

Assessment of PM_{2.5}-bound water-soluble anions during episodic air pollution events in Colombo Metropolitan City, Sri Lanka

Y. B. Thuduhena¹, R. D. R. Ruhunuge², H. D. S. Premasiri^{2*}

¹College of Chemical Sciences, Institute of Chemistry Ceylon, Rajagiriya 10107, Sri Lanka

²Environmental Studies and Services Division, National Building Research Institute, No 99/1, Jawatta Road, Colombo 05

* director.essd@nbri.gov.lk

Particulate matter (PM_{2.5}) is a major air pollutant that poses significant environmental and public health concerns. The Colombo Metropolitan City (CMC) is influenced by multiple pollution sources, including urban emissions, industrial activities, and regional atmospheric transport. This study aimed to assess the concentrations and spatial-temporal variability of PM_{2.5}-bound water-soluble anions during episodic air pollution events in the CMC region. PM_{2.5} samples were collected from six locations within the CMC between December 2025 and February 2026. Concentrations of major water-soluble anions (NO₂⁻, NO₃⁻, SO₄²⁻, Cl⁻, and F⁻) were determined using ion chromatography (IC). Variability among sampling locations and periods was evaluated using descriptive statistical analysis. PM_{2.5} mass concentrations were averaged at 17.5 µg m⁻³, ranging from 2.7 to a maximum of 33.2 µg m⁻³, which indicates considerable variability across sampling locations and periods (CV = 59.3%). Among the measured water-soluble anions, Nitrate and sulfate were the most abundant species, showing the mean concentration of 2.9 µg m⁻³ & 2.8 µg m⁻³, and the maximum concentration of 13.5 µg m⁻³ & 6.8 µg m⁻³, respectively. Chloride exhibited a mean concentration of 2.7 µg m⁻³ with a maximum of 9.5 µg m⁻³. Nitrite and fluoride showed lower mean concentrations of 0.2 and 0.8 µg m⁻³, reaching to maximum values of 0.6

and 7.4 µg m⁻³, respectively. The high coefficients of variation (64.7–270.6%) observed for all ions indicate substantial spatial and temporal fluctuations in PM_{2.5} chemical composition. . These findings suggest the influence of multiple pollution sources and atmospheric processes affecting PM_{2.5} composition within the study area. In conclusion, PM_{2.5}-bound water-soluble anions exhibited substantial variability across the CMC during episodic air pollution events, highlighting the complex nature of urban air pollution and the need for continued monitoring of particulate matter composition.

Keywords:

Particulate Matter (PM_{2.5}), Water-Soluble Anions, Urban Air Pollution, Secondary Aerosol Formation, Colombo Metropolitan City

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