Small-scale spatial variability of flame retardants in indoor dust and implications for dust sampling

Simona Jílková[1]; Lisa Melymuk, PhD[1]; Šimon Vojta, PhD[1]; Martina Vykoukalová[1]; Pernilla Bohlin-Nizzeto, PhD[2]; Jana Klánová, PhD[1]

[1]Research Centre for Toxic Compounds in the Environment (RECETOX), Masaryk University, Kamenice 753/5, Pavilion A29, Brno, 62500 Czech Republic, jilkova(at)recetox.muni.cz; [2]Norwegian Institute for Air Research (NILU), Kjeller, Norway

Indoor dust is often used to evaluate levels of organic compounds indoors, particularly for compounds with indoor sources, such as flame retardants (FRs). Yet there are uncertainties about the type of information that can be obtained from indoor dust. This study reports detailed dust sampling to assess spatial variability in indoor dust concentrations, the relationship between FR sources and dust, and the implications when interpreting dust concentrations. The main objectives of this study were (1) to identify the differences in FR profiles and levels obtained by two sampling methods (wet wipes and vacuuming), (2) to identify the range of concentrations within individual rooms and thus identify what effect the choice of sampling location may have on reported concentrations, and (3) to determine the extent to which concentrations are influenced by room type and proximity to room elements (electronics, furnishings, different usage of the space, etc.), and identify whether greater heterogeneity in room furnishings and use leads to greater heterogeneity in indoor dust.

Multiple dust samples were collected from a range of surface types in three large rooms: a residential flat, a university seminar room, and a university computer room in Brno, Czech Republic, from March to July 2014. The samples were collected by vacuum cleaner and by wipes. Samples were analyzed for polybrominated diphenyl ethers (PBDEs), novel halogenated flame retardants (NFRs) and organophosphate esters (OPEs).

FRs levels in dust varied significantly between and within rooms. Levels typically ranged over one order of magnitude within a room, and up to four orders of magnitude for a few OPEs. The spatial distribution of FRs related (in some cases) to proximity to sources, surface properties, and dust surface loadings. Differences also existed between surface and floor dusts, e.g., the contribution of tris(2-butoxyethyl) phosphate (TBOEP) to ∑OPEs was higher in floor than surface dust, which has implications for human exposure assessment; adults typically have more contact with elevated surfaces, while young children have greater contact with floor surfaces. Overall, significant spatial heterogeneity exists in indoor dust, even in seemingly homogeneous indoor spaces, thus hampering comparability between studies and locations when single samples are collected. Composite samples are strongly recommended to limit the influence of spatial heterogeneity.

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