

## A novel particle sampling system for toxicological characterization of emissions

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Several studies have shown that combustion-derived fine particles cause adverse health effects. Previous toxicity studies on combustion-derived fine particles have rarely involved multiple endpoints and a thorough analysis of chemical composition. Comprehensive toxicological characterization of the emission particles needs relatively large amount of sample mass (tens of milligrams). Thus, the samples have been previously collected with large equipments to reach sufficiently high flow rates. To get representative particle samples, the sample flow of flue gas is first diluted and cooled down to obtain semivolatile components in the particle phase. In this study, we have developed a new compact system to sample emission particles for toxicological analyses.

Two laboratory measurement campaigns were conducted to compare a modified Harvard high-volume cascade impactor (HVCI – 850 litres/min) (Sillanpää et al. 2003) with a new system that consists of a porous tube diluter, Dekati Gravimetric Impactor (DGI - 70 litres/min; Dekati Ltd.) and flow control. In the first campaign, the differences between the impactors were tested by drawing particle samples from a dilution tunnel with dilution ratio (DR) around 100. In the second campaign, the sample for DGI was diluted using a porous tube diluter with DR 10-20. The combustion sources used in the campaigns were a light-duty diesel engine, a pellet boiler and a conventional masonry heater. In addition, Dekati Low-Pressure Impactor (DLPI, Dekati Ltd) was used to measure a more detailed particle mass size distribution. To determine PM<sub>1</sub> emissions, polyurethane foam and PTFE backup filter were used as impaction substrates in the HVCI, while PTFE filters were used in the DGI. None of the substrates were greased, since it interferes with toxicological analyses.

The composition of emitted particles varied between the sources. PM<sub>1</sub> from diesel exhaust contained a lot of soot, and those from pellet boiler and masonry heater contained large amounts of alkali metal compounds and organic material, respectively.

There was a relatively good agreement on PM<sub>1</sub> concentration between the HVCI and DGI in the dilution tunnel. In contrast, the PM<sub>1</sub> emissions differed from each other, when the DGI was operated

with the porous tube diluter. This may be due to different gas-to-particle conversion of organic vapours. The contributions of organic carbon in conventional masonry heater were between 8.5% and 16.9% to the DGI-PM<sub>1</sub> and between 7.1% and 10.6% to the HVCI-PM<sub>1</sub>.

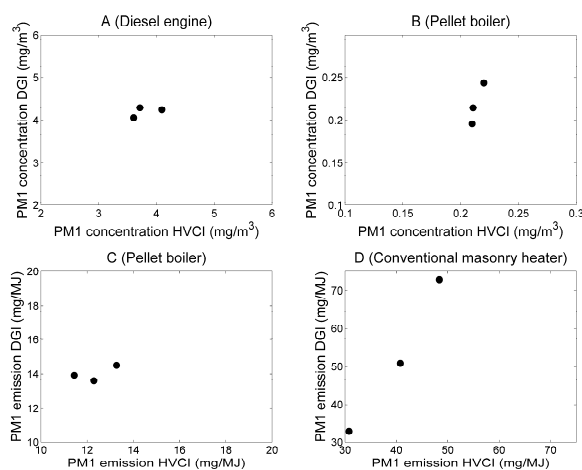


Figure 1. PM<sub>1</sub> emissions as measured using the DGI and HVCI. Panels A and B: All samples collected from dilution tunnel. Panels C and D: Samples for DGI collected using porous tube diluter.

The HVCI dilution tunnel method was found to result in a slightly lower PM<sub>1</sub> emission than the DGI porous tube diluter method. The differences in the measured PM<sub>1</sub> emission were likely connected to particulate organics. With the HVCI method, the DR was higher, which is known to give a lower fraction of emitted particulate organics (Lipsky et al., 2006).

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