I-5 Analysis for the origin of visibility degradation in Seoul

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I. INTRODUCTION

Visibility degradation is one of the major adverse effect of air pollution. It can be used as an indicator of overall air quality because it is an integrated result of air pollution. As we analyse the long term changes of visibility in Korea, the result shows that the visibility has been decreasing in major cities of Korea although the concentration of the total suspended particulates(TSP) and that of the sulphur dioxide have been decreased significantly during the past decades. Then, a question arises why the decrease of TSP has not improved the visibility at all, and what are the real causes of visibility degradation. In order to answer to this question we are undergoing an extensive study of field measurements and chemical analyses of particulates and other pollutants. An interim result is presented below.

II. FIELD EXPERIMENTS

1. Instruments

Followings are variables and instruments used during the field measurement period in 1995 and 1996 at the Seoul National University campus.

Visibility by eye
Scattering coefficient by a nephelometer (Model 1598, Belfort Instrument Co.)
PM-10 by a beta gauge (Wedding & Associates)
TSP by a high volume sampler (Chung Engineering Instrument Co.)
Size distribution of aerosol by an Optical Particle Counter
Aerosol mass concentration by a Cascade Impactor
NOx (Model 42, Thermo Electron Co.)
O_3 (Model 49, Thermo Electron Co.)
Temperature, humidity and wind by an automatic weather station(A.I.R.)

All variables except eye observation of visual range and aerosol size distribution were measured continuously, and stored onto a computer at an the interval of one hour. Chemical analyses of particulates collected by the high volume sampler were done by an ion chromatography and an atomic absoprtion spectroscopy.

2. Data Analyses

Visibility can be calculated by the Koschmeider formula

$$\alpha = 3.9/b_{ext} \fallingdotseq 3.9/b_{scat} \fallingdotseq 3.9/b_{sp}$$

where α is the nephelometer visibility(m), b_{ext} is the light exitinction coefficient which is the sum of scattering and absorption by particles and gases, b_{scat} is the scattering coefficient by particles and gaes, and b_{sp} is the scattering coefficient by the particles. The nephelometer visibility caculated by the Koschmeider formula is well correlated with the prevailing visibility observed by eye, but it is higher than the prevailing visibility.

Correlation between the visibility and aerosol concentration of each size interval shows that the particles less than 2.5 μm are most highly correlated with visibility degradation. Chemical analyses shows that nitrates increases most significantly on poor visibility days.

III. CONCLUSIONS

1. Major causes of poor visibility in Seoul seem to be
   i) increase of fine particulates less than 2.5 μm, and
   ii) increase of NO_2 and nitrates which are emitted mostly from automobiles.

2. Diurnal variation of visibility is such that it becomes poorest at 11:00 a.m., at which time NO_2 concentration reaches the daily maximum and the wind direction changes from down the slope to up the slope of the Kanak Mt..