SELECTED POLYBROMINATED DIPHENYL ETHERS IN HOUSE DUST IN CHINA

Li K, Fu S, Xu X B

State Key Laboratory of Environmental Chemistry and Ecotoxicology, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, Post Office Box 2871, Beijing 100085, People's Republic of China

Abstract
A total of eleven house dust samples were collected from one of China's metropolises for analysis seven polybrominated diphenyl ethers (PBDEs). The PBDEs concentration ranged from N.D.- 1.3×10^3 ng g^{-1}. The dominant BDE congener detected in house dust samples was BDE-209, which contributed above 85% to all the BDE congeners analyzed. The levels of PBDEs concentration in house dust in China were lower than those in other countries.

Introduction
Polybrominated diphenyl ethers (PBDEs) are man-made chemicals widely used as flame retardants in a wide variety of plastics, textiles and electronic components[1]. PBDEs have the potential for endocrine disruption, bioaccumulation, and long-range transport[2], while an increasing number of studies have been conducted with regard to their carcinogenic and mutagenic properties[3,4]. Recently, certain commercial mixtures of PBDEs (penta and octa formulations) were banned in Europe because of their persistence and potential environmental and human health risks[5]. However, the demand for PBDEs has been increasing rapidly, and in Asia all commercial BDE mixtures are used without regulation[6].

The sources of human exposure to PBDEs remain poorly understood. Since PBDEs can easily accumulate on particles, contamination of house dust has a direct impact on public health, increasing the risk of human exposure via inhalation, ingestion or direct skin contact[7]. So house dust is an especially important exposure pathway for people, especially young children. Due to the paucity of data on levels of PBDEs in house dust in China, this study investigated the composition, profile and characterization of PBDEs in house dust samples obtained from different types in one of China's metropolises. The main objective of this study was to identify the possible sources of pollution in the house dust of China's metropolises.

Materials and Methods
House dust samples were collected from 11 different types in one of China's metropolises, including 3 homes, 3 offices, a dinner room, a storage and 3 electronical products shops. Dust was collected from the filters of air conditioning units (ACUs) in the houses, according to the sampling method of Tan[6].

A standard solution of EO-5278 (purchased from Cambridge Isotope Laboratories, Andover, MA) was used to quantify the seven PBDE congeners (BDE- 47, 99, 100, 153, 154, 183 and 209). All solvents used were pesticide grade (J. T. Baker, USA).

Three grams of each house dust sample were weighed and then ground with anhydrous sodium sulfate until they formed a free-flowing powder. The samples were then extracted, cleaned and analyzed according to the methods of Li K[8].

Results and Discussion
Seven BDE congeners, including BDE-47, 99, 100, 153, 154, 183 and 209 were identified in each of the house dust samples. The detection rates of the PBDEs in the dust were up to 100%, which indicated wide occurrence of these compounds in indoor environment. PBDEs concentration ranged from N.D.- 1.3×10^3 ng g^{-1} (dry weight) in house dust (Table 1).

The dominate BDE congener detected in this study were BDE-209, accounting for more than 85% of the total

PBDEs in all of the samples. BDE-209 was the major pollutant in this study. The BDE congener profiles of the house dust were similar to those in surface soil of urban area in China[8].

Table 1 Concentration of PBDEs in each sample (data units are in ng g^{-1} dust; N.D., not detected)

Sample No.	BDE-47	BDE-99	BDE-100	BDE-153	BDE-154	BDE-183	BDE-209
1	1.1	1.7	0.2	1.2	0.6	2.6	266.3
2	5.9	2.6	0.2	1.2	0.5	1.9	134.8
3	2.3	1.2	0.1	0.7	0.2	2.1	99.3
4	2.6	2.8	0.2	2.2	0.8	3.1	225.7
5	13.6	18.2	1.9	7.6	2.4	10.1	988.9
6	4.5	11.2	2.3	7.4	2.5	11.0	1.1×10^3
7	6.1	7.0	1.0	2.1	0.9	3.3	786.0
8	1.8	3.0	N.D.	4.2	1.8	6.0	552.3
9	2.5	2.0	0.3	1.7	0.3	4.0	1.3×10^3
10	52.1	16.9	0.8	5.1	1.5	4.9	685.4
11	33.4	14.0	0.7	4.0	1.3	3.0	485.0

House dust in homes and electronical product shops were the most polluted area. This profile was reasonable since many electronical products in which PBDEs always used in circuit board and casings were used in this area. The concentration of PBDEs in office 3 was much higher than that in office 1 and 2. The possible reason was that the electronical products in office 3 were much more than those in office 1 and 2. It could be concluted that the contamination of PBDEs in house dust are strongly associated with the the prevalent use of PBDE as a flame retardant in China.

We compared the indoor dust concentrations of PBDEs reported elsewhere in the literature. The levels were much lower than these in Singapore, Ottawa, Washington DC and Birmingham. The concentrations of PBDEs except BDE-209 were also much lower than these in Toronto. But for BDE-209, it was similar to that in Toronto.

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