

Sorption of Organophosphorus Flame-Retardants on Settled Dust

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ABSTRACT

Dust is a significant sink for indoor air pollutants, such as organophosphorus flame-retardants (OPFRs) that are used as additives in industrial and consumer products including electrical and electronic products, furniture, plastics, textile, and building/construction materials. Because of their small size and large surface area-to-volume ratio, dust particles can settle on indoor surfaces and then be re-suspended, contributing to both ingestion and inhalation exposure. OPFRs, including tris(2-chloroethyl) phosphate (TCEP), tris(1-chlor-2-propyl) phosphate (TCPP), and tris(1,3-dichloro-2-propyl) phosphate (TDCPP) are EPA action plan chemicals for chemical assessments under the Toxic Substances Control Act (TSCA). This research investigated the sorption of these three compounds on settled Arizona Test Dust (ATD) using a dual small chamber system. During the test, constant gas phase OPFRs from the source chamber were dosed into the sink test chamber where ATD dust trays were placed. The dust was removed at different exposure times to determine the amount of OPFRs absorbed. The ATD has been characterized for a nominal particle size and surface area. OPFRs concentrations at the inlet and faceplate of the test chamber were monitored by collecting polyurethane foam (PUF) samples. The OPFR exposed dust and PUF samples were solvent extracted and analyzed on GC/MS. The data were used to calculate the OPFR sorption concentration on the dust through dust/air partition. Our results showed that settled dust can adsorb OPFR from air, and the sorption concentration was dependent on the OPFR concentration in the air and favored less volatile compounds. This work explores the relationship between OPFR concentrations in settled dust and air. The data can be used to determine partitioning of OPFRs between the gas phase and settled dust indoors and to inform strategies to reduce exposure and risk.