PM_{10} CONCENTRATION MEASUREMENTS AT FOUR SELECTED SITES IN SEMENANJUNG MALAYSIA: A COMPARISON BETWEEN SITES WITH DIFFERENT BACKGROUND.

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Mass concentration of ambient particulate matter with aerodynamic diameter less than 10 um (PM_{10}) are reported for four sites in Semenanjung Malaysia over an eight months monitoring period. The PM_{10} were measured using Beta Attenuation (BAM) monitors. Analysis of the ambient mass concentration data with reference to daily averages concentrations (DAC) and monthly average concentrations (MAC) are presented. Results shows that the PM_{10} DAC at site with industrial background range between 39 – 159 ugm^{-3} and MAC ranges between 60 – 92 ugm^{-3}. The site with residential background recorded PM_{10} DAC between 21 to 131 ugm^{-3} and PM_{10} MAC ranges between 34 – 64 ugm^{-3}. The sites with suburban background records PM_{10} DAC ranges between 21 – 110 ugm^{-3} and range for PM_{10} MAC between 40 – 59 ugm^{-3}. The traffic background site recorded MAC between 60 to 90 ugm^{-3} and PM_{10} DAC between 40 to 162 ugm^{-3}. Severals high PM_{10} concentration days were observed and due to the effect of transboundary sources from Indonesia forest fires.

Introduction

Air pollution has been a problem since the onset of urbanization. It has long been known that airborne particulates are associated with adverse effects on amenity through visibility reduction and the soiling of buildings (Harrison, 1997). The latter were investigated quite intensively in western countries, whereas in Malaysia, there has been no study of such nature conducted. Exposure to serious particulate pollution has long been associated with adverse health effects on human. More recent research, however, has shown a clear statistical connection between particulate matter pollution and daily mortality (Dept. of Health UK, 1995). Nevertheless, this link is usually considered as secondary and selective due to the fact that sensitive groups were most affected. Most recent air pollution discourse has revealed that non-sensitive individual could turn sensitive depending upon his exposure to particulate pollutants. In recognition of these health effects, the United Kingdom Expert Panel on Air Quality Standards has recommended a limit on airborne particulate matter (PM_{10}) concentrations of 50 ugm^{-3} measured as a rolling 24 h average (EPAQS, 1995).

In Malaysia, standards for air quality are not available. PM_{10} concentrations in ambient air in Malaysia are monitored based on Recommended Malaysian Guidelines (RMG) at a threshold of 150 ugm^{-3} for 24 h average and an annual means of 50 ugm^{-3}. The air pollution in Malaysia is reported in the form of index, which allows the general public to better understood the meaning (Ramli, 2001)

In this study, concentrations of PM_{10} at four sites from different category were investigated. Monitoring data gathered from these sites for a period of eight months in are presented. The ambient concentrations which indicate the exposure levels of PM_{10} on the population represented by these monitoring stations are examined.

Experimental

PM_{10} hourly average concentrations data from continuous air monitoring stations (CAMS) of four sites were gathered and collated. These sites represent different categories of background, namely residential, industrial, sub-urban and traffic. These stations employ Beta Attenuation Method (BAM) to measure PM_{10} concentrations. This method is recognized by the United State Environmental Protection Agencies (USEPA) as Federal Equivalent Method (FEM) for measuring PM_{10} in ambient air. These data were extrapolated to obtained daily average concentration (DAC) and monthly average concentration (MAC). High particulate pollution (above 150 ugm-3) episodes were carefully investigated and identified against the RMG.

Results and discussion

Eight months data of hourly concentrations of PM_{10} were analysed. Summary statistics of these are presented in Table 1-4. Table 1 showed the PM_{10} DAC at site with industrial background which ranges between 39 – 159 ugm^{-3}. The PM_{10} MAC shows upward trends beginning from month 3 and ranges between 60 – 92 ugm^{-3}. The highest MAC was recorded in month 8. Month 3 marked the beginning of dry season in Malaysia. One day of PM_{10} DAC higher than RMG was recorded.

Table 1: Summary Statistics of PM_{10} DAC concentrations for 'Industrial' site (ugm^{-3}).

Month	1	2	3	4	5	6	7	8
Average	63	60	69	73	70	77	84	92
Maximum	89	88	82	125	97	123	141	159
Minimum	41	39	51	38	47	49	52	56
Std.Dev.	10.8	11.2	9.6	20.7	13.3	16.2	28.3	23

Summary statistics for site with residential background recorded PM_{10} DAC between 21 to 131 ugm^{-3} (Table 2). The PM_{10} MAC ranges between 34 – 64 ugm^{-3}, and the highest were recorded during month 4. No clear upward trend observed for this site, however MAC and maximum were high between month 3 to 8.

Table 2: Summary Statistics for PM_{10} DAC concentrations at 'Residential' site (ugm^{-3}).

Month	1	2	3	4	5	6	7	8
Average	34	41	56	64	44	43	54	56
Maximum	53	65	82	131	120	79	105	113
Minimum	21	27	32	27	26	22	22	32
Std.Dev.	7	10.1	12.8	29.9	17.4	15	24.5	18.6

Table 3 summarised data recorded for site with suburban background between month 1 to month 8. This site records PM_{10} DAC ranges between 21 – 110 ugm^{-3}. Unlike the rest sites, highest MAC was recorded during month 2. The range for PM_{10} MAC was also smaller between 40 – 59 ugm^{-3}. Highest maximum PM_{10} DAC were recorded during month 7 and 8.

