# Research Brief 167: SBRP Researcher Finds Previously Unidentified PCB in Urban Airshed

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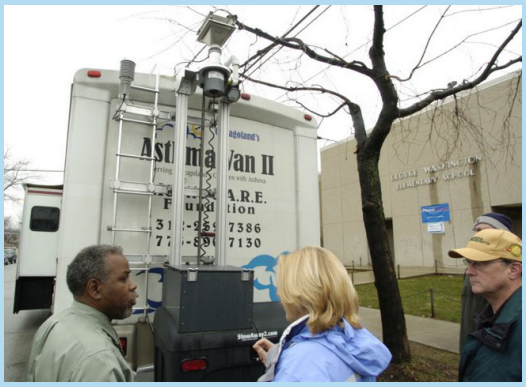
## Background:

Polychlorinated biphenyls (PCBs) are a family of low-volatility compounds manufactured extensively across the United States and Europe between the 1920s and the 1970s. Due to their stabilizing and insulation properties, PCBs were commonly used as coolants for capacitors and transformers, as insulation in electrical wiring, and to a lesser extent as plasticizers in paint, caulk, and other sealants. Though they were banned in 1977 over concerns of demonstrated environmental stability and bioaccumulation as well as potential carcinogenicity, PCBs continue to be volatilized into the environment from old disposal sites and through the breakdown of manufactured materials which contain them. As a part of the University of Iowa SBRP, Dr. Keri Hornbuckle is working to determine sources of PCBs observed in ambient air in urban Chicago using a novel sampling method developed for this project. The goal of this research is to identify "hotspots" of PCB volatilization in the urban airshed, characterize the spatial extent of contamination in the city, and estimate the strength of the emission sources.

## Advances:

Field sampling in urban areas has historically been a problem due to the logistics of setting up sampling equipment, maintaining the system, and transporting samples for analysis once they are complete. If the logistical difficulties can be surmounted, field sampling at multiple sites is often prohibitively expensive. In collaboration with Dean Macken, Director of the University of Iowa's Engineering Design and Prototyping Center, Dr. Hornbuckle developed a high-volume (Hi-Vol) sampling system that can be mounted on the back of medical vans operated by the Mobile C.A.R.E. Foundation of Chicago. These vans are used for on-site care at local elementary schools for children with asthma and other respiratory diseases. Mobile C.A.R.E. lent assistance to Dr. Hornbuckle in sample collection for this study.

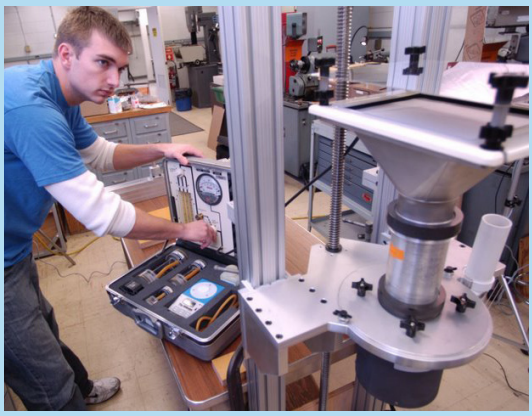


Rodger Peck (Mobile C.A.R.E.), Keri Hornbuckle, and Dean Macken

The Hi-Vol system consisted of a quartz fiber filter for particle sampling in series with an XAD-2 resin cartridge to capture PCBs in the gas phase. Two vehicles were used, which allowed sampling to occur at two different sites on the same day. When a van arrived at a care location, the Hi-Vol system was set up by the driver; samples were collected for the six to eight hours in which the van was parked at the school. Temperature and humidity data were also collected.

The researchers analyzed samples with GC/MS/MS, using a variant of the current EPA method (EPA 1668A). They chose to use a SP-Octyl capillary column instead of a nonselective column and multiple reaction monitoring (MRM) instead of electron capture detection (EC) mass spectrometry. These changes permitted the researchers to resolve 209 congeners into 169 peaks and also allowed for the positive identification of PCB11 in their assay. PCB11 is a known byproduct of 3-3'-dichlorobendzidine and has been otherwise identified in waste from paint and pigment industries. Very little study of PCB11 has been undertaken and its toxicity is currently

unknown. Dr. Hornbuckle found PCB11 in 91% of the samples taken; it contributed to, on average, 5% of total PCB mass. This concentration is far higher than what is reported to be in commercially produced Aroclor mixtures, where PCB11 constituted up to 0.16% of total mass.



Hornbuckle collaborates with Bill Wombacher, a masters student at UI's College of Engineering; they are working on a piece of equipment that will be used to measure particles in the air.

Dr. Hornbuckle notes that it is possible that PCB11 has been present in the ambient chemical profile for some time. The Chicago metro area experiences elevated background concentrations of PCBs relative to other parts of the country due to the presence of heavy industry in the area prior to the banning of their manufacture in 1977. Previous studies have identified PCBs in the airshed, though no other groups have positively identified PCB11 in their assays. In addition, Dr. Hornbuckle notes that none of the potential precursors to PCB11 are present in large quantities in the local air profile. Dr. Hornbuckle suggests that this indicates a source other than commercial Aroclor products. Given both the widespread geographic distribution and the high concentrations found in residential areas, a possible source of contamination may be current and/or historical use of paint on building interiors and exteriors. Indoor concentrations, and therefore exposures, may be far higher than what was detected outdoors in this study.

## Significance:

Dr. Hornbuckle's work chronicles the first identification of PCB11 in an ambient urban atmosphere. The development of the mobile Hi-Vol sample collection system mitigates the logistical difficulties of sampling at multiple remote sites by removing some of the costs associated with installing and maintaining the equipment. It also reduces the labor costs of collecting and transporting samples. Additional study of PCB11 is needed, as much is unknown about this potentially toxic compound. Further areas of study include: positively identifying sources; determining prevalence, if any, in other geographic areas; and investigating if this compound is present in any other matrices or ecosystems.

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## To learn more about this research, please refer to the following sources:

Hu, Dingfei, Keri C. Hornbuckle, and A. Martinez. 2008. Discovery of Non-Aroclor PCB (3,3'-Dichlorobiphenyl) in Chicago Air. Environmental Science and Technology. (http://pubs.acs.org/journals/esthag/) doi:10.1021/es801823r (http://dx.doi.org/10.1021/es801823r) 42:(in press)