Levels of polybrominated diphenyl ethers in the ambient air of automobile dismantling plants from southern Taiwan

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As a class of brominated fire retardants (BFRs), polybrominated diphenyl ethers (PBDEs) are only used to decrease the flammability of consumer products including electronics (e.g. air conditioner, TV sets, and cellular phones), automobiles, furniture, and electrical wirings and textile application (Alaee *et al.*, 2003). PBDE contamination has been raising the global concern due to their lipophilicity, persistence, and bioaccumulation. PBDEs are ubiquitously existed in indoor environment due to their persistence and the widespread use in consumer products. Therefore, PBDEs have been recognized as the significant persistent pollutants of the indoor environment in recent years.

Since PBDEs are highly lipophilic and can accumulate in human fatty tissues, they have been investigated in most human tissues including breast milk (Chao *et al.*, 2007), cord blood (Lin *et al.*, 2011), venous blood (Lim *et al.*, 2008), placenta (Gómara *et al.*, 2007), and adipose tissue (Petreas *et al.*, 2010). PBDE levels in blood from workers of e-waste dismantling plants were significantly higher than those from computer clerks and hospital cleaners (Sjödin *et al.*, 1999). The recent report indicated that emission levels of predominant PBDE congeners (i.e. BDE-209) from indoor air to outdoors were roughly accounted for 90% of total PBDE emissions to outdoor air in Sweden, indicating that contaminated indoor air is an important source of PBDE contamination to outdoor air (Björklund *et al.*, 2012). Recently, PBDEs in car dust was found (Kalachova *et al.*, 2012). Little is known about PBDEs in indoor and outdoor air from automobile dismantling plant.

In this study, three automobile dismantling plants were selected in southern Taiwan to be investigated in 2012/10 and 2013/1. Indoor air in dismantling plants and ambient air nearby the corresponding plants was simultaneously sampled by high-volume PS-1 air samplers for 48 h. Air samples in on-duty and off-duty time were separately collected. $^{13}C_{12}$-labeled PBDEs were added into the samples before the extraction. The extract was cleaned up as follows. After the extraction, gas and particle phase was combined together. The first cleanup involved treatment with concentrated sulfuric acid. The next cleanup procedure involved a multi-layered silica column. The final cleanup procedure involved an acid alumina column. The eluate was collected, concentrated to near dryness by using N_2, and then transferred to a vial. A total of 50 μl of ^{13}C-labeled BDE-139 was added to a vial containing the eluate as an internal standard after the clean-up prior to injection. The final extract was reduced in volume to 0.2 mL under a stream of nitrogen. Fourteen PBDEs (BDE-28, 47, 49, 99, 100, 153, 154, 183, 196, 197, 203, 207, 208, and 209) were analyzed by high resolution gas chromatograph with high resolution mass spectrometry.

Levels of Σ_{14}PBDEs were 1200-8750 pg/m^3 in indoor air from automobile dismantling plants and 254-2740 pg/m^3 in the ambient air from corresponding plants, respectively. BDE-209 was the predominant congener consisting for 63-86% of the total in indoor and outdoor air. Although PBDEs in indoor air was higher than that in outdoor from dismantlers, no statistically significant differences were found for individual PBDE levels in paired of indoor and outdoor air samples, indicating that air PBDE levels in indoor and outdoor were not different.

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