



Ten-year Pollution Characteristics of Particulate-associated Polycyclic Aromatic Hydrocarbons in Beijing, China

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Polycyclic aromatic hydrocarbons (PAHs) are well-known air pollutants of health concern. However, they are not listed as routinely measured pollutants in China, in spite of benzo[a]pyrene (BaP) being included in the National Ambient Air Quality Standard (NAAQS). Thus, very limited continuous measurements are available for PAHs, which would hinder the understanding of long-term pollution characteristics of PAHs in context of rapid development of economy and intensive urbanization in China.

To investigate annual variation and its causes of airborne particulate-associated PAHs, a total of 18 PAHs (including 16 USEPA priority species) in PM₁₀ and PM_{2.5} were measured in Beijing, the capital and one of megacities of China, for a decade (from the year of 2004 to 2013) with meteorological data simultaneously recorded. The long-term measurements of PAHs showed significant annual and seasonal variations for the total concentration of PAHs (Σ PAH₁₈) and individual PAH species. The Σ PAH₁₈ in PM₁₀ was highest in 2010 and lowest in 2006. Likewise, the Σ PAH₁₈ in PM_{2.5} reached the highest level in 2010 and dropped to the lowest level in 2005. The annual concentration varied insignificantly for 2- and 3-ring PAHs, were relatively high in the year of 2004, 2007 and 2010 for 4-ring PAHs, and increased gradually with year for 5- to 7-ring PAHs, the markers of motor vehicle emission. As for seasonal variation, the concentrations in winter (heating period) was higher than those in summer, while concentrations in spring and autumn ranked in the middle. As for BaP, one of criteria pollutants, its concentration exceeded NAAQS of China in winter.

Source apportionment by factor analysis suggested the contributions of coal combustion, vehicle emissions, fugitive dust and straw burning. Especially, the great contributions of coal combustion and vehicle emission were also supported by diagnostic ratios. The backward trajectories showed air mass crossing polluted cities and transporting in low atmospheric boundary layer (ABL) along with local stagnant condition would lead to severe pollution of PAHs at the study area.

Correlation analysis between the concentrations of PAHs with socio-economic status (SES) indicated the significant impacts of population, vehicle fleet and Gross Domestic Products (GDP). With growing vehicle fleet and GDP (indicating economic development) and increasing population (indicating urbanization level), the Σ PAH₁₈ showed an increasing tendency. In the decade covered by the study, China has been optimizing energy structure and implementing policy encouraging more efficient energy use. The remarkable improvement of air quality by the policies, with the data collected in this study, would unfortunately not be noticed in a short period but could be expected in long-term.

Key Words: Polycyclic Aromatic Hydrocarbons; Airborne Particulate Matter; Annual Variation; Source; Socioeconomic status; Beijing

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