

SUMMARY OF PM10 MONITORING AT ONE SITE
OF KUALA LUMPUR; TWO YEARS SURVEY

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ABSTRACT

RESULTS OF PM10 (inhalable particulate matter) monitoring in Kuala Lumpur from September 1986 to September 1988 are reported. Sampling was done using a size-selective high volume air sampler located on the roof-top of a four storey building at the existing UTM Air Quality Monitoring station.

On average, measurements of PM10 obtained was 50.8 ug/m³. This is closed to the annual value of USEPA standard of 50 ug/m³. Other pertinent findings are discussed in this paper.

INTRODUCTION

The existing Ambient Air Quality Standards for atmospheric particles pertaining to the mass concentration of total suspended particulate matter (TSP) has now been reviewed by respected Environmental Agency in many countries in the world. The TSP measured by the Hi-vol sampler, consists of the mass of particles less than approximately 50 um in diameter. But there is scientific evidence that the health effect of particles depend on the size distribution and chemical composition of the particles. Thus, standard based on TSP alone is now found to be inadequate and that future particulate monitoring should be focussed on inhalable size fraction which gives better assessment of particulate pollution impacts on human health.

Acknowledging the fact above, a comprehensive air quality monitoring station was set up in Universiti Teknologi Malaysia beginning January 1986. Among the main objectives of the establishment of the station was to assess the level of particulate pollution particularly the inhalable size fraction in the Kuala Lumpur area.

This note presents, the accumulated sampling data of TSP and inhalable particulate (or PM10 i.e. particles having less than 10 um in aerodynamic diameter) for a preliminary assessment.

METHODOLOGY

The locations of the UTM air quality monitoring station as well as the surrounding industrial areas are shown in Figure 1. The TSP and PM10 were collected using a standard. High volume (SA-1H) and size-selective high volume (SA-321A) air samplers respectively. Samplers were placed on the roof-top of a four storey building in the campus area. Both samplers were calibrated and operated concurrently at 1.13 cubic meter/min with a sampling frequency of once in four days. The preconditioned glass fiber filters (EPM-2000) were used to collect the particles.

The meteorological parameters mentioned in this paper were gathered from the nearest Malaysian Meteorological Services station located in Petaling Jaya.

RESULTS & DISCUSSION

This paper summarizes some of the pertinent findings with regard to the air particulate monitoring data gathered at the UTM Air Quality Monitoring Station. These findings are discussed below:

Monthly Variation of Suspended Particulate Matter.

Both PM10 and TSP are also regarded as suspended particulate matter (SPM). The monthly averages of the PM10 and TSP are shown in figure 2. As expected, the TSP was found to have higher concentration than PM10 in most of the time. This clearly indicate that the PM10 constitutes an inhalable particulate portion of the TSP. This was the main reason why many countries have started to agree to review the present TSP standard.

Both PM10 and TSP concentrations were found to vary in each month and the variations were consistent throughout the study period (i.e as PM10 increases, TSP also increases or vice versa). The variation of the SPM in the atmosphere is very much influence by the meteorological factors such as daily wind speed and direction. Weather condition such as

rain can also play an important role in reducing the amount of particulate in the atmosphere. Figure 2 clearly demonstrates that during raining months (somewhere November - December) the SPM levels off to the minimum as compared to during dry months (somewhere June - July) where the SPM levels were much more higher. To a certain extent, the PM10 is seen to predominate the TSP level during some of the months. Prolong wetness in ground level during raining period could cause this effect but this needs further investigations. The effect of rain on SPM concentrations is also discussed in the later part of this paper.

The broken lines in figure 2 denote the discrepancy in the data collection during the study period due to technical problems.

Annual Average SPM Concentrations.

The annual average of PM10 and TSP concentrations were 50.8 and 66.0 $\mu\text{g}/\text{m}^3$ respectively. The PM10 value exceeds the annual standard value of USEPA of 50 $\mu\text{g}/\text{m}^3$ by a very small fraction. Even, this is so, detail investigation is warranted to further assess the implication of this finding as probably data from a station may not be adequate to evaluate the impact of the inhalable particulate pollution for the whole region.

