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Ambient Lead Levels in Urban Areas

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Lead is released to the atmosphere both from natural and man-made sources. Man-made emissions arised from the production and use of lead and its compounds and these overwhelm natural sources. Lead from petrol combustion is largely emitted on fine particulates from autoexhaust Other sources of the lead includes; the smelting and refining of non-ferrous metal ores, coal combustion, refuse incineration and the production of batteries and cables. Lead and their compounds are associated with fine particulate matter in ambient air. This is very important from health point of view as fine particles are responsible for quick absorption of lead in the blood. The fine particles tend to persist in the atmosphere where they can undergo chemical reaction and are transported from their sources over long distances to pristine areas of the environment (Gajghate and Hasan 1997).

Presence of the lead in the environment has led to an increasing awareness and concern of its detrimental effect to ecosystem and human health (WHO 1977; Mathur etal. 1997). It is found that lead is associated with fine particulate matter of various size range (P10-P100) present in the ambient air of urban agglomerations. The elevated concentration of fine dust in Indian urban cities is a common phenomena attributable mostly to arid climatic condition prevalent during major periods of the year. These particles contain lead and pose serious concerns from human health point. In urban atmosphere automobile exhaust is considered to be a significant contributor to total atmospheric lead. Correlation between airborne lead concentration and traffic density has been reported by several workers (Khandekar etal. 1980; Khan 1981; Woleed 1990). Lead content of airborne dust decreases exponentially with distance from the road (Brawn 1986). It is also reported that populations living in industrial areas have relatively higher concentrations of lead in their blood (Chamberlain 1983; Walter and Raveendram 1990). In the city of Mumbai, India, lead along with other trace elements has been observed to be present in considerable quantities in ambient air. (Khandekar etal. 1984; Tripathi etal. 1989). Airborne lead in the city of Varanasi, India has also been reported (Tripathi Anamika 1994). Status of airborne metals in air environment in India and various strategic approaches for air management of air pollution have been reported (Gajghate and Hasan 1995; 1996). The present communication reports lead levels in ambient air of nine major cities of India.

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MATERIALS AND METHODS

A network spread over urban centres was operated to get entire coverage of ambient Respirable Suspended Particulate Matter (RSPM) and lead for metropolitan cities of India. The major urban centres viz. Ahmedabad, Mumbia, Calcutta, Delhi, Hyderabad, Jaipur, Kanpur, Kochi, Chennai and Nagpur have been selected on the basis of(i) representative to major regional group centres. (ii) high rate of industrialization and urbanization. (iii) representing to the regional topoclimatic characteristics. RSPM were collected from the locations using samplers operated at a rate of 1.5 m^3/min for 24 hrs on pre-weighed glass fibre filter of 20x25cm size and reweighed after sampling in order to determine the mass concentration of the particles collected. The concentration of particulate matter in ambient air were then computed on the net mass collected divided by the volume of sampled. Twelve circles of 1" diameter were punched out from the filter paper and digested in concentrated nitric acid. The content was filtered through Whatman paper No. 42 and final volume madeup to 100 ml by double distilled water, The filtrate was used to determine the lead by GBC 900 Atomic Absorption Spectrophotometry. The details of sampling procedure are given elsewhere (Aggarwal etal. 1995).

RESULTS AND DISCUSSION

The mean RSPM concentrations of all urban centres is depicted in Fig. 1. RSPM averaged level over the entire perio at various centres ranged from 53-222 µg/m^3. The highest mean concentrations occured at Delhi which confirms that the contribution is mostly from vehicular activity. Mean concentration of RSPM in coastal cities viz. Mumbai, Kochi and Chennai ranged from 55 to 88 µg/m^3, however, for remaining inland cities RSPM ranged between 73 and 222 µg/m^3. Delhi is having the maximum vehicular traffic in India. RSPM concentrations, however, are highly variable depending on the proximity of the sampler to road, local traffic conditions, industrial activity, and prevealing metereological conditions.

