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COMMUNICATION V

Lead in Kuala Lumpur Urban Dust

ABSTRAK

Satu siasatan rintis bagi plumbum dalam debu-debu bandar Kuala Lumpur telah dijalankan. Paras plumbum dari 22.9 hingga 6986.6 $\mu g\, g^{-1}$ telah didapati, bergantung kepada kawasan dari mana debu dikumpul. Terdapat satu perhubungan di antara paras plumbum dan kepadatan trafik. Jumlah plumbum yang dapat dilesapkan dalam air hujan adalah tinggi dan masalah ini perlu dikaji lebih dalam.

ABSTRACT

A preliminary survey of lead in Kuala Lumpur urban dust was carried out. Lead levels of 22.9 to 6986.6 $\mu g\, g^{-1}$ were obtained, depending on the locations where the dust was collected. There is a direct relationship between lead level in dust and traffic density. The amount of lead leachable by rain water is sufficiently high to warrant further investigation.

INTRODUCTION

Lead pollution and its effect on health is a matter of general concern, especially its potential danger to children (Chilsom, 1971; King, 1971). One of the main sources of lead pollution is attributed to automobile exhaust (Day, 1977; Low *et al*, 1981). Various direct and indirect methods have been used to measure ambient lead levels, and street dust has been used by many investigators to examine environmental lead pollution (Nasralla, 1985; Lau and Wong, 1982; Fergusson *et al*, 1980; Day *et al*, 1975). Lead levels varying from 85 to 5060 $\mu g\, g^{-1}$, depending on the location of dust collection, have been reported.

The present work is a preliminary study of the distribution of lead in street dust in and around Kuala Lumpur city; an investigation on the solubility of lead in rainwater is also included. The study is aimed at providing some information on the possible source of lead contamination in this area.

MATERIALS AND METHODS

Seventy-seven dust samples were collected from June, 1984 to May 1985. The method of sample collection was as reported by Nasralla (1984). The samples were randomly collected from highways, roadside, footpaths, car parks, bus stops, playground and a chemical laboratory in and around Kuala Lumpur. *Fig. 1* shows the location of Kuala Lumpur in relation to Petaling Jaya and Serdang.

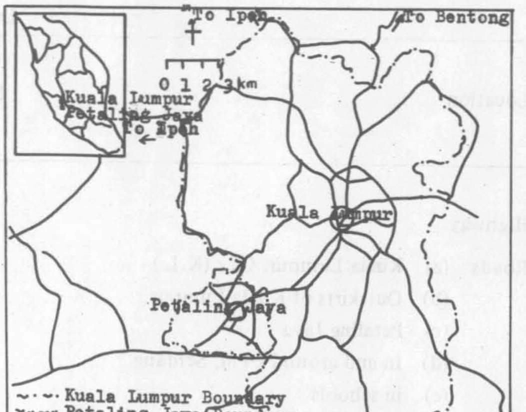

Fig. 1. Kuala Lumpur in relation to Petaling Jaya and Serdang. The map is adapted from that of Sham Sani, Sains Malaysia. **5(1)**, *27–37(1976).*

The dust samples were sieved through a 0.5 mm sieve before analysis. One g sample was digested with 20 cm^3 of 8M HNO_3 as reported by Solomon and Hartford (1976). Lead content was determined by inductively coupled plasma atomic emission spectrometry (ICP-AES) at lead emission line of 220.36 nm using Labtest Plasmascan 710.

Two dust samples were fractionated on the basis of particle size. This was carried out using sieves of apertures 850, 300 and 75 μm. Digestion and determination of lead of each fraction is as described above.

In the solubility study, three dust samples of high (6989 $\mu g\ g^{-1}$), medium (360 $\mu g\ g^{-1}$) and low (22 $\mu g\ g^{-1}$) lead contents were selected arbitrarily. Twenty (20) g dust (850 μm), in a polypropylene bottle, was shaken with 100 cm^3 of rainwater which was collected from a gutter at Universiti Pertanian Malaysia, fifteen minutes after a heavy rainfall started. Maximum agitation rates were used to simulate water runoff conditions during a rainstorm. Aliquots of 10 cm^3 were withdrawn at hourly intervals during the first four hours of the experiment. They were immediately filtered through No. 42 Whatman paper. pH of the filtrate was determined before a drop of 6M HNO_3 was added to maintain lead in soluble form and to reduce lead adsorption by the polyethylene bottle. Lead was determined by ICP-AES.

