Polymeric Concentration and Morphological Features of Atmospheric Microplastics in Kuala Lumpur

Syazwaana Mohd Noor[1*], Sara Yasina Yusuf[1,2], Mohd Rosiskada Mohamed[1,3], Nor Anis Nadhirah Md Nasir[1], Nor Ruwaida Jamian[4], Dewika Naidu[5]

[1]*Faculty of Civil Engineering & Technology, Universiti Malaysia Perlis, Perlis, Malaysia*
[2]*Sustainable Environment Research Group (SERG), Centre of Excellence Geoploymer and Green Technology (CeGeoGTech), Universiti Malaysia Perlis, Perlis, Malaysia*
[3]*Department of Environment Malaysia, Putrajaya, Malaysia*
[4]*Air Resources Research Laboratory, Malaysia Japan International Institute of Technology, Universiti Teknologi Malaysia, Kuala Lumpur, Malaysia*
[5]*School of American Education, Sunway University, Bandar Sunway, Selangor, Malaysia*

Abstract

Atmospheric microplastic (MP) pollution is an emerging concern due to its potential implications for environmental and human health. The extent to which certain polymer types are associated with specific morphological traits such as fibrous or fragment shapes and color variations, remains poorly characterized in tropical urban settings. This study aims to investigate the relationship between polymeric composition and morphological attributes (shape and color) of atmospheric microplastics (MPs) in an urban environment, with the goal of enhancing source identification and understanding the contribution of specific plastic types to airborne MP pollution in Kuala Lumpur. Using both passive (dust deposition gauges) and active (low-volume pump samplers) collection methods, MP samples were obtained at Universiti Teknologi Malaysia (UTM) Kuala Lumpur. Quality control procedures were employed through the use of procedural blanks and field replicates. Microscopic analysis was conducted to determine MP shape, color, and abundance, while polymer composition was identified using Micro-Raman spectroscopy. Results revealed that fibrous MPs, primarily originating from textile sources, were the most dominant shape, with deposition rates reaching 3.408×10^3 MP/m²/day and suspension concentrations at 1.254 MP/m³. Non-fibrous MPs occurred at significantly lower levels in both deposition (0.046×10^3 MP/m²/day) and suspension (0.005 MP/m³). Transparent fibers were the most frequently observed, followed by black, blue, green, yellow, and red particles. Polymer analysis identified polymethyl methacrylate (PMMA), polybutylene terephthalate (PBT), polyamide (PA), polyvinyl alcohol (PVA), and unidentified mixed fragments—suggesting dominant sources such as synthetic textiles, packaging materials, and construction dust. These findings underscore the substantial contribution of textile-derived MPs to urban atmospheric pollution in Kuala Lumpur. The study calls for targeted mitigation strategies, including textile waste management and urban air quality monitoring, to curb MP emissions and support evidence-based policymaking toward sustainable plastic usage.

Keywords: Atmospheric microplastics; Urban air pollution; Polymer identification; Morphological characterization