Studies have been conducted on the monitoring of ambient lead levels during 1991. The minimum and maximum values, arithmetic and geometric means togetherwith their standard deviation for lead in air respirable dust of 9 cities are given in Table 1. Data evaluation projected that the lead concentrations ranged from 0.009 to 2.30 µg/m^3 in various centres. Mean lead pollution levels of more than 0.25 µg/m^3 were observed at Calcutta, Delhi & Kanpur. Highest concentration 0.78 µg/m^3 was recorded at Calcutta. High lead concentration were recorded in Mumbai, Calcutta and Delhi besides Kanpur whereas in other cities low levels were observed. The mean lead concentrations of 0.25 µg/m^3 was observed in Delhi and Kanpur ranged from 0.05 to 0.45 µg/m^3 and 0.03 to 0.46 µg/m^3 respectively. The lowest mean lead levels were recorded at Nagpur, Chennai and Kochi with minimum 0.02 and maximum 0.21 µg/m^3. The lead at Calcutta observed to be highest among all the values reported. This city has large number of small scale industries within the urban zone and the increased lead levels appeared to be contributed from sources other than auto emissions. The source of emission could also be partly from fuel or refuse burning. Ambient lead levels

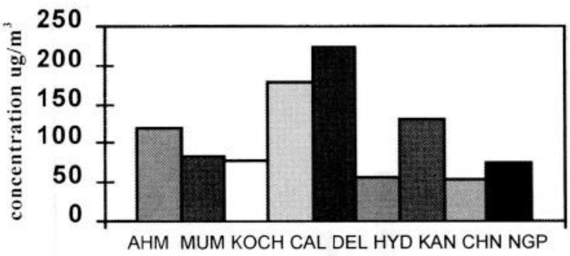

Figure 1. RSPM concentrations in various urban centres, 1991

of Kanpur city was recorded highest among 6 cities and may be significant contribution due to sources other than auto emission. The findings confirm that there is a good correlation between number of automobiles and /or lead based industries with ambient lead levels (Gajghate etal. 1997). Annual average of lead content in ambient air in Indian cities revealed that lead in megacities was approaching the guideline of WHO and CPCB. It is seen from Table 1 that the levels in Indian cities are low compared to those in Western countries and are, in fact, closer to the rural levels in most of the cases. Auto exhaust is the major contribution to the urban atmospheric lead and its distribution vary with particle size range of lead from exhaust and mixing rate of pollutants. For example, mixing rate is higher at tropical and sub tropical latitude due to the higher intensity of isolation. The mean maximum mixing height in Indian cities is in the range of 0.8 to 3.2 Km which is about three times higher than in the mid latitude cities of the west.

Table 1 . Concentration of Lead in Respirable Dust (µg/m^3)

City	AM	SD	GM	SGD	Min	Max
Ahmedabad	0.14	0.26	0.04	4.45	0.009	0.26
Mumbai	0.11	0.12	0.04	5.67	0.048	0.31
Kochi	0.07	0.08	0.05	2.86	0.016	0.21
Calcutta	1.36	0.77	1.14	2.03	0.43	2.30
Delhi	0.25	0.13	0.21	2.15	0.05	0.45
Hyderabad	0.10	0.10	0.06	3.28	0.01	0.28
Kanpur	0.27	0.15	0.21	5.07	0.05	2.23
Chennai	0.08	0.07	0.06	2.64	0.02	0.21
Nagpur	0.06	0.06	0.09	4.01	0.02	0.16

AM Arithmatic Mean. SD : Standard Deviation, GM Geometric Mean, SGD : Standard Geometric Deviation

Seasonal variation data of lead concentration is depicted in Fig. 2. It could be seen from this Figure that the lead concentration was highest in winter season followed by summer and monsoon season in the most of the cities. The seasonal variation of lead profile indicate that

