Name of research institute or organization:

Institute for Chemical and Bioengineering, Swiss Federal Institute of Technology, ETH Zurich

Title of project:

Quantitative characterization of the impact of environmental factors on the performance of passive air samplers for semi-volatile organic compounds

Project leader and team:

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Project description:

Some semi-volatile organic compounds (SVOCs) such as polychlorinated biphenyls (PCBs) or polybrominated diphenyl ethers (PBDEs) have been recognized as persistent organic pollutants (POPs). POPs represent environmental contaminants of particular concern because they can affect human health and the environment and are concurrently recalcitrant to degradation, accumulate in human and animal tissue, biomagnify along food chains, and undergo long-range atmospheric transport. SVOCs have appreciable vapor pressures of 10^{-12} - 10^{-2} Pa (at 20°C). Thus, SVOCs are volatile enough to be significantly mobile in the atmosphere, where they partition between the gaseous and particulate phase. Accurate quantification of SVOCs in air samples is very challenging and particularly time, labor and resources intensive.

In the last few years, passive air samplers have been developed and proved that in many cases they represent suitable alternatives to active air samplers. A major limitation of passive samplers consists in the longer sampling period necessary for the sufficient accumulation of SVOCs to overcome analytical detection limits. Typical air sampling rates are 1 - 5 m^3/day. Furthermore, the volume of air sampled by the passive sampler is difficult to control, limiting seriously the accurate determination of air concentrations of SVOCs. Thus, in studies where active samplers are not available or impossible to use, but where higher temporal resolution of sampling is still essential, an additional sampling technique is required. Therefore, flow through air samplers have recently been developed (Figure 1).

Figure 1. *Picture of the original flow through air sampler installed at Jungfraujoch (picture Matthew MacLeod, Stockholm University).*

The initial testing phase in 2009 proved that the original low through sampler is unsuitable for air sampling at the High Alpine Research Station Jungfraujoch. The

rapid formation of ice around the sampler revealed to be a major obstacle. Regularly, ice clogged the sorbent and hindered the rotation of the sampler.

Based on the valuable observations at Jungfraujoch, a new version of the original flow through sampler has been developed. The new sampler was completely redesigned and reconstructed with high-grade materials (Figure 2). A three module heating system intended to prevent ice formation on the sampler has been integrated into the flow tube, sorbent casing, and articulated joint.

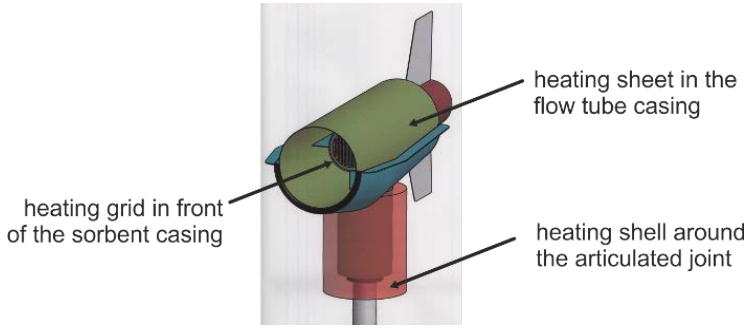

Figure 2. *Sketch of the newly constructed flow through air sampler.*

Within the last project year, the new flow through sampler was tested at ETH Zurich. First experiments with the new sampler exposed to ambient air, revealed some remaining weaknesses that could be resolved successfully. The next step will consist in comparing the performance of the new sampler with the initial device. Later, it is planned to install the new sampler at Jungfraujoch for an evaluation under real field conditions. On a mid-term, the continuous operation of the new flow through sampler at Jungfraujoch is planned with the objective to study temporal variations of SVOCs.

Key words:

semi-volatile organic compounds, persistent organic pollutants, air monitoring, passive air sampling

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