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A high throughput method for measuring cloth-air equilibrium distribution ratios for SVOCs present in indoor environments

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Accumulation of chemicals from the environment to clothing and other textiles can influence human uptake by several exposure routes. In this research, we demonstrate that the cloth-air equilibrium distribution ratio for species *i*, K_{CA_i}, can be measured relatively easily and quickly using headspace analysis of cloth dosed with two common indoor air SVOCs, diethyl phthalate (DEP) and di-n-butyl phthalate (DnBP). A known mass of a phthalate was applied to the cloth in a volatile solvent carrier. After evaporation of the solvent, the cloth was placed in a vial and allowed to equilibrate with the air in the vial. Since the volume of headspace air is small, the total mass required to transfer from cloth to air is small and also the time required for air equilibration with the fabric surface is very short (minutes). Distribution ratios for the two phthalate esters sorbed to cotton jean material, reported as the concentration in the bulk cloth divided by the air concentration, were measured at 20, 25, 32, and 40˚C. The volume-normalized distribution ratio, K_{vol} [(μg/m^3)/(μg/m^3)], ranged from (0.75±0.01)×10^5 to (5.6±0.2) ×10^5 for DEP and (5±0.3)×10^5 to (57±1) ×10^5 for DnBP. Mass-normalized distribution ratio, K_{mass} [m^3/g], ranged from (0.25±0.01) to (1.8±0.1) for DEP and (1.6±0.1) to (18.5±0.5) for DnBP. The cloth-air distribution ratios obtained from this study compare favorably with previously published results using other methods. Although equilibration with air in the headspace can be rapid, diffusion into the textile fibers is a slower equilibration process. Overall, this simple method has the potential to rapidly generate distribution ratios for a large number of chemical-textile pairs.