

## IDENTIFICATION AND QUANTIFICATION OF ATMOSPHERIC POLLUTANTS IN NATURAL AND MAN-MADE ECOSYSTEMS

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### Introduction

Haze becomes a common phenomenon in Malaysia and usually occurs during the dry season (Tusin, 1995). During the haze episode, the atmospheric particulate concentration is high and visibility is severely reduced. The haze pollution has not only resulted in considerable health impacts on the people but also severely affected transportation, construction and agrobased industries. Two mechanisms have been proposed to explain the haze formation i.e. concentration build up of vehicle emissions during stable conditions and biomass burning (Pinto et al. 1998). The objective of this study was to characterise haze's particles as characterisation provides useful information for the evaluation of their effects on health, source identification, apportionment study, and policy and decision makings.

### Materials and Methods

Haze particles, were collected on fibreglass filter papers (20.5 cm x 25.5cm) using higher volume sampler (HVS KIMOTO) from the top of the Department of Environmental Science's building, UPM. The flow rate used was 1.22m<sup>3</sup>/min and the samples were collected daily (24 hr average). The mass of the particulate matter was determined gravimetrically. Morphology of the particles collected on the filter was observed by scanning electron microscope (JOEL Model 6400). To determine the trace element content, the samples were first digested in a mixture of concentrated HNO<sub>3</sub>-HCl (1:3 v/v) for 6h, diluted with deionised water and analysed by atomic absorption spectrophotometry. Organic compounds were determined by gas chromatography-mass spectroscopy after they were extracted into an organic solvent using soxhlet extraction.

### Results and Discussion

Daily samples collected from 17<sup>th</sup> to 30<sup>th</sup>, September 1997 during the haze showed significant increase in TSP and PM<sub>10</sub> levels. The highest levels recorded for TSP and PM10 were 466.6 µg/m<sup>3</sup> and 406.7 µg/m<sup>3</sup> respectively. The average TSP

values during the non-haze period or relatively low-haze (from November 1977 to February 1998) were in the range of 80 to 150 µg/m<sup>3</sup>. Electron micrographs of the particles collected on the filter revealed that the particulates were smaller than 10µm and most of them were with the diameter of less than 2.5µm which were normally associated with long range particulate transportation. Formation of clusters without clear boundary between the adjacent particles (this could be clearly observed from the micrograph at high magnification) suggested that the haze particles were liquid (or liquid like) particles. They formed solid clusters during the sampling as they were forced through the filter. Seven metal ions (Na, K, Ca, Pb, Al, Mn and Zn) in the particles were determined. In general, except for K, the concentrations of these ions during and after the haze periods were similar. The concentration of K during the haze (September 24 and 25, 1997) were relatively higher compared to those of non haze period, indicating the source of the particulate was from biomass burning activities (Rashid et al. 1990). The similar concentration of Pb during and before haze episodes suggested that vehicle exhaust emissions were not the major source of the 1997-haze episode. Significant increase in the concentration of eleven polycyclic aromatic hydrocarbons (PAHs) was also observed in the particulates collected during the haze period. The concentration of individual PAHs in the haze particles were few hundreds nanogram/g of dry weight while these concentrations before or after the haze were less than 200 mg/g. The relative abundance of total methylphenanthrenes to phenanthrenes suggested that the source of the particulates was combustion at high temperature (forest fires).

### Conclusions

The concentration of particulates during the 1997-haze episode was few times higher than the concentration recorded before or after the haze. The majority of the particles were smaller than 2.5µm in diameter and displayed a liquid behaviour. Size, elemental and PAHs analyses indicated that the source of the haze was from long distance forest fires.

### References

- Pinto, J.B., Grant, L.D. and Hartlage, T.A. 1998. Report on U.S. EPA Air monitoring of haze from S.E. Asia Biomass Fires, Report no EPA/600/R-98/071, National Centre for Environmental Assessment, Research Triangle Park, NC.
- Rashid, M., Kamarul, A.I. and Khalik, A. 1990. Elemental characteristics of palm oil mill boiler clinker and fly ash, Proceeding of the Fourth National Symposium on Analytical Chemistry, UPM, Sept. 4-6.
- Tusin, A.M. 1995. Thick haze in Malaysia. Proceeding of the International Symposium on Climate and Life in the Asia-Pacific (ed. K.U. Sirinanda), Universiti Brunei Darussalam, p.105-124.