

# Polybrominated diphenyl ethers (PBDEs) in soil from municipal solid waste dumping sites of India

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## Abstract

Polybrominated diphenyl ethers (PBDEs), identified as persistent organic pollutants (POPs) and toxins for human and animal health, have accrued in the ecosystem worldwide due to their use in a behemoth quantity as a flame retardant. Concurrently, in the last decade, an abrupt growth of the PBDE congener BDE-28, BDE-47, BDE-99, BDE-100, BDE-153, BDE-154, BDE-183 and BDE-209 has been observed in different environmental matrices of Asian countries due to their increasing population and economic growth.

In the present study, the concentration of 8 predominant PBDE congeners was investigated in soil samples collected from different municipal solid waste (MSW) dumping sites from India. Also, factors affecting the dissemination of different BDE congeners in soil were evaluated. Samples were dried and sieved through a 2 mm sieve, henceforth, PBDEs were extracted using a mixture of dichloromethane-hexane (1:1 v/v), followed by purification of these extracts which was performed with a multilayer column of glass wool, silica gel and sodium sulphate. Then, purified fractions were concentrated by a rotary evaporator and the final volume of 1 ml was collected in hexane for analysis by gas chromatography-mass spectroscopy.

The total PBDE concentration from tri to deca BDE congeners in soil ranged from 6.497 to 308.504 µg/g dry weight and showed a trend towards higher concentration of PBDEs in the dumping site of a more populous city. BDE-183 was a predominant congener in the soil of both the dumping sites. The congener profile in the soil exhibits the composition of the deca-BDE technical mixture and biological and photo-degradation of deca-BDE into hepta-BDE congeners. A significant correlation was observed between the concentration of congener BDE-183 and percentage of carbon and nitrogen ( $r^2 = 0.528$ ,  $p < 0.01$ ,  $r^2 = 0.448$ ,  $p < 0.05$ , respectively) in the soil. Similarly, concentration of BDE-209 congener was also observed and correlated significantly with carbon, nitrogen and hydrogen percentage ( $r^2 = 0.683$ ,  $r^2 = 0.804$ ,  $r^2 = 0.592$   $p < 0.01$ , respectively). Principal

component analysis (PCA) revealed that commercial deca-BDE could be considered as the main source of PBDEs pollution in the studied regions.

The results of the present study revealed that the MSW dumping sites of India may be a predominant source of PBDE contamination to the Indian environment, which may lead to the toxicity for biota, probably through the photo and biological debromination of the deca-BDE congener.