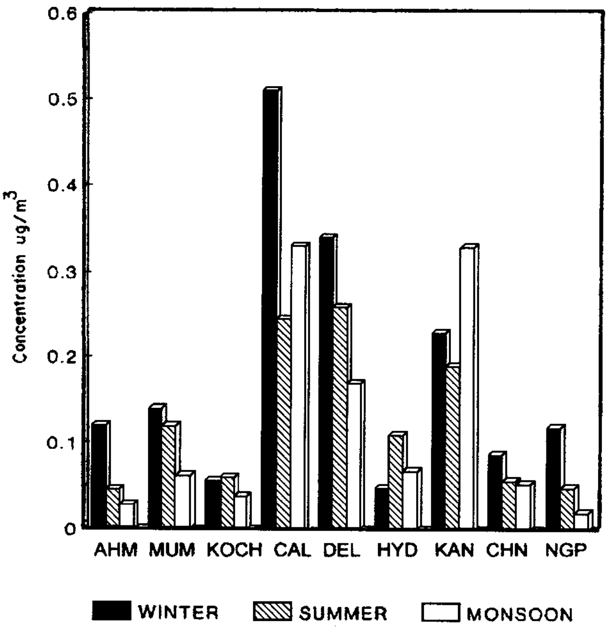

Figure 2. Seasonal variations in ambient lead in major cities : 1991

Calcutta city experiences high lead concentrations followed by Delhi in the winter month. Table 1 presents both arithmetic and geometric means, however, the results are discussed on the based of geometric mean concentrations, since the air pollutant concentration generally follow a log normal distribution. Arithmatic mean is probably more meaningful for any exposure evaluation. The Geometric Standard Deviations (GSD) included in Table 1 give an idea of the spread of the data set. Large GSDs generally result in a poorer log normal fit. The frequency distribution of lead for 9 cities are presented in Fig. 3 through Fig. 4. The log-normal approximation is seen to be good for many cities. The fit for Calcutta and Kanpur was poorer due to multiplicity of sources. Auto exhaust has been traced to be one of the major source of lead in the ambient air (Sadasivan and Negi 1990; Lee etal. 1994). The results of the study has clearly demonstrated that the autoexhaust emission is the predominant source for lead pollution in major urban centres.

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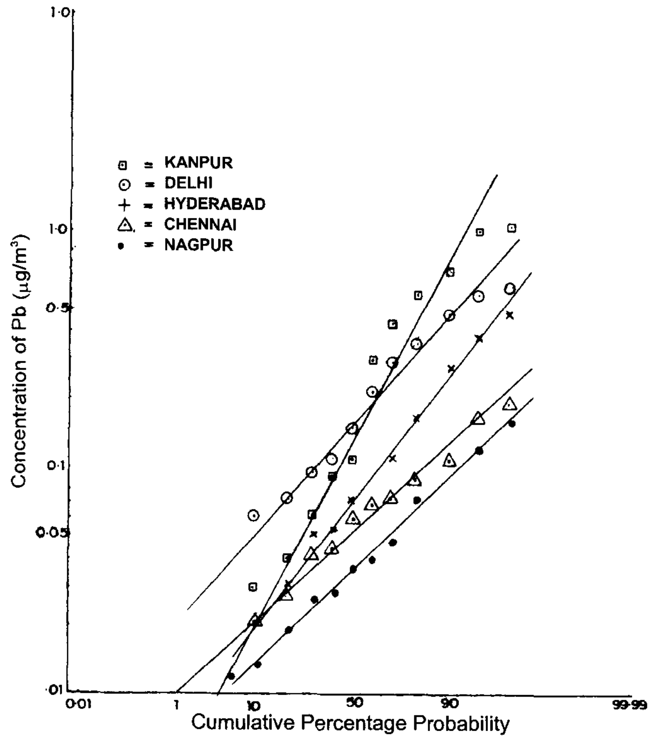

Figure 3. Frequency Distrubution of Pb in RSPM in various cities

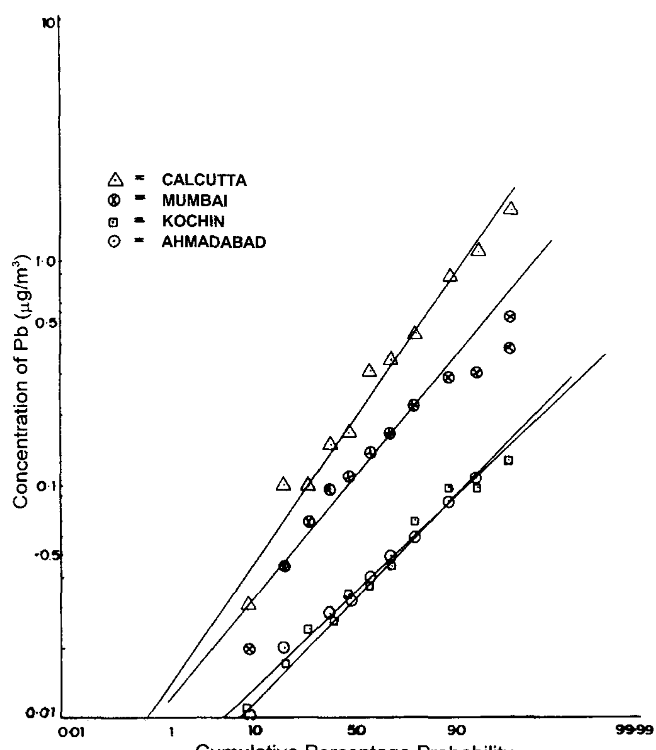

Figure 4. Frequency Distrubution of Pb in RSPM in various cities

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