Field comparison of three inhalable aerosol samplers for welding fumes (IOM, PGP-GSP 3.5 and BUTTON)
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METHODOLOGY

- Sampling was carried out in a welding training centre, where Manual Metal Arc (MMA) and Metal Active Gas (MAG) processes were used.
- Static samples were collected using the sampling assembly designed to place 12 samplers and 2 Marple cascade impactors at the same time.
- Three assemblies were used to compare the inhalable aerosol samplers:
  - Assembly 1 (A1): 6 Button samplers vs. 6 IOM samplers.
  - Assembly 2 (A2): 6 Button samplers vs. 6 PGP-GSP 3.5 samplers.
  - Assembly 3 (A3): 6 PGP-GSP 3.5 samplers vs. 6 IOM samplers.
- In each test, samplers positions in the bars were selected at random.
- Glass Fibre (GF) filters, with a pore size of 1 µm, were used as collection substrate and the mass of aerosol collected was determined by gravimetric analysis.
- The ratio of welding fumes mass concentrations was the chosen parameter to compare the behaviour of the samplers.

RESULTS

- The welding fumes concentrations were ranged between 2 mg/m³ and 5 mg/m³.
- For each type of sampler, the pooled coefficient of variation of the replicated samples were less than 3 %.
- About 70 % of the total mass collected by the 8-stage Marple cascade impactors was composed by particles with an aerodynamic diameter less than 3.5 µm.
- The differential particle size distribution of the welding fumes showed a bimodal distribution, characterized by two mass median aerodynamic diameters (MMAD) and two geometric standard deviations ($\sigma_g$).
- The sampler performance was studied comparing the mass concentration of one sampler with the concentration of the closest paired-samplers. 232 pairs of valid results were considered.

SAMPLER COMPARISON

- To compare the samplers performance, the relations Button/IOM, Button/PGP-GSP 3.5 and PGP-GSP 3.5/IOM were used.

CONCLUSIONS

- The aerosol homogeneity in the sampling area allows to compare the behaviour of the samplers (pooled CV < 3 %).
- The welding fumes collected by the impactors show a bimodal size distribution, characterized by the following mass median aerodynamic diameters and geometric standard deviations ($\sigma_g$):
  - Particles < 3.5 µm (70 % mass): MMAD = 0.6 µm ($\sigma_g = 2.0$ µm)
  - Particles > 3.5 µm (30 % mass): MMAD = 7.9 µm ($\sigma_g = 2.7$ µm)
- The sampler performance was studied comparing the mass concentration of one sampler with the concentration of the closest paired-samplers. 232 pairs of valid results were considered.

For MMA and MAG processes and the described particle size distribution of the welding fumes:
- The IOM sampler collects significantly more amount of the aerosol ($P < 0.001$) than the Button sampler.
- The IOM sampler collects significantly more amount of the aerosol ($P < 0.001$) than the PGP-GSP 3.5 sampler.
- The Button sampler and the PGP-GSP 3.5 sampler show similar performance ($P = 0.598$).