RESULTS AND DISCUSSION

Lead in Dust

Table 1 lists the lead content in dust samples collected at different locations. Although no actual traffic density data were collected, there appears to be a correlation between lead content and traffic density. A similar trend has been observed by Nasralla (1984), Fergusson *et al.* (1980) and Day *et al.* (1975).

The highest lead content in dust was found in samples collected along the highway where the traffic is heaviest.

The levels of lead in dusts collected at busy roads in the city centre and roads with light traffic in the outskirts reflect the traffic density in these areas. Day *et al.* (1975) reported a mean lead of 1001 $\mu g\ g^{-1}$ in major roads with moderate to heavy traffic density, and mean lead of 888 and 933 $\mu g\ g^{-1}$ in streets with moderate to light traffic. These values are comparable to those obtained in this study. The same trend is observed in the lead levels of dust samples collected at the various open-air car parks. In the city where the number of vehicles entering and leaving car parks is greater, the lead

TABLE 1
Lead in dust

Location		Sample Size	Lead ($\mu g\ g^{-1}$) Range	Mean
Highway		8	547.2 – 6986.6	3313.4
Roads	(a) Kuala Lumpur, City (K.L.)	8	360.5 – 2833.7	1041.3
	(b) Outskirts of Kuala Lumpur	16	60.7 – 445.4	223.2
	(c) Petaling Jaya	9	131.9 – 2146.4	821.2
	(d) In and around UPM, Serdang	3	141.6 – 254.1	188.0
	(e) in schools	3	47.9 – 55.0	51.5
Parking Lot	(a) Kuala Lumpur	2	737.5 – 1497.1	1117.3
	(b) Petaling Jaya	4	41.8 – 358.0	150.3
	(c) UPM, Serdang	8	64.2 – 211.7	155.3
Bus Stop		6	179.1 – 3204.6	949.8
Playground		6	22.9 – 166.4	60.4
UPM Laboratory		2	35.1 – 148.4	91.8
Hospital Compound		1		733.9
Domestic Residence		1		1053.8

*UPM – Universiti Pertanian Malaysia.

level is higher. The high density of vehicle movement also accounts for the high levels of lead at bus stops and hospital compounds.

The average lead content (60.4 $\mu g\ g^{-1}$) of the samples collected at the playground, however, is lower than the level of 1014 $\mu g\ g^{-1}$ reported by Day *et al.* (1975) and 815 $\mu g\ g^{-1}$ reported by Nasralla (1984). It would appear that the play fields in schools as well as public playgrounds where samples were collected are somehow shielded from surrounding traffic movements.

The dust samples collected at the chemical laboratory did not have high lead level (91.8 $\mu g\ g^{-1}$) whereas Solomon and Hartford (1976) have reported lead level as high as 11,400 $\mu g\ g^{-1}$ in chemical laboratories. The lead content of the residential sample is comparable to that reported by Nasralla (1984). A substantial fraction of this relatively high lead level (1953.6 $\mu g\ g^{-1}$) is probably due to lead settling from automobile emissions. There is no known lead emitting source in the vicinity.

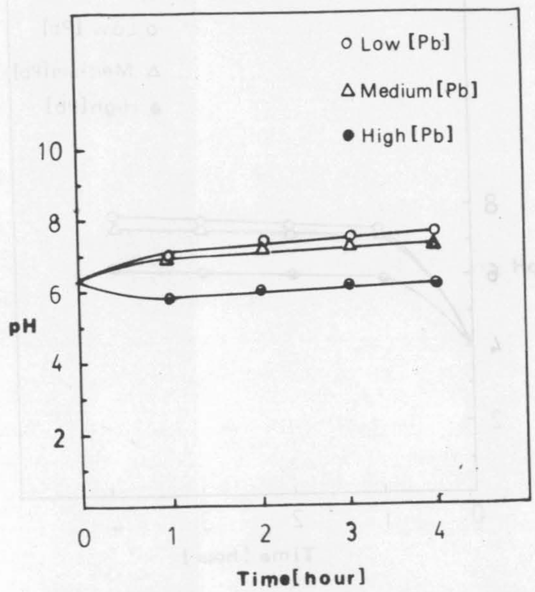

Fig. 2. Variation of pH with contact time, initial pH = 6.4

Fractionisation of Dust

The result of the fractionisation of dust on the basis of particle size is given in Table 2. The highest concentrations of lead occur in the dust with the smallest particle size. The same trend was reported by Fergusson *et al* (1980). Presumably smaller particles with larger surface area are capable of retaining more lead particulates emitted from motor vehicle exhaust.

