

Characteristics and Source Apportionment of Water-Soluble Ionic Components in Atmospheric PM_{2.5} in Urban Urumqi: Postprint

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Abstract

To investigate the water-soluble ion components and sources of PM_{2.5}, the primary pollutant in Urumqi's atmospheric environment, a sampling site was established in the central urban area in 2023. A total of 164 samples were collected via membrane sampling. PM_{2.5} mass concentration and concentrations of various water-soluble ion components were determined according to relevant testing standards, and their sources were analyzed. The results showed that: (1) The mass concentration of PM_{2.5} and concentrations of various ion components during the heating period were all higher than those during the non-heating period. (2) The total ion concentration during the heating period was 15.7 times that during the non-heating period, accounting for 73.84% and 26.26% of PM_{2.5} concentrations, respectively. The ratios of anions to cations (AE/CE) were 0.914 and 0.600, respectively, indicating that the chemical properties of PM_{2.5} were alkaline. (3) The annual average values of sulfur oxidation rate (SOR) and nitrogen oxidation rate (NOR) were 0.43 ± 0.30 and 0.15 ± 0.13 , respectively, indicating that during the heating period, these secondary transformation mainly existed in the forms of $(\text{NH}_4)_2\text{SO}_4$ and NH_4NO_3 during the heating period, while it existed in the form of NH_4NO_3 during the non-heating period. (4) Principal component analysis results showed that during the heating period, pollutants primarily originated from secondary pollution, industrial production, and motor vehicle exhaust pollution, followed by mineral dust and coal combustion pollution, with a cumulative contribution rate of 80.24%; during the non-heating period, the primary sources were dust and industrial production, followed by secondary pollution, and finally pollution from coal combustion, with a cumulative contribution rate of 86.34%. It can be seen that there were significant differences in the sources of water-soluble ions in PM_{2.5} between different periods.

Full Text

Keywords

Air pollution; ion concentration; vehicle exhaust; principal component analysis

1. PM2.5 Monitoring

[Figure 1: see original paper] Schematic diagram of PM2.5 monitoring stations

1.3 Sample Analysis and Quality Control

Mean values of PM2.5, ion concentrations, and related indicators during heating and non-heating periods

2.1 Variation Characteristics of PM2.5 and Gaseous Pollutant Concentrations

2.2 Variation Characteristics of Ions

[Figure 2: see original paper] Proportion of water-soluble ions during heating and non-heating periods

[Figure 3: see original paper] Correlation between NH_4^+ , NO_3^- , and SO_4^{2-} during heating and non-heating periods

2.3 Acidity-Alkalinity Analysis of PM2.5

Results of principal component analysis of chemical components in PM2.5 during heating and non-heating periods

[Figure 4: see original paper] Charge balance and correlation of anions and cations during heating and non-heating periods

References

Note: Figure translations are in progress. See original paper for figures.

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