

The National Survey of POPs in Soil: A study of polybrominated diethyl ethers (PBDEs) in Soil in Taiwan

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The United Nations Environment Programme (UNEP) elaborates the Stockholm Convention on Persistent Organic Pollutants (Stockholm Convention) to protect human health and the environment through a range of measures aimed at reducing and eliminating the production and use of POPs. In order to understand the distribution of POPs in soil, a national soil quality survey has been carried out by Taiwan Environmental Protection Administration (EPA). The survey result can serve as the basis for promoting the management measures and evaluation of management effectiveness. In Taiwan, decabromodiphenyl ether (decaBDE) is still being used as flame retardants that are mostly used in electronic and electrical products. This study discusses the survey result of PBDEs in soil as one of the achievements of soil quality survey.

The strategy of soil quality survey involved investigation for potential pollution sources areas and baseline soil quality areas (Figure 1). Industries handled with a large quantity of decaBDE, large waste treatment facilities for waste electrical and electronic equipments and industrial parks were identified as potential pollution sources which were selected and soils sampled were collected at their surrounding areas. The baseline soil quality survey were undertaken to understand the environmental soil quality without the effect of potential pollution sources. Sixty composite soil samples were collected at surrounding areas of potential pollution sources and 60 composite soil samples were collected at baseline survey areas. Soil samples were analyzed for 24 PBDE congeners by gas chromatography /high resolution mass spectrometer (GC/HRMS).

The survey result shows that PBDEs concentration of all soil samples, collected from surrounding areas of the potential pollution sources and baseline survey areas, are ranged from 0.189 $\mu\text{g/kg}$ to 656 $\mu\text{g/kg}$ (the mean concentration is 39.6 $\mu\text{g/kg}$) and 0.268 $\mu\text{g/kg}$ to 41.9 $\mu\text{g/kg}$ (the mean concentration is 6.25 $\mu\text{g/kg}$), respectively (Table 1 and Figure 2). The levels of PBDEs in all soil samples are far lower than U.S. EPA's Regional Screening Levels. The study also performed hypothesis test and the result shows that the concentration at surrounding areas of potential pollution sources is significant higher than that at baseline survey areas. It means that the industrials with high polluting potential may have impact on their surrounding environment. In addition, this study compares the spatial distribution of soil surrounding potential pollution sources and baseline survey areas. The higher PBDEs concentrations are detected in soil at surrounding areas of the industrials using decaBDE. It is speculated that decaBDE which is an additive type flame retardant is affected their surrounding soil by emissions during the use of the addition process. The soil concentrations at the surrounding areas of waste treatment facilities for waste electrical and electronic appliances are on an equal level with baseline areas. Furthermore, the PBDE congener pattern is analyzed. The BDE congener pattern is dominated by BDE-209 and account for more than 80% of the total PBDEs concentration. It is speculated that it may be related to the use of decaBDE in recent years in Taiwan and accumulate easier than other BDEs with low bromine number in soil due to their solubility.

To monitoring the condition of the soil quality, assessing the effect of the potential pollution sources on soil quality, a systematic survey and monitoring plan for POPs in the Stockholm Convention was

established by Taiwan EPA. The survey and monitoring works will be conducted in accordance with latest chemical lists of Stockholm Convention. The achievement of soil quality monitoring will help to tracking the influence of potential pollution sources and changes on environmental quality. It also can provide information to assess the effectiveness of control measures, strengthen the soil quality management and ensure the sustainable use of land resources.

