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Prediction of the PCB pollution in the soils of Bursa, an industrial city in Turkey

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ABSTRACT

The purpose of this study was to predict the equilibrium soil concentrations and distributions of Σ_{41} Polychlorinated Biphenyl (PCB) congeners from the air data measured at 4 sites (urban, suburban, residential, and industrial) in Bursa between 2004 and 2005. The soil–air partition coefficient (K_{SA}) was used for the predictions. Predicted soil concentrations ranged from 25 pg/g to 690 pg/g, while the atmospheric concentrations fluctuated between 35 pg/m³ and 1112 pg/m³. The soil concentrations were found to be in agreement with the lower range of European and global values, and below the regulatory limits. The urban and residential sites yielded higher PCB concentrations and a higher degree of heavier congeners than the sites characterized as suburban. The urban and residential sites were dominated by hexa-chlorinated biphenyls (CBs), followed by tri-CBs, while the industrial site was dominated by tri-CBs, followed by tetra-CBs. PCB congeners of 153, 180, 138, 118, and 101 were higher in all locations. The effect of the temperature changes on the concentrations was found to be insignificant, as the correlations ranged between 0.0009 and 0.22 for all sites. The K_{SA} approach yielded reasonable results, and it is recommended to use this approach when there is limited data about the pollution levels of a certain media such as soil by using the measured levels of the other media such as air.

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1. Introduction

Because of their toxic and persistent nature and carcinogenic/mutagenic health effects, polychlorinated biphenyls (PCBs) are among the twelve persistent organic pollutants (POPs) of the Stockholm Convention of 2001. The Stockholm Convention, signed by 125 countries globally, brought several responsibilities such as establishment of inventories on the levels of the POPs, decreasing and eliminating their presence in environmental media, etc.

PCB usage was banned in 1995 in Turkey [1]. PCBs have never been produced in Turkey, however it is known that PCB-containing equipment has been exported. According to a survey made in 2004 [1], 1972 capacitor and 290 PCB-containing transformer is being used by the industry, currently, which yields an estimation of approximately 5000 tonnes of PCB load in Turkey.

Thanks to the increasing concern about the risks that PCBs pose to human health and the environment, and the global initiatives such as the Stockholm Convention and European Union's environmental regulations, Turkey has promulgated a regulation on the management of PCBs [2]. The regulations bring limit values to the presence of PCBs in the environment. There is an important lack

of PCB data measured at different media in Turkey. This situation makes the management of the PCBs difficult and hinders the enforcement of the regulations. Article 16 of the Turkish PCB regulation [1] states that the soils polluted by PCBs above a level of 50 ppm must be treated as hazardous waste. Article 9 of European Council Directive of 96/59/EC [3] also brings the same target level by stressing the objective of decontamination as “to reduce the level of PCBs to less than 0.05% by weight and, if possible to not more than 0.005% by weight.” The Netherlands' target values [4] for soil are related to negligible risk for ecosystems. Site concentrations less than target values indicate no restrictions. For practical and economical reasons, seven PCB Congeners (International Union of Pure and Applied Chemistry-IUPAC no 28, 52, 101, 118, 138, 153, and 180) are monitored to assess environmental exposure in Europe and they are generally referred as “Dutch 7”. These indicator congeners are generally considered to be stable in the environment and may be good markers for PCB exposure. The sum of the 6 congeners (except for PCB118 from the Dutch 7) is defined by the Netherlands' regulation [4] and its value is 0.02 mg/kg dry matter.

Several investigators studied the PCB levels in the air of some cities in Turkey [5–8]. Aydin et al. [9] and Tor et al. [10] studied the PCB levels in the wastewaters, and Karakoc et al. [11] investigated the PCB pollution in the sea waters in Turkey. However, soil related studies are fewer. The only two published study on PCB pollution in the Turkish soils were conducted by Cetin et al. [5] and Meijer et al. [12]. Cetin et al. [5] studied the soils of an industrial region

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