Meanwhile the annual average TSP concentration was a below the Department of Environment guideline value of 75 $\mu\text{g}/\text{m}^3$. The height of the sampling point could also caused the TSP value to be lower than expected as in this case.

Effect of Wind Speed on SPM.

Wind speed is said to be one of the most important meteorological parameters that can affect the dispersion of pollutants in Kuala Lumpur^{1,2}. Figure 3 presents the percentage of occurrence of wind directions (vector sums) in four major sectors (NW, SW, SE and NE) during the study period. While Figure 4 presents the percentage contributions of both PM10 and TSP in each of the wind sectors.

It seems that the SW wind sector contributes the highest pollution load of PM10 and TSP to the sampling site although the percentage of occurrence of wind direction from this sector was among the lowest during the study period. The highest contribution of PM10 or TSP from this wind sector is expected since most of the important industries

are located along this sector. The SW wind direction will probably carry the pollutants along with it as it moves into the Klang Valley region. Meanwhile the pollutant contribution from other sectors (i.e. NW, NE and SE) were relatively the same.

Effect of Rainfall on SPM.

As discussed previously, the rainfall was said qualitatively to influence the SPM concentration in the atmosphere. Table 1 presents the particulate concentration data for both rainy and non-rainy days during the study period. From Table 3, it seems that rainfall has very minimal effect on the TSP and only 9% difference in TSP concentration was found between the two different days. In contrast, the rainfall was shown to have no significant effect on PM10 concentration. It would be expected that fine particles like PM10 are very difficult to remove as compared to big size particles and this is the most likely reason for the above finding.

Since, only the TSP is affected by the rainfall and not PM10, a higher PM10/TSP ratio is expected during rainy days than non-rainy days. This is clearly shown in Table 1. The PM10/TSP ratio were 0.64 and 0.58 for rainy and non-rainy days respectively. Here, higher PM10/TSP ratio is registered during rainy days.

Further investigation reveals that there are two components of rainfall that need to be considered: 1) amount and 2) duration of rainfall. The effect of these components on SPM concentration can be quantify statistically by looking into the correlation coefficient of SPM againsts each of these components separately as given in Table 2. Both PM10 and TSP were better correlated (negatively) with the duration term as compared to the amount of rainfall. The PM10 has better correlation coefficient ($r = -0.42$) than the TSP ($r = -0.37$) against the duration of rainfall. But at the sametime the PM10 has a poor correlation coefficient ($r = -0.09$) against the amount of rainfall as compared to the TSP. This indicated that a longer time and not the amount of rainfall is required to remove these fine particles from the atmosphere. It is commonly observed that fine rain water droplets are produced during a rainy day that last for hours. Evidently, this will give a better collection efficiency for fine particles as well as the big size particles. However, the overall effect of rainfall on the SPM concentration is still dependent on the amount and duration components of the rainfall.

CONCLUSION

Some of the pertinent findings on air particulate pollution data collected at UTM air quality monitoring station have been reported. On average, the inhalable particulate PM10 concentration was found to be 50.8 ug/m³ which exceeded the annual standard of USEPA value of 50 ug/m³ by a small margin. This will certainly need an attention to relevant agency to further investigate the possible health effect of these fine particles on public health at large. And if find necessary, steps should be taken from now in order to control the possible inhalable particulate sources in the region. It is incumbent on responsible authority to see that future ambient air particulate monitoring should emphasize the collection of inhalable size fraction as this would give a better epidemiological understanding between man and his environment.

REFERENCES

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2. Mohd. Rashid M.Y., Hashim H, Izani M.Z.; The effect of wind and rainfall on the distribution and concentration of the suspended particulate matter in Kuala Lumpur. Jurnal Teknologi 1988 (submitted for publication).

