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Comparative Analysis of Benzene, Toluene, Ethylbenzene, and Xylene Concentrations at Roadside and Urban Background Sites in Leicester and Lagos Using Thermal Desorption-Gas Chromatography-Mass Spectrometry

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Abstract : This study investigates the prevalence and extent of BTEX (Benzene, Toluene, Ethylbenzene, and Xylene) contamination in Leicester, United Kingdom, and Lagos, Nigeria, through field measurements at roadside (RS) and urban background (UB) sites. Using thermal desorption gas chromatography mass spectrometry (TD-GC-MS), BTEX concentrations were quantified. In Leicester, the average RS concentration was 24.9 ± 8.9 µg/m³, and the UB concentration was 12.7 ± 5.7 µg/m³. In Lagos, the RS concentration was significantly higher at 106 ± 39.3 µg/m³, and the UB concentration was 20.1 ± 8.9 µg/m³. The RS concentration in Lagos was approximately 4.3 times higher than in Leicester, while the UB concentration was about 1.6 times higher. These disparities are attributed to differences in road infrastructure, traffic regulation compliance, fuel and oil quality, and local activities. In Leicester, the highest UB concentration (20.5 ± 1.7 µg/m³) was at Knighton Village, near the heavily polluted RS Wigston roundabout. In Lagos, the highest concentration (172.1 ± 12.2 µg/m³) was at Ojuelegba, a major transportation hub. Correlation analysis revealed strong positive relationships between the concentrations of BTEX compounds in both cities, suggesting common sources such as vehicular emissions and industrial activities. The ratios of toluene to benzene (T:B) and m/p xylene to ethylbenzene (m/p X:E) were analysed to infer source contributions and the photochemical age of air masses. The T:B ratio in Leicester ranged from 0.44 to 0.71, while in Lagos, it ranged from 1.36 to 2.17. The m/p X:E ratio in Leicester ranged from 2.11 to 2.19, like other UK cities, while in Lagos, it ranged from 1.65 to 2.32, indicating relatively fresh emissions. This study highlights significant differences in BTEX concentrations between Leicester and Lagos, emphasizing the need for tailored pollution control strategies to address the specific sources and conditions in different urban environments.

Keywords : BTEX contamination, urban air quality, thermal desorption GC-MS, roadside emissions, urban background sites, vehicular emissions, pollution control strategies
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