

We-PL-I2: Indoor Environment

We-PL-I2.1

Flammability Standards Impact Flame Retardant Concentrations in Dust

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Aim: Furniture flammability standards are typically met with chemical flame retardants (FRs), and the nature and amount of FRs used depends on the properties of the material and on how the performance-based test is conducted. In the U.S., most furniture purchased by colleges and universities meets one of two flammability standards: Technical Bulletin (TB) 117 or TB 133. In the absence of national flammability standards, California's TB 117 and TB 133 have become the de facto national standards. Because TB 133 requires furniture to withstand a much larger test flame than TB 117, we hypothesize that TB 133 furniture have different FR profiles and potentially higher levels of FRs compared to TB 117 furniture, and that these FRs will migrate out of furniture and into dust.

Methods: We collected 96 vacuum dust samples from residential spaces on 2 northeastern U.S. college campuses adhering to either TB 117 or TB 133. Chemical analysis targeted 54 FRs, including 12 polybrominated diphenyl ether (PBDE) congeners, 20 other brominated FRs, 2 Dechlorane Plus isomers, 3 hexabromocyclododecane isomers, 12 organophosphate flame retardants (OPFRs), and 5 polybrominated biphenyls.

Results: PBDEs and OPFRs were found in the majority of dust samples, and OPFRs tended to have the highest median dust concentrations. Median levels were comparable to our previous measurements in California house dust; however, maxima were up to 100x higher than previous residential measurements. The maximum TDCIPP (chlorinated "tris") concentration was 170,000 ng/g, higher than levels previously reported in U.S. dust, even office dust, which tends to be higher than house dust. Dust concentrations of several FRs, including BDE 209, decabromodiphenylethane (DBDPE), anti-Dechlorane Plus, and tri-(2ethylhexyl) phosphate (TEHP), were significantly higher on the TB 133 campus compared to the TB 117 campus. BDE 209, and its replacement DBDPE, are used in textile back-coatings to meet stricter upholstered furniture flammability standards, like TB 133. Dust concentrations in samples collected from student dorm rooms (i.e. sleeping spaces) were generally higher and more variable than concentrations in samples collected from common spaces in residence halls. This is likely a result of additional furnishings and electronics brought in by students.

Conclusions: FR concentrations varied by flammability standard used. The high density of FR-treated products, including furniture, furnishings, and electronics, in student dorm