Keywords: PBDEs, Soil, Taiwan

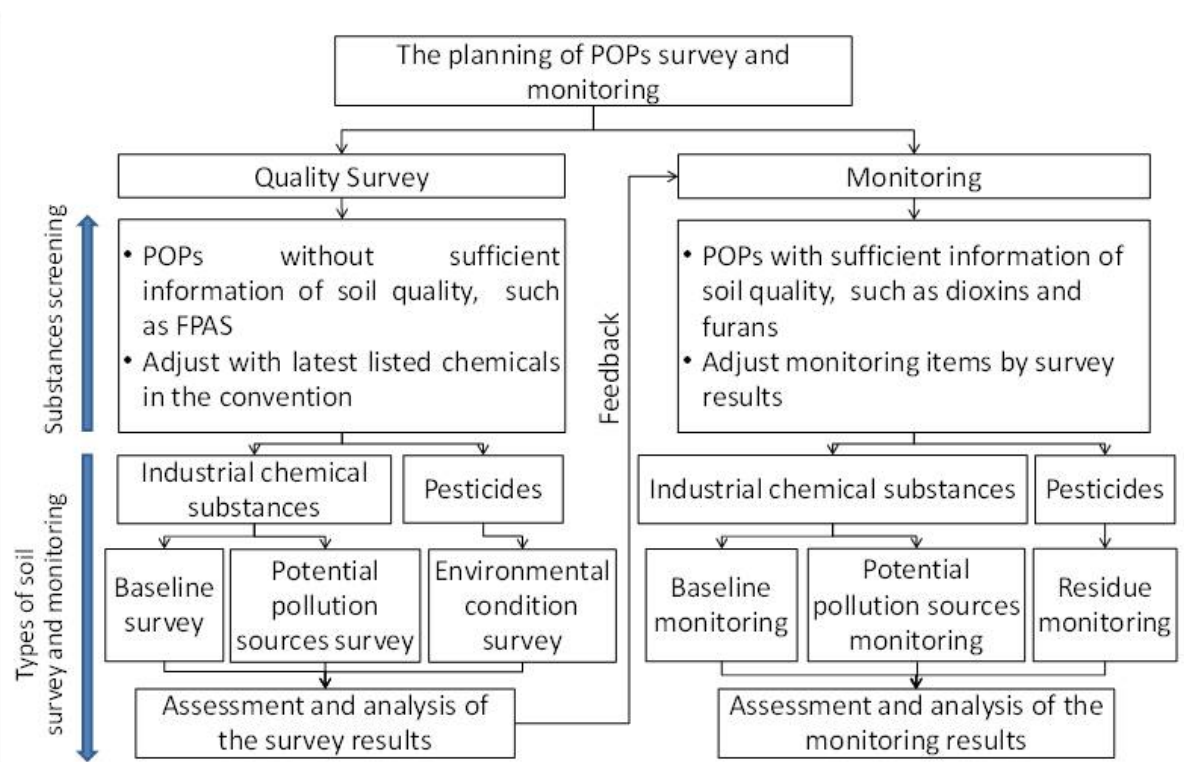


Figure 1 Framework of soil survey and monitoring plan

Table 1 Investigation results of PBDEs in soil in Taiwan

POPs	Type of soil survey	No. of samples	Results (µg/kg)	
			Range	Average
PBDEs	Surrounding areas of potential pollution sources	60	0.189~656	39.6
	Baseline survey	60	0.268~41.9	6.25

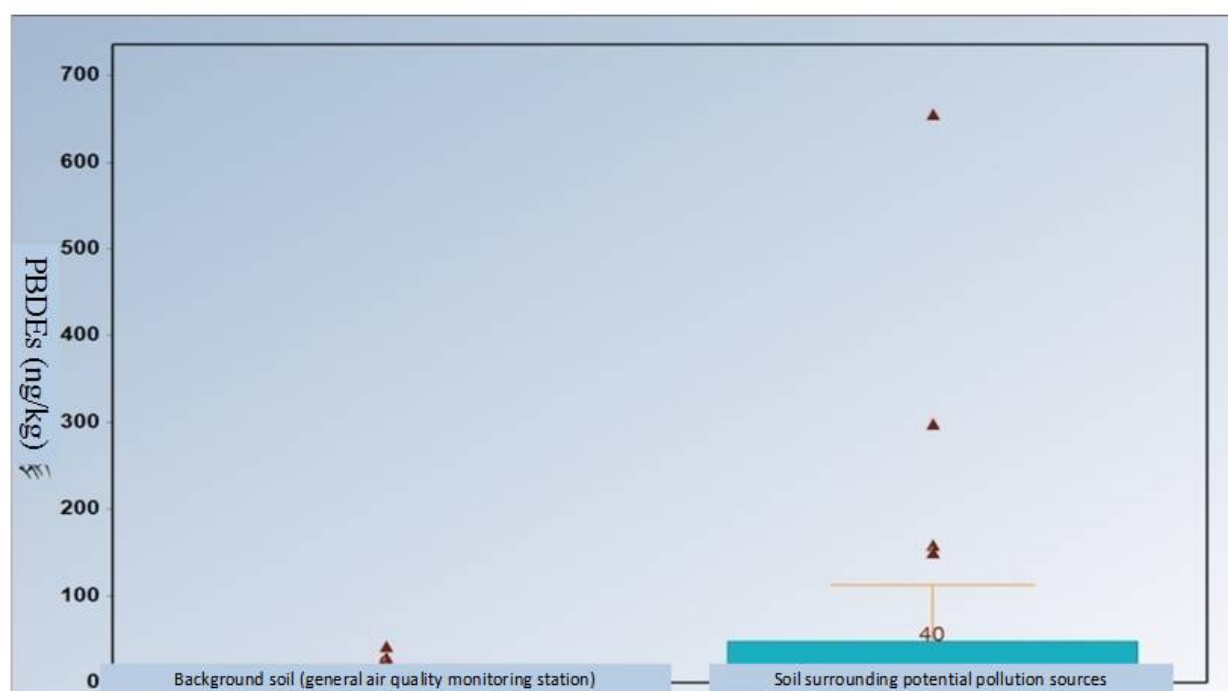


Figure 2 The distribution of PBDEs concentration in soil from potential pollution sources areas and baseline survey areas