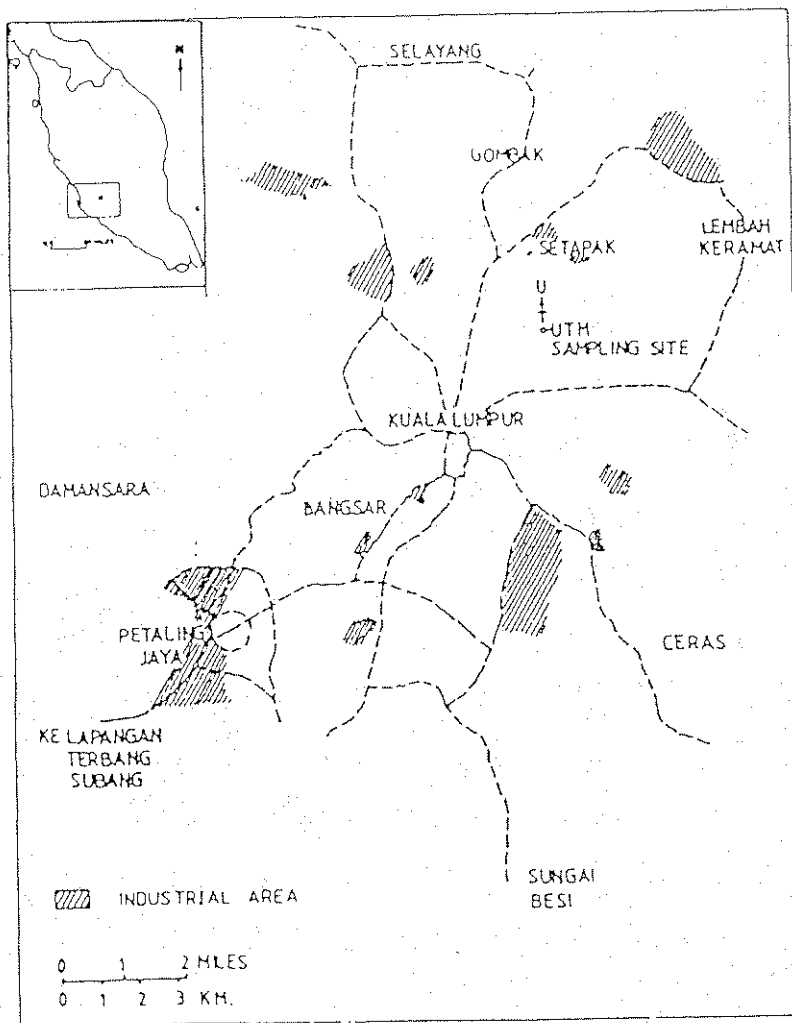


Figure 1: Sampling Site Location

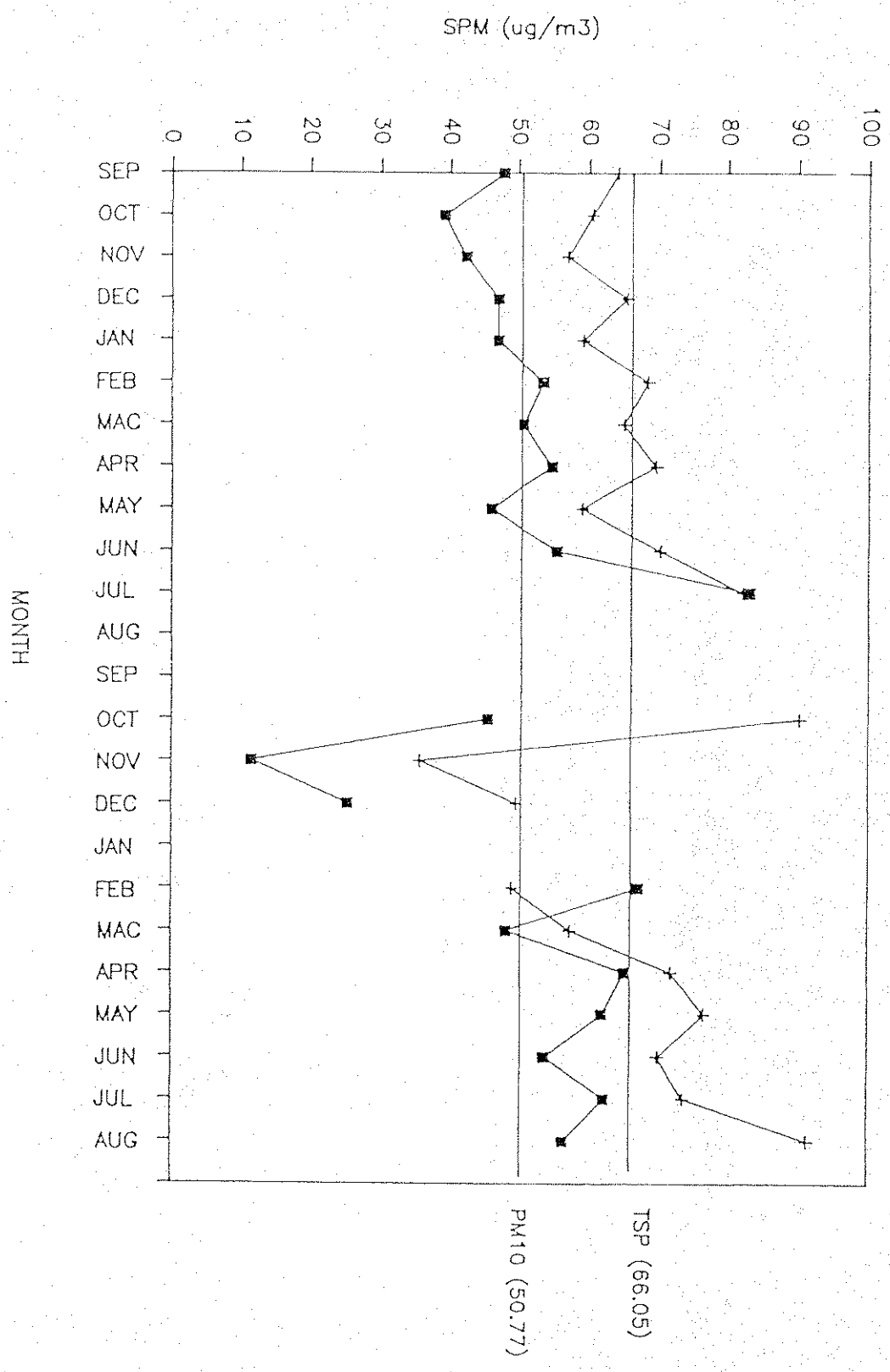


Figure 2 : Monthly Average of Suspended Particulate
From September 1986 - August 1988.

