Laboratory Study of Polychlorinated Biphenyl (PCB) Contamination in Buildings Emissions from Selected Primary and Secondary Sources

Problem: Polychlorinated biphenyls (PCBs) are a class of organic chemicals, known as congeners, that have been used in a variety of commercial products. PCBs were used in caulking, electronics, fluorescent light ballasts and other building materials from the 1950s to the late 1970s. Buildings built or renovated during that time may contain PCBs in caulking and other materials.

In 1979, the U.S. Environmental Protection Agency (EPA) banned the commercial production of PCBs, citing health and environmental concerns. Health concerns related to PCB exposure include, but are not limited to, cancer, reproductive effects and neurological effects.

PCBs are regulated by the Toxic Substances Control Act (TSCA) Title 40, Part 761 (enacted in 1976). Unless specifically authorized, current regulations require the removal of materials using PCBs if their PCB content is above a concentration of 50 parts per million (ppm). However, there is no federal requirement for testing of materials so the amount of PCBs in materials and PCB emissions are often unknown.

In response to concerns raised by the public about PCBs in schools, EPA announced in the fall of 2009 a series of steps that building owners and school administrators should take to reduce exposure to PCBs that may be found in caulk and other materials in buildings constructed during this timeframe. In addition, EPA scientists began conducting research in the following areas:

- Characterization of potential sources of PCB exposures in schools (caulk and other materials).
- Investigating the relationship of these PCB sources to PCB concentrations in air, dust, and soil.
- Evaluation of mitigation methods to reduce exposures to PCBs in caulk and other sources.

This fact sheet summarizes EPA's test results for PCB emissions from primary indoor sources, with emphasis on PCB-containing caulk and light ballasts, secondary sources, and the factors that may affect emissions.

Action: EPA conducted research to address specific questions related to the scope of PCBs in caulking materials and their potential effect on the quality of indoor environments. The main objectives of these research studies were to collect new data to reduce the uncertainty in models by understanding the behavior of PCB sources in building materials, including caulking materials and light ballasts, and secondary sources, to support risk management decisions, and the development and refinement of exposure assessment models such as the Stochastic Human Exposure and Dose Simulation (SHEDS) model.

Results: In the study on primary sources, PCBs were present in the 12 field caulk samples tested at concentrations ranging from <10 to 136,000 µg/g. The PCB emission rates (*i.e.,* off-gassing rates) were proportional to the PCB content in the caulk, and PCB emissions increase as the temperature increases. There were significant differences between the congener profiles of caulk and air samples, with the more volatile congeners being present at higher proportions in the air samples. Emission factors for congeners in caulk can be estimated as long as the content in the caulk and the vapor pressure are known. However, the uncertainty associated with the PCB concentration in air for Aroclors needs further evaluation. (Commercial PCB products were mixtures of different PCB congeners and have many different trade names such as Aroclor, Eucarel, and Pyranol.)

Also in the study on primary sources, 13 types of light ballasts were tested for PCB emissions. None had visible fluid leakage. Overall, the emission rates for PCB containing light ballasts were small at room temperature for non-leaking ballasts, but increased significantly at temperatures similar to those reached during operation. PCB emissions from un-ruptured fluorescent light ballasts are difficult to predict, but as old fluorescent light ballasts have exceeded their designed lifespan, the chance for rupture and emitting PCBs is significant. Overall, the study on primary sources established a direct link between the PCB content in caulk and light ballasts and PCB concentrations in room air by experimentally measuring the emission rates.

Secondary sources of PCBs occur when building materials, furniture, and other indoor constituents (such as settled dust) act as sinks for airborne PCBs. Results from this study indicate that sink materials absorb PCBs from air in the presence of a primary source, and the sink becomes a re-emitting source only after the primary source is removed. The experimentally determined sorption concentrations for 20 materials differed by as much as a factor of 50, indicating that the sink strengths vary greatly from material to material. The sorption capacity for a given material (*i.e.,* the maximum amount of PCBs the material can absorb from the air), depends on the concentration of the congener in the air and the material/air partition coefficient. The rate of PCB accumulation on sink materials depends on the material/air partition coefficient and the diffusion coefficient of the congener into the material, as well as the exposure history. Settled dust is a particular indoor sink for PCBs, as it can absorb PCBs either from the air or by direct contact with a source.

Impact: The data and empirical models presented in the reports on primary and secondary sources can be used by risk assessors and risk managers to rank indoor PCB sources or as input for indoor contaminant models and for exposure models. Although more research needs to be done, these studies advance our understanding of PCB emissions from primary sources, their transport from primary to secondary sources, and the subsequent emissions.