Comité Européen de Normalisation, Brussels, Belgium.

CEN (2014). *EN 13205 Workplace exposure – Assessment of performance of instruments for measurement of airborne particle concentrations*, Comité Européen de Normalisation, Brussels, Belgium.

Kenny, LC, Aitken, RJ, Baldwin, PEJ, Beamont, GC, Maynard, AD (1999). *J. Aerosol Sci.* 30(5):627-638.

Lidén, G. & Surakka, J. (2009). *Ann. occup. Hyg.*, 53(2): 99-116.

SKC (2016). http://www.skcltd.com/index.php/face-level-sampling. Assessed 160223

Sleeth, DK, Vincent, JV (2011). *Ann. occup. Hyg.* 55(5):476-484.