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Assessing the environmental fate of selected polybrominated diphenyl ethers in the region surrounding the Zhuoshui River of Taiwan based on an Equilibrium Constant fugacity model

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Polybrominated diphenyl ethers (PBDEs) are a group of flame retardants that have been in use since the 1970s. They are included in the list of hazardous substances known as persistent organic pollutants (POPs) because they are extremely hazardous to the environment and human health. PBDEs have been extensively used in industry and manufacturing in Taiwan, thus its citizens are at high risk of exposure to these chemicals.

An assessment of the environmental fate of these compounds in the Zhuoshui river and Changhua County regions of western Taiwan, and also including the adjacent area of the Taiwan Strait, was conducted for three high risk congeners, BDE-47, -99 and -209, to obtain information regarding the partitioning, advection, transfer and long range transport potential of the PBDEs in order to identify the level of risk posed by the pollutants in this region.

The results indicate that large amounts of PBDEs presently reside in all model compartments – air, soil, water, and sediment – with particularly high levels found in air and especially in sediment. The high levels found in sediment, particularly for BDE-209, are significant, since there is the threat of these pollutants entering the food chain, either directly through benthic feeding, or through resuspension and subsequent feeding in the pelagic region of the water column which is a distinct possibility in the strong currents found within the Taiwan Strait. Another important result is that a substantial portion of emissions leave the model domain directly through advection, particularly for BDE-47 (58%) and BDE-209 (75%), thus posing a risk to adjacent communities.

Model results were generally in reasonable agreement with available measured concentrations. In air, model concentrations are in reasonably good agreement with available measured values. For both BDE-47 and -99, model concentrations are a factor of 2-3 higher and BDE-209 within the range of measured values. In soil, model results are somewhat less than measured values. In sediment, model results are at the high end of measured values.