Characteristics of atmospheric aerosols in Cheonan, Korea during 2006

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Currently, Korea has a regulation only on PM10 concentration for atmospheric particles, and the 250 National Air Quality Monitoring Stations measure only PM10 mass concentrations. Thus, relatively little data are available on characteristics of atmospheric aerosols in Korea. Furthermore, National air quality standard for the daily average PM10 concentration has been strengthened to 100µg/m³ from 150µg/m³ in 2007. Therefore, areas unsatisfied the new standards are required to set up the effective air quality control strategy, and characterizations of atmospheric aerosols are necessary. Cheonan is located at 83.6km south from Seoul with approximately 500 thousand people. It is a centre of transportation for the national roads and railroads, and has been changing into industrial areas. The daily average PM10 concentrations in Cheonan often exceeded the new PM10 standards (Oh, 2006). Thus, the purpose of this study is to characterize atmospheric aerosols, and provide the data concerning size fractions, trends, and concentrations of aerosols in Cheonan, Korea.

Size-differentiated mass concentrations of aerosols were determined using a high volume air sampler (Andersen, GV2360) equipped with a 5-stage cascade impactor (Andersen, Model 235) at a site about 1,000m away from heavy traffic highway in Cheonan. Samples were taken for 24 hours of the total 22 times during January and December of 2006. In addition to these manual operations, real time concentrations of PM10 and PM2.5 were monitored at an interval of 1 minute with a laser spectrometer (Grimm Model 1.107).

Sampled aerosols showed mostly bimodal distributions with a saddle point in 1.5~3.0µm range in diameter and a larger peak in the fine mode, indicating urban characteristics (Willeke & Whitby, 1975). A MMD of fine mode particles were 056±0.17µm with a GSD of 2.65±0.82, and those of coarse mode particles were 5.14±0.68µm and 2.15±0.28, respectively. Errors represent 95% confidence intervals. As listed in Table 1, mean values of the daily average concentrations of TSP, PM10, and PM2.5 were 57.0, 50.7, and 39.5µg/m³, respectively. The highest daily average PM10 concentration exceeded the new national standard. Fractions of PM10 and PM2.5 in TSP were 88.9±1.8% and 69.3±3.9%, and the fraction of PM2.5 in PM10 was 77.9±2.2%. The results indicate that atmospheric aerosols in Cheonan were mainly fine mode particles.

Table 1. Daily average concentrations of TSP, PM10, and PM2.5 in µg/m³.

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<tr>
<th></th>
<th>TSP</th>
<th>PM10</th>
<th>PM2.5</th>
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<tbody>
<tr>
<td>Mean</td>
<td>57.0</td>
<td>50.7</td>
<td>39.5</td>
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<tr>
<td>Highest</td>
<td>129.0</td>
<td>105.9</td>
<td>76.2</td>
</tr>
<tr>
<td>Lowest</td>
<td>10.1</td>
<td>9.4</td>
<td>7.7</td>
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</tbody>
</table>

Diurnal variations in 1-hr average concentrations of PM10, PM2.5 (fine particles), and PM2.5~10 (coarse particles) are shown in Figure 1. While PM2.5~10 variations were insignificant, PM10 and PM2.5 variations were remarkable and showed the similar pattern, highest in the commuting periods of between 6:00~9:00am and 7:00~9:00pm. The ratio of the highest to lowest concentrations of PM10, PM2.5, and PM2.5~10 were 2.05, 2.56, and 1.46, respectively. The results clearly indicate that secondary aerosols from mobile sources were major component in fine particles. Thus, control of fine particles focusing on mobile sources should be the primary concern for PM10 control strategy in Cheonan, Korea.

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