AC9) 황사기간중 제주지역의 에어로졸과 수용성이온의 크기분포

Study on Size Distribution of Total Aerosol and Water-soluble Ions During an Asian Dust Storm Event at Jeju Island

박성훈 · 송창병 · 김민철 · 권순박 · 이규원
광주과학기술원 환경공학과 분진공학연구실

1. INTRODUCTION

Soil dust particles transported from loess regions of the Asian continent, called Asian dust, highly influences the air quality of north-eastern Asia and the northern Pacific Ocean. The effects of these dust storms, on the chemical composition of atmospheric aerosol particles with different size, was investigated. Measurements of size distributions of total aerosol and major ion species were carried out on Jeju Island, Korea. Jeju Island was chosen for the study because the levels of emissions of anthropogenic air pollutants were expected to be very low, at the time of the study, i.e April 2001.

A 5-stage cascade impactor was used to sample size-fractionated aerosol particles. The observations on the particle size distribution and chemical composition of aerosols would be valuable for understanding their physical/chemical characteristics, sources, and behavior and formation mechanism as well as for establishing control strategies.

2. DESIGN AND EXPERIMENT

The particle size distribution was measured with a five-stage cascade impactor (ATL cascade impactor) developed at the Kwangju Institute of Science and Technology. The instrument operates at 30 L min^{1} with nominal cut-sizes of 0.7, 1.01, 2.49, 4.92 and 10.07 ㎛ aerodynamic diameters. Particles less than 0.7 ㎛ were collected on an after filter. The PM10 and PM2.5 samplers, also developed at the Kwangju Institute of Science and Technology, consisted of aluminum particle cup impactors with cut sizes of 10 and 2.5 ㎛, respectively, operated at a flow rate of 25 L min^{1} followed by a Teflon filter pack for a 47 mm filter, a calibrated rotameter, and a vacuum pump.

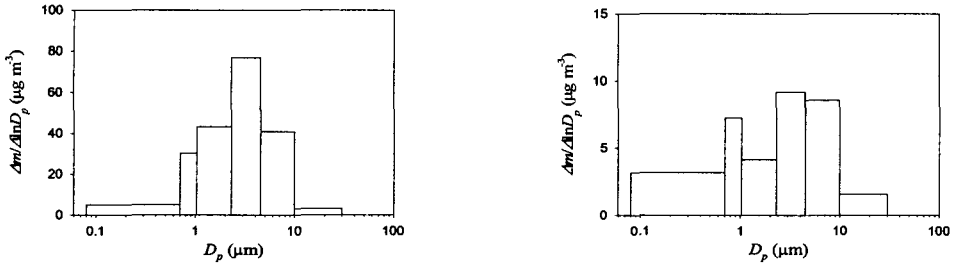
The water-soluble fraction was extracted from the filters by ultrasonic agitation in 10 mL of distilled water. All the extraction solutions were filtered and stored in plastic vials in the refrigerator at 4℃ until chemical analysis. Ion chromatograph (Dionex DX-120) was used to determine the major anion and cation species including: Cl^-, NO_3^-, SO_4^{2-}, Na^+, NH_4^+, K^+, Mg_2^+ and Ca_2^+.

3. RESULTS AND DISCUSSION

The average mass of the total aerosol for the Asian dust period and the non-Asian dust period was found to be 108.3 and 24.4 g m^{-3}, respectively. The ratio of average concentration for the Asian dust period over that for the non-Asian dust period was 4.4. Figures 1(a)-(b) show typical examples of the mass size distribution of total particulate matter based on the data sample obtained for Asian dust period and non-Asian dust period. The size distributions of total aerosol and its water-soluble ion species were calculated using the method of Kadowaki.

The average concentration of total water-soluble ion species was 7.4 g m^{3} for non-Asian dust

period and 21.9 g m^{-3} for Asian dust period, which constitute 30.2% and 20.2%, respectively, of total particulate matter. Among the ionic species, sulfate contributed the maximum to water-soluble aerosol mass: 36.5% for non-Asian dust period and 31.3% for Asian dust period.

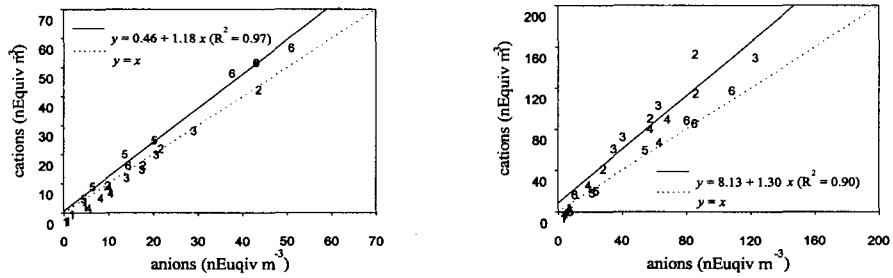


(a) Asian dust period (b) non-Asian dust period

Figure 1. Typical examples of the mass size distribution of total aerosols

The average concentration of total water-soluble ion species was 7.4 mg m^{-3} for non-Asian dust period and 21.9 mg m^{-3} for Asian dust period, which constitute 30.2% and 20.2%, respectively, of total particulate matter. Among the ionic species, sulfate contributed the maximum to water-soluble aerosol mass: 36.5% for non-Asian dust period and 31.3% for Asian dust period.

In Figures 2(a)-(b), the total equivalent concentration of the anions was plotted against those of the cations. Ion balance was achieved with a small deficit of anions for the non-Asian dust period while for the Asian dust period significant deficit of anions occurred. This anion deficit may be due to unanalyzed HCO_3 and CO_3^{2-} ions which are major constituents of the soil dust.



(a) non-Asian dust period (b) Asian dust period

Figure 2. Comparison of total equivalent concentrations of anions and cations

ACKNOWLEDGEMENT

This work was supported in part by the Brain Korea 21 program from the ministry of Education through the Graduate Program for Chemical & Environmental Engineering at Kwangju Institute of Science and Technology.

REFERENCE

Parmar, R. S., Satsangi, G. S., Kumari, M., Lakhani, A., Srivastava, S. S., and Prakash, S., (2001) Study of size distribution of atmospheric aerosol at Agra. Atmospheric Environment 35, 693-702.