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Analysis of Polycyclic Aromatic Hydrocarbons in Size Fractionized Atmospheric Aerosol Obtained by Personal Monitoring

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Personal monitoring represents a useful tool to obtain more detailed information on exposure histories, microenvironment concentrations and air pollution sources in studied areas. Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous environmental contaminants. Long-term inhalation exposure to PAHs has been associated with different types of cancer, cardiovascular, respiratory and other diseases. Airborne particles (PM) of different sizes can bound various amounts and types of PAHs depending on their volatility and molecular structure. In our study, we employed SKC Leland Legacy Pump with Sioutas Cascade Impactor to analyse 20 US EPA and EU 15+1 priority PAHs in different size fractions of PM (<0.25, 0.25–2.5, and >2.5µm). A total set of 129 volunteers from two localities of the Czech Republic: industrial area of the city of Ostrava (n=65) and a control area of České Budějovice city (n=64), participated in 24h personal air sampling taking place from August 2019 to August 2021. Personal monitoring data were accompanied by a detailed questionnaire and PM_{2.5} measurements from the nearest monitoring stations. Extraction of the target PAHs was carried out by organic solvent extraction in an ultrasonic bath. The analytical method for PAH determination was developed using gas chromatography coupled to tandem mass spectrometry in electron ionization. The total amount of 20 PAHs ranged from 0.1 to 42.2 ng/m³. Concentration of Benzo(a)pyrene, an air quality standard, ranged from 0.01 to 3.27 ng/m³. The EU daily averaged concentration limit of 1.0 ng/m³ was exceeded in 20 out of 129 volunteers, especially those exposed in the industrial locality and the winter season. The particle size distribution showed 87% of the total amount of PAHs to be bound to PM_{0.25} (PM<0.25µm) and only 1% to the fraction larger than 2.5µm. Comparing the industrial and control areas, Ostrava air contained twice as high mean concentrations of PM-bound PAHs compared to České Budějovice. The highest concentrations were observed in January and February, indicating the significant contribution of local heating. The results of the personal monitoring contribute to the identification of local and seasonal sources of PAHs and specific activities with high PAH exposure.

This work was financially supported by the European Regional Development Fund under Grant Healthy Aging in Industrial Environment HAIE (CZ.02.1.01/0.0/0.0/16_019/0000798) and by the specific university research (A1_FPBT_2022_05).

Keywords:

PAHs; personal monitoring; air pollution; particulate matter; size fractions.