

Polycyclic aromatic hydrocarbon in urban soils of the Eastern European megalopolis: distribution, source identification and cancer risk evaluation

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Abstract

The study explores qualitative and quantitative composition of 15 priority PAHs in urban soils of some parkland, residential and industrial areas of the large industrial center in the Eastern Europe on example of Saint-Petersburg (Russian Federation). Aim of the study was to test the hypothesis on the PAH loading differences between urban territories with different land use scenarios. Benzo(a)pyrene toxic equivalency factors (TEFs) were used to calculate BaP_{eq} in order to evaluate carcinogenic risk of soil contamination with PAHs. Results of the study demonstrated that soils within residential and industrial areas are characterized by common loads of PAHs generally attributed to high traffic activity in the city. Considerable levels of soil contamination with PAHs were noted. Total PAH concentrations ranged from 0.33 to 8.10 mg·kg⁻¹. A larger portion of high molecular weight PAHs along with determined molecular ratios suggest the predominance of pyrogenic sources, mainly attributed to combustion of gasoline, diesel and oil. Petrogenic sources of PAHs have a significant portion as well defining the predominance of petroleum associated low molecular weight PAHs such as phenanthrene. Derived concentrations of 7 carcinogenic PAHs as well as calculated BaP_{eq} were multiple times higher than reported in a number of other studies. The obtained BaP_{eq} concentrations of the sum of 15 PAHs ranged from 0.05 to 1.39 mg·kg⁻¹. A vast majority of examined samples showed concentrations above the safe value of 0.6 mg·kg⁻¹ (CCME, 2010). However, estimated incremental life time risks posed to population through distinct routes of exposure were under acceptable range. One-way ANOVA results showed significant differences in total PAHs and the sum of 7 carcinogenic PAH concentrations as well as in levels of FLU, PHE, FLT, PYR, BaA, CHR, BbF, BaP and BPE between parkland, residential and industrial land uses, suggesting the influence of land use factor.