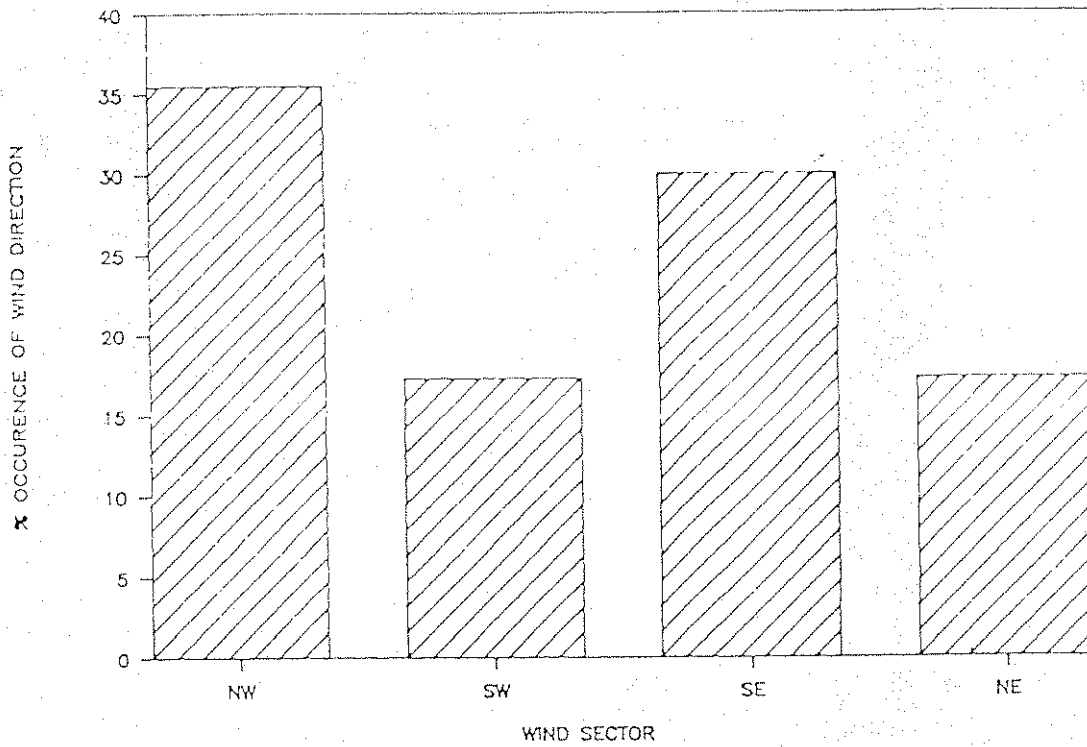


Figure 3 : Percentage Occurrence of Wind Direction During the Study Period.

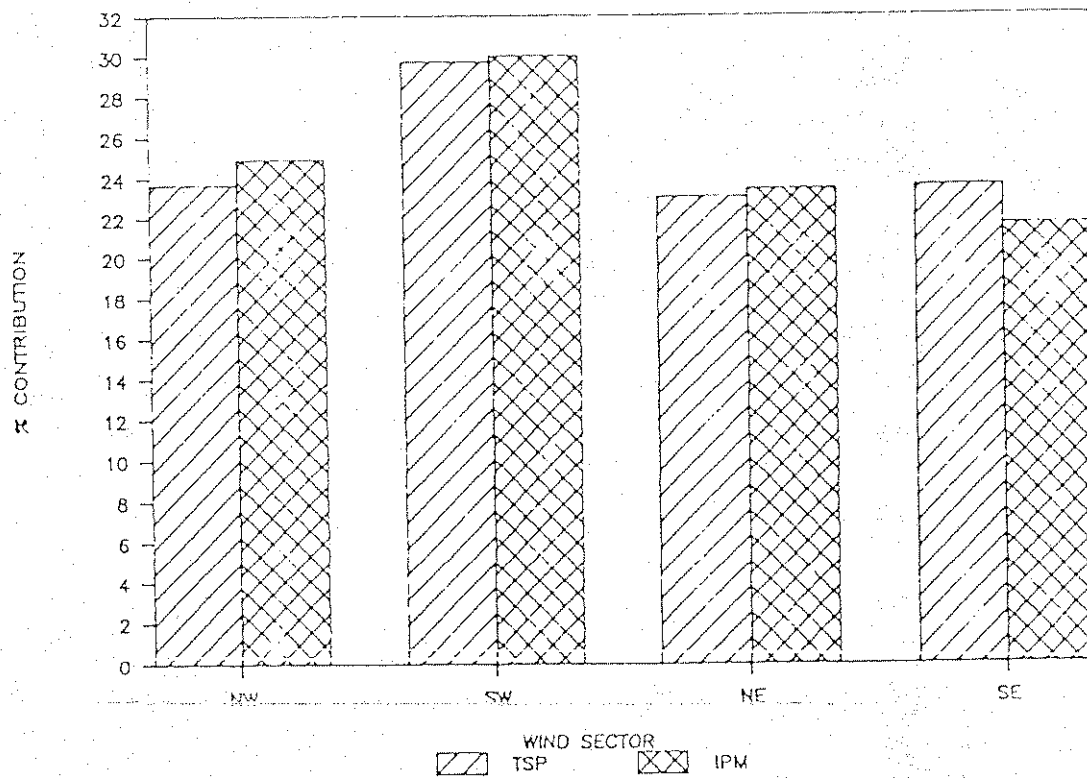


Figure 4 : Percentage Distribution of Suspended Particulate by Wind Sectors.

TABLE 1 : The Effect of Rainfall on Suspended Particulate Matter

Particulate	Particulate Conc.		
	Non-Rainy	Rainy	% Removal
TSP	69.1	63.1	9%
PM10	40.3	40.2	-
PM10/TSP	0.58	0.64	

Table 2 : The Correlation Coefficients of Particulate Against the Rainfall Components

Particulate	Correlation Coefficients	
	Amount of Rainfall	Duration of Rainfall
TSP	- 0.11	- 0.37
PM10	- 0.09	- 0.42