Table 3: Summary Statistics for PM_{10} DAC concentrations at 'Suburban' (ugm^{-3})

Month	1	2	3	4	5	6	7	8
Average	45	59	49	40	44	49	52	49
Maximum	55	82	97	59	64	84	107	110
Minimum	36	36	22	29	26	28	21	22
Std.Dev.	6.0	14.7	18.5	7.6	9.8	17.6	16.7	21.8

Fluctuations of PM_{10} concentrations at site with traffic background were summarized in Table 4. This site recorded higher range of MAC between 60 to 90 ugm^{-3}. Highest DAC was recorded in month 3 (162 ugm^{-3}) and followed by month 8 (132 ugm^{-3}). The PM_{10} DAC ranges between 40 to 162 ugm^{-3}. Two days of PM_{10} DAC higher than RMG were recorded.

Table 4: Summary Statistics for PM_{10} DAC concentrations at 'Traffic' (ugm^{-3})

Month	1	2	3	4	5	6	7	8
Average	60	70	90	90	79	72	84	81
Maximum	87	90	162	115	99	114	125	138
Minimum	44	40	52	55	54	52	47	57
Std.Dev.	11.6	12.4	26.5	13.3	9.5	17.4	17.7	20.7

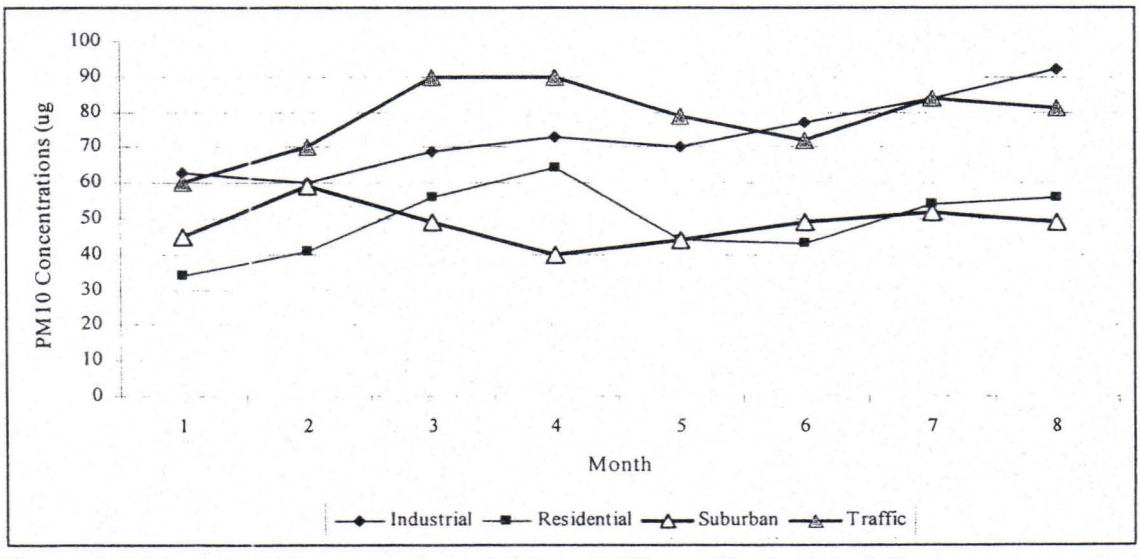

Figure 1: PM_{10} MAC Concentrations for Four Different Background Sites.

Month 3 is the onset of dry season in Malaysia. It can be observed that PM_{10} DAC tended to be higher during these months. During month 7 and 8, haze episodes recurred

in Malaysia. It was due to the transboundary movement of pollutants and brought into Malaysia from Indonesia by wind. However, there were only three days whereby the PM_{10} DAC had breached the RMG. Overall, there were 50 days with PM_{10} DAC above 100 ugm^{-3}. There were also high pollutant episodes recorded during month 4, 7 and 8.

Generally, PM_{10} concentrations at all four sites were lower than RMG (150 ugm^{-3}). The RMG in Malaysia can be considered as high compared to more stringent standards, for example, 50 ugm^{-3} in the UK. However, standard like this is fairly difficult to be achieved practically, as tropical country tends to be drier and hotter. Furthermore, a developing country like Malaysia needs some room to develop. Guidelines rather than standards without compromising sustainable development approach as being employed by the government should be used as an example by other countries. Furthermore, high particulate events normally occur due to transboundary sources and Malaysia continuously support efforts to minimize the effect this condition at regional level.

Conclusion

The results reflects the air quality at the four selected sites were generally good. The exposure levels were generally low although there were several days with high concentrations recorded. Sites with traffic and industrial background experienced higher PM_{10} DAC compared to sites with residential and suburban background. This study is hope to give a clearer picture of the air quality in Malaysia which is good and reverse to what had been reported by foreign media.

References

Department of Health (1995) Non-biological Particles and Health. HMSO, London

EPAQS (1995) *Particles*. Expert Panel on Air Quality Standards. HMSO, London.

Harrison, R.M. (1997). *Comparative Receptor Modelling Study of Airborne Particulate Pollutants in Birmingham (United Kingdom), Coimbra Portugal) and Lahore (Pakistan)*. Atmospheric Environment Vol 31, No. 20, pp. 3309-3321. Elsevier Science Ltd. Publ.

Ramli (2001) *Seasonal Locational and Diurnal Variations of Particulate Matter in Small Towns in Wales and Malaysia*. University of Wales Aberytwyth. United Kingdom.