Arch Environ Contam Toxicol (2013) 65:619–634
DOI 10.1007/s00244-013-9943-z

Seasonal Variations of Polychlorinated Biphenyls in Surface Soils and Air–Soil Exchange in Bursa, Turkey

Güray Salihoglu · Yücel Tasdemir · Nezih Kamil Salihoglu · Hüseyin Savas Baskaya · Ertugrul Aksoy

Received: 29 December 2012 / Accepted: 22 July 2013 / Published online: 21 August 2013

Abstract This study investigates the seasonality of polychlorinated biphenyl (PCB) levels in soils of Bursa city located in northwestern Turkey. Forty-three soil samples were collected each season during a 1-year period. Air and soil samples were collected concurrently 3 or 3 times in a month during a 1-year monitoring period from 2 of the 43 locations. The samples were analyzed for 83 PCB congeners. Flux levels, fugacity fraction (ff) levels, and net flux levels of PCB congeners were calculated for 2 specific regions. The influence of humic substance and total organic carbon content of soil on PCB levels was also examined. The mean concentrations of the total PCBs were 1275 ± 1120, 4075 ± 2740, 2185 ± 2010, and 1150 ± 1540 pg/g dry weight in spring, summer, autumn, and winter seasons, respectively. Four- and 5- CBs were the most abundant homologue groups in soils, and their contribution to the total was 55 %. PCB-74, followed by PCB-153, was the dominant congener. Air and soil PCB levels increased together with the soil temperature suggesting the influence of instantaneous air–soil exchange toward the equilibrium conditions. Flux and ff levels also showed a positive significant correlation with soil temperature. Flux levels were mostly positive for the 2 regions indicating volatilization from soil to air.

Polychlorinated biphenyls (PCBs) are a group of organic pollutants having toxicity, persistence, and bioaccumulation potential (Wang et al. 2008). They were widely used for industrial and commercial applications before their production was gradually banned or restricted starting in the 1970s (Breivik et al. 2002). Because of the tendency of organic chemicals to accumulate in organic matter (OM) (Sweetman et al. 2005; Cornelissen et al. 2005; Armitage et al. 2006), soil is an important reservoir for pollutants such as PCBs. Soils have been shown to have an important role in supplying and receiving contaminants from the atmosphere and in the global cycling of persistent organic pollutants (POPs) (Sweetman et al. 2002; Meijer et al. 2003). Monitoring the distribution of these chemicals is important to better understand soil contamination, and data on their spatial distribution is necessary to predict their potential health effects.

PCBs have a tendency to (re)volatilize from secondary source compartments, such as soil, vegetation, water, and atmospheric particles (Halsall et al. 1999). Several researchers (Melymuk et al. 2012; Cindoruk and Tasdemir 2010; Ruzickova et al. 2008; Cetin et al. 2007; Manodori et al. 2006; Yeo et al. 2003) have reported on seasonality in air concentrations indicating that the highest air concentrations occurred in summer. Cabrerizo et al. (2011) reported that soil fugacities tend to be higher than air fugacities in summer, which indicates the direction of PCB movement from soil to air. Ruzickova et al. (2008)also reported higher soil fugacities than air fugacities in summer.

Electronic supplementary material The online version of this article (doi:10.1007/s00244-013-9943-z) contains supplementary material, which is available to authorized users.

G. Salihoglu · Y. Tasdemir (✉) · N. K. Salihoglu · H. S. Baskaya
Department of Environmental Engineering, Faculty of Engineering and Architecture, Uludag University, 16059 Bursa, Turkey
e-mail: tasdemir@uludag.edu.tr

E. Aksoy
Department of Soil Science and Plant Nutrition, Faculty of Agriculture, Uludag University, 16059 Bursa, Turkey