CHARACTERISTICS OF INORGANIC IONS OF PM$_{2.5}$ IN PENINSULAR MALAYSIA

MASTURA MAHMUD & YUSUKE FUJI
UNIVERSITI KEBANGSAAN MALAYSIA & UNIVERSITY OF KYOTO

Bogor West Java, Indonesia
4-7 August 2015
INTRODUCTION

• IN SOUTHEAST ASIA, PARTICULATE MATTER IS A MAJOR CAUSE OF AIR POLLUTION.

• MALAYSIA IS ONE OF THE COUNTRIES HAVING PM POLLUTION FROM MANY SOURCES (LOCAL URBAN AND TRANSBOUNDARY SOURCES).

• TOTAL PM EMISSIONS IN MALAYSIA WERE 2,700 TON
  • (SOURCE CONTRIBUTION: MOTOR VEHICLES = 17%, POWER PLANTS = 25%, INDUSTRIES = 48%) IN 2010 [DEPARTMENT OF ENVIRONMENT, 2011]
SAMPLING OF PM$_{2.5}$ DATA

• THE SAMPLING SITE WAS UNIVERSITI KEBANGSAAN MALAYSIA (UKM) LOCATED IN BANGI, SELANGOR, MALAYSIA.

• PM$_{2.5}$ AND TSP SAMPLES WERE COLLECTED AT THE ROOF IN UKM.

• LENGTH OF OBSERVATION: 13 – 24 SEPTEMBER 2013
LOCATION OF UKM

Straits of Malacca

Sumatra
ChemComb model 3500 speciation sampling cartridge, Thermo)
The setting on the Rooftop of the Faculty
Daily MAPI < 100, indicates moderate air quality
The daily PM$_{2.5}$ mass concentrations during the sampling period was $44.5 \pm 8.52 \, \mu g \, m^{-3}$ at high level compared to the average concentrations in September (2006–2009) had exceeded the national air quality standard of 35 $\mu g \, m^{-3}$ for 24-hour PM2.5 established by the U.S. Environmental Protection Agency.
<table>
<thead>
<tr>
<th></th>
<th>Range (min–max)</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PM$_{2.5}$ mass [$\mu$g m$^{-3}$]</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PM$_{2.5}$</td>
<td>34.6–59.5</td>
<td>44.5</td>
</tr>
<tr>
<td><strong>Carbonaceous components [weight % of PM$_{2.5}$]</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OC</td>
<td>14.9–40.6</td>
<td>24.4</td>
</tr>
<tr>
<td>EC</td>
<td>6.45–13.5</td>
<td>9.41</td>
</tr>
<tr>
<td><strong>Ions [weight % of PM$_{2.5}$]</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oxalate</td>
<td>7.83–17.2</td>
<td>12.6</td>
</tr>
<tr>
<td>Chloride</td>
<td>N.D.–0.0575</td>
<td>–</td>
</tr>
<tr>
<td>Nitrate</td>
<td>0.0122–0.251</td>
<td>0.101</td>
</tr>
<tr>
<td>Sulfate</td>
<td>7.42–17.8</td>
<td>10.6</td>
</tr>
<tr>
<td>Sodium</td>
<td>0.282–1.05</td>
<td>0.620</td>
</tr>
<tr>
<td>Ammonium</td>
<td>1.25–5.10</td>
<td>2.44</td>
</tr>
<tr>
<td>Potassium</td>
<td>1.01–2.99</td>
<td>1.99</td>
</tr>
</tbody>
</table>
AOD AT 550 NM (AQUA)
5 DAY BACKWARD TRAJECTORIES
13 SEP & 15 SEP
Air particles originate from Sumatra
DISPERSION 16 SEP 2013

12 hrs: 0600 16 Sep to 1800 16 Sep

24 hrs: 1800 16 Sep to 0600 17 Sep

48 hrs: 1800 17 Sep to 0600 18 Sep

72 hrs: 0600 18 Sep to 0600 19 Sep

GDAS METEOROLOGICAL DATA
Zonal Wind

Date (September 2013)

Height (km)

Legend

Westerlies dominate
Southerlies dominate
Total PM2.5 ions concentrations were $7.22 \pm 3.20 \, \mu g \, m^{-3}$ and the most abundant inorganic ion was sulfate of 67% of total inorganic ionic mass concentration.

The average concentrations of individual anions and cations decreased in the order of $SO_4^{2-} > NO_3^- > Cl^- \text{ and } NH_4^+ > K^+ > Na^+$. 
KUALA TERENGGANU (2006-2009)

Kterengganu-PM2.5

East coast station
Semi-urban

Tahir et al 2012
PM$_{10}$ MONTHLY VALUES: AUG 2005

Klang air
Quality station
(Sulaiman et al 2013)

Nitrates, sulphates, chloride anions, Ammonium, sodium, potassium cations
Daily MAPI and PM10 values

(Mahmud, 2009)
CONCLUSION

• INORGANIC IONS IN PM$_{2.5}$ WERE COMPOSED OF SULFATE ION (66% OF TOTAL IONS MASS) IN 2013.

• PARTICULATE SULFATE EXISTS IN THE FORM OF MIXTURES OF AMMONIUM (61%), POTASSIUM (24%), AND SODIUM SULFATES (15%) IN THE ATMOSPHERE.

• SULFATE AND POTASSIUM WERE IN THE PM$_{2.5}$ SIZE RANGE AND THE COARSE FRACTION WAS NEGLIGIBLE.
TERIMA KASIH