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Polycyclic Aromatic Hydrocarbons: Pollution and Ecological Risk Assessment in Surface Soil of the Tezpur Town, on the North Bank of the Brahmaputra River, Assam, India

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Abstract : In the present study, pollution level of polycyclic aromatic hydrocarbon (PAH) in surface soil of historic Tezpur town located in the north bank of the River Brahmaputra were evaluated. In order to determine the seasonal distribution and concentration level of 16 USEPA priority PAHs surface soil samples were collected from 12 different sampling sites with various land use type. The total concentrations of 16 PAHs (∑16 PAHs) varied from 242.68µgkg-1to 7901.89µgkg-1. Concentration of total probable carcinogenic PAH ranged between 7.285µgkg-1 and 479.184 µgkg-1 in different seasons. However, the concentration of BaP, the most carcinogenic PAH, was found in the range of BDL to 50.01 µgkg-1. The composition profiles of PAHs in 3 different seasons were characterized by following two different types of ring: (1) 4-ring PAHs, contributed to highest percentage of total PAHs (43.75%) (2) while in pre- and post- monsoon season 3- ring compounds dominated the PAH profile, contributing 65.58% and 74.41% respectively. A high PAHs concentration with significant seasonality and high abundance of LMWPAHs was observed in Tezpur town. Soil PAHs toxicity was evaluated taking toxic equivalency factors (TEFs), which quantify the carcinogenic potential of other PAHs relative to BaP and estimate benzo[a]pyrene-equivalent concentration (BaPeq). The calculated BaPeq value signifies considerable risk to contact with soil PAHs. We applied cluster analysis and principal component analysis (PCA) with multivariate linear regression (MLR) to apportion sources of polycyclic aromatic hydrocarbons (PAHs) in surface soil of Tezpur town, based on the measured PAH concentrations. The results indicate that petrogenic and pyrogenic sources are the important sources of PAHs. A combination of chemometric and molecular indices were used to identify the sources of PAHs, which could be attributed to vehicle emissions, a mixed source input, natural gas combustion, wood or biomass burning and coal combustion. Source apportionment using absolute principle component scores–multiple linear regression showed that the main sources of PAHs are 22.3% mix sources comprising of diesel and biomass combustion and petroleum spill,13.55% from vehicle emission, 9.15% from diesel and natural gas burning, 38.05% from wood and biomass burning and 16.95% contribute coal combustion. Pyrogenic input was found to dominate source of PAHs origin with more contribution from vehicular exhaust. PAHs have often been found to co-emit with other environmental pollutants like heavy metals due to similar source of origin. A positive correlation was observed between PAH with Cr and Pb (r2 = 0.54 and 0.55 respectively) in monsoon season and PAH with Cd and Pb (r2 = 0.54 and 0.61 respectively) indicating their common source. Strong correlation was observed between PAH and OC during pre- and post-monsoon (r2=0.46 and r2=0.65 respectively) whereas during monsoon season no significant correlation was observed (r2=0.24).

Keywords : polycyclic aromatic hydrocarbon, Tezpur town, chemometric analysis, ecological risk assessment, pollution
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