Airborne Microplastic Particle Concentration and Characterization in Education Vicinity

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Abstract

Airborne microplastics (MPs) are emerging contaminants, yet data on their distribution across functional zones in educational institutions remain limited. This study quantified and compared airborne MP abundance and characteristics across academic, administrative, and student affairs zones at Universiti Malaysia Terengganu. Sampling was conducted at six locations using a low volume sampler over 24 hours in August 2024. Suspected MPs were isolated based on their physical characteristics (colour, shape, size) under a stereomicroscope. The mean MP concentration was 1.06 ± 0.30 particles/m³ (range: 0.53–1.33). One-way ANOVA showed a significant difference among zones ($p = 0.031$), with student affairs exhibiting lower MP levels than academic and administrative zones. Transparent fragments were most prevalent (30.4% by colour; 49.8% by shape), followed by fibres (42.5%) and films (7.8%). Other colours included brown (24.6%), black (20.0%), blue (12.4%), and others (<12.0%). Size classification revealed small MPs (≤1 mm) accounted for 84.2%, and large MPs (>1 mm) comprised 15.8%, suggesting atmospheric fragmentation or primary fine sources. Principal component analysis (PCA) showed strong factor loadings for MP abundance (0.946), global radiation (0.791), and wind speed (0.761), indicating meteorological influence. Scanning electron microscopy (SEM) showed weathered, cracked surfaces, and μ-Fourier transform infrared spectroscopy (μ-FTIR) identified polyethylene terephthalate (PET) predominating in student affairs, and polymethyl methacrylate (PMMA) in academic and administrative zones. Estimated Daily Intake (EDI) calculations suggest university personnel may inhale at least 0.337 MP particles/kg of body weight daily. This study provides baseline airborne MP data and highlights spatial variability driven by localized human activities.

Keywords: Airborne microplastics; Education vicinity; Principal Component Analysis; Polyethylene Terephthalate; Health risk.