pH and Lead Solubility

The change of pH with contact time in rainwater in the solubility experiments is shown in *Figs. 2* and *3*. There appeared to be a buffering effect in the system, and pH invariably equilibrated at about 7 for samples with high lead content and at about 6 for samples with low lead content. This could be due to the presence of clays in the samples (Solomon and Hartford, 1977).

Fig. 4 shows the solubility of lead in rainwater. At pH 6.4, the solubility ranged from 0.10 to 1.59 mg l^{-1} for samples containg 22 $\mu g\ g^{-1}$ to 6989 $\mu g\ g^{-1}$ lead respectively. These amounts are lower than the amounts of 0.5 to 5 mg l^{-1} reported by Solomon and Hartford (1979). According to the Malaysian standards for industrial effluents (1979), the allowable level of lead for discharge into inland waters within the catchment areas was 0.10 mg l^{-1} while the level for discharge

TABLE 2
Lead distribution according to particle size

size (um)	Sample 1 (Low Pb)		Sample 2 (High Pb)	
	wt %	$\mu g\ g^{-1}$	wt %	$\mu g\ g^{-1}$
300 – 850	3.85	14.0	11.73	5112.0
75 – 300	67.95	31.9	63.37	6441.3
<75	28.20	189.5	23.90	10801.8

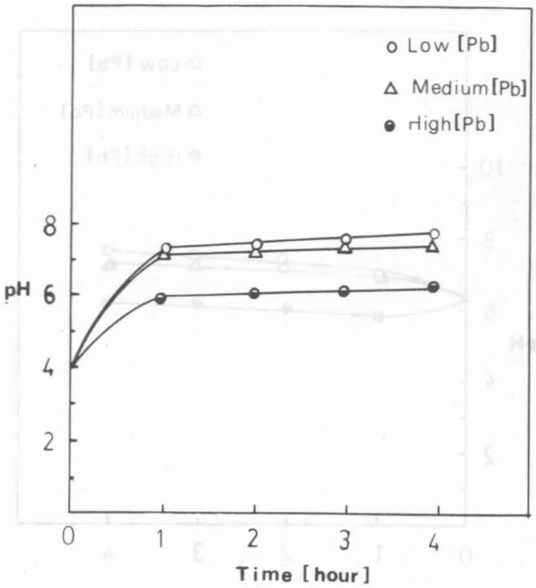

Fig. 3. Variation of pH with contact time; initial pH = 4.0

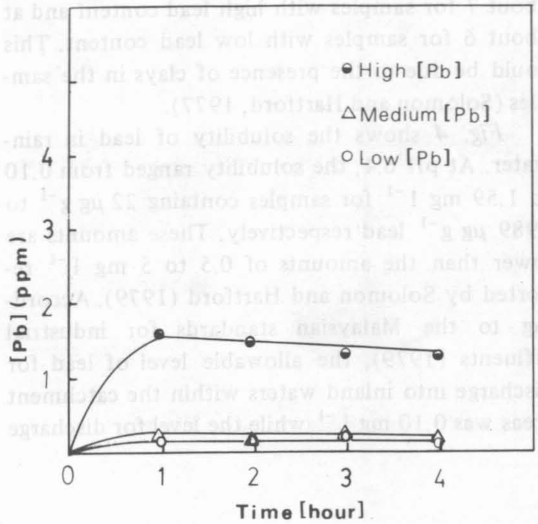

Fig. 4. Solubility of lead in rainwater.

into any other waters is 0.50 mg 1^{-1}. It thus appears that the amount of Pb eachable by rain water is high enough to pose a threat to water quality.

CONCLUSION

The level of lead in street dust in urban Kuala Lumpur is generally comparable to that found in the other parts of the world. There appears to be a direct relationship between lead level and traffic density. The amount of lead leachable by rain water appears high enough to be hazardous to the ecosystem.

A wider scope of this investigation is thus necessary in order to establish statistical correlation of lead in dust with traffic density. In addition, an in-depth study of lead solubility in rain water is warranted.

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