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Characteristics of carbonaceous species in the ambient particles measured at Seoul, Korea

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As major constituents of atmospheric particulate matter (PM), carbonaceous species play significant roles in visibility reduction, radiative forcing, and adverse human health effects. Carbonaceous particles in the atmosphere consist of two major components, OC (organic carbon) and EC (elemental carbon). EC is originated from direct emissions of particles, predominately during combustion. OC is either emitted from direct emissions of particles or formed from the atmospheric oxidation of volatile organic compounds (VOCs). We call the latter is as Secondary OC (SOC) and this is associated with smog and low visibility.

In this study, the carbonaceous species (OC and EC) were monitored to understand the characteristics of carbonaceous aerosol and evaluate the possible sources of OC and EC in Seoul from 2006 to 2007. PM10 and PM2.5 samples were collected using the filter packs containing prebaked (450°C overnight) quartz–fiber filters (Whatman International Ltd.) connected with the 16.7 L min-1 flow rate cyclones. For OC and EC analysis, the National Institute of Occupational Safety and Health (NIOSH) method 5040 which used a thermal-optical transmittance (TOT) method (Sunset Labs) was applied.

The average PM10 and PM2.5 mass concentrations were 60.6 and 43.5 μg m-3, respectively, and PM2.5 was accounting for 70% of PM10. Total carbon (TC) was determined as sum of OC and EC, contributing 15.7% and 4.4% to PM10 mass concentration and 21.4% and 6.2% to PM2.5 mass concentration, respectively. In this study, using the equation "OCsoc = OCtoc – EC(OC/EC)min" (Lim and Turpin, 2002, Environ. Sci. Technol., 36, 4489-4496), SOC concentration was estimated. Where OCsoc is the SOC concentration, OCtoc is the total OC concentration, and (OC/EC)min is the minimum OC/EC ratio observed during the sampling period. The average ratio of SOC to OC was comprised of 51% in PM10 and 60% in PM2.5, respectively. In PM10, the highest concentrations of OC, SOC and EC were observed in winter but the fraction of SOC and EC to PM10 were highest in summer. In case of PM2.5, the seasonal trend of OC, SOC and EC concentrations were consistence with those in PM10, while, the highest fractions of all compounds were observed in fall.

The major factor causing seasonal variations of carbonaceous species at Seoul, Korea is due to direct emission from primary source. In addition, long-range transport of carbonaceous species could influence the determination of the ambient concentration of those in Seoul. In this study, the characteristics of carbonaceous aerosol and the possible sources of OC, SOC and EC will be further discussed by comparison with correlation of these compounds with other air pollutants and back-trajectory analysis of NOAA HYSPRIT model.