

Calibration of polyurethane foam (PUF) disk passive air samplers for quantitative measurement of polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs): Factors influencing sampling rates

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Abstract

PUF disk passive air samplers are increasingly employed for monitoring of POPs in ambient air. In order to utilize them as quantitative sampling devices, a calibration experiment was conducted. Time integrated indoor air concentrations of PCBs and PBDEs were obtained from a low volume air sampler operated over a 50 d period alongside the PUF disk samplers in the same office microenvironment. Passive sampling rates for the fully-sheltered sampler design employed in our research were determined for the 51 PCB and 7 PBDE congeners detected in all calibration samples. These values varied from 0.57 to 1.55 m³ d⁻¹ for individual PCBs and from 1.1 to 1.9 m³ d⁻¹ for PBDEs. These values are appreciably lower than those reported elsewhere for different PUF disk sampler designs (e.g. partially sheltered) employed under different conditions (e.g. in outdoor air), and derived using different calibration experiment configurations. This suggests that sampling rates derived for a specific sampler configuration deployed under specific environmental conditions, should not be extrapolated to different sampler configurations. Furthermore, our observation of variable congener-specific sampling rates (consistent with other studies), implies that more research is required in order to understand fully the factors that influence sampling rates. Analysis of wipe samples taken from the inside of the sampler housing, revealed evidence that the housing surface scavenges particle bound PBDEs.

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1. Introduction

Although they were first available in the 1930s (Tolnai et al., 2000), passive air samplers, were not mathematically characterised using Fick's law of diffusion until 1973 (Palmes and Gunnison, 1973). Since that date, several passive sampling media (PSM) have been characterised and utilized for monitoring concentrations of persistent organic pollutants (POPs) in air (Petty et al., 1993; Shoeib and Harner, 2002; Zabiegala et al., 2002; Bartkow et al.,

2005; Harrad et al., 2006). The benefits of using passive samplers are that they are easy to handle, are more cost-effective than active monitors, and do not require electricity (Nothstein et al., 2000), thus facilitating simultaneous monitoring in many spatially distinct locations. Furthermore, their noise-free operation and relative unobtrusiveness, makes them ideal for the determination of indoor air quality. Similarly, although passive samplers have relatively low sampling rates necessitating long sampling times at low air concentrations that prevents study of short-term concentration variations (that could inter alia facilitate source apportionment), they are ideal for providing time weighted average (TWA) concentrations. Given that the

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