STATUS OF AIR POLLUTION CAUSED BY COAL WASHERY PROJECTS IN INDIA

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Abstract. The importance of coal washeries in India is growing as local coals have a high ash content. At present, there are 23 coal washeries with an annual rated input of 45 Million Tonnes. During the various operations in washeries, large amounts of dusts and gaseous pollutants are generated. Four coal washery projects were surveyed to study their air pollution characteristics. Air monitoring stations were set up in local industrial, residential and sensitive areas and air pollution samples were collected along with micro-meteorological data. Diurnal variations of SPM, SO_2 NO_x and CO are discussed. SPM concentrations were found to exceed the permissible limits at all locations. SO_2 and NO_x were also found to exceed the permissible limit in residential and sensitive areas. It was observed that about 50% of the dust particles were less than 10 μ in diameter. Benzene soluble matter in SPM ranged from 45-62%.

1. Introduction

Coal either from underground mines or opencast mines contains a mixture of minerals. As Indian Coals (Ghose *et al.*, 1993a) are believed to be of drift origin, they have very high ash content. The demand for coal with ash content within well defined limits has led to plans for the upgrading of coal quality. This has been carried out by the larger sizes of coal as mined, being crushed into smaller sizes and subjected to washing procedures in coal washeries (Mitchell, 1956) where dirt is eliminated by gravity separation processes. During the various operations (Khowry, 1981) of the washery such as tipping, crushing, screening, loading and unloading and vehicular movement on dusty roads, a substantial amount of dust is generated. Also burning of coal and vehicular movements produce a lot of gaseous pollutants. These are not only causing pollution problems in the washery premises but also surrounding areas.

The Indian reserve of coking coal (CMRS report, 1961) is mainly located in the Jharia Coalfield of Bharat Coking Coal Ltd. (BCCL). The total consumption of coking coal in the steel plants of Steel Authority of India Ltd. (SAIL) is about 15 million tonnes. SAIL has introduced the importation of coking coal up to 4 million tonnes a year. At present, there are 23 washeries located in the region with an annual rated input of 45 million tonnes. The number of washeries at present are not sufficient to fulfil the demand for washed coal. Thus, there are plans for a large number of new washeries to be installed within this area, which will create more serious air pollution problems.

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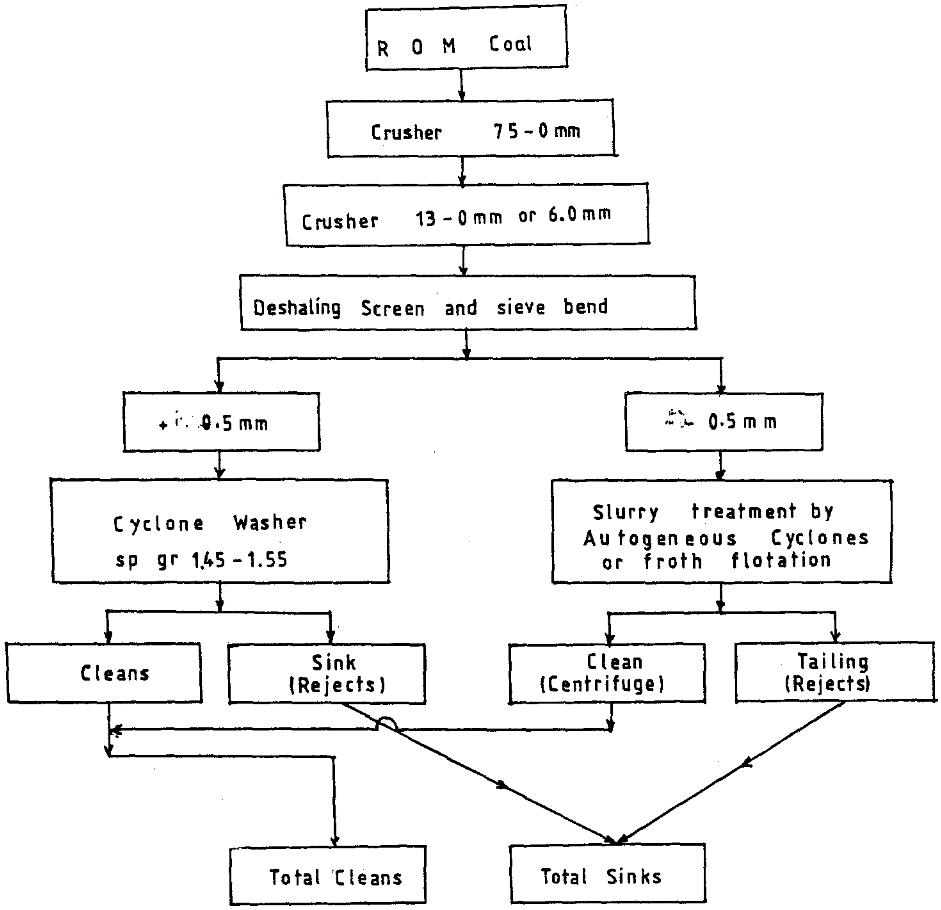

Fig. 1. A general washing process flow diagram.

Thus it is important to understand the characteristics of pollution arising from thr coal washery projects of BCCL. In the present work four coal washeries of BCCL have been surveyed for this purpose.

2. Working Principle of the Washery and Characteristics of the Particulate Matter Emitted

A general process flow diagram for upgrading inferior coking coal is shown in Figure 1. The major constituents of the particulate matter contain coal particles and fly ashes. The particulate matter also contains organic compounds which are benzene soluble, which may contain some aliphatic as well as some polynuclear aromatic hydrocarbons, most of which are carcinogenic. Particle size of SPM is an

TABLE I

Locations of ambient air-monitoring stations of coal washery under study

Station no.	Station site	Direction from plant building	Location
DA1	Coal washery	Centre	On the roof top of the manager's office which is about 5 m above the ground
DA2	Coal washery	NE	On the roof top of water filter plant which is about 10 m from the ground
DA3	Coal washery	NW	On the roof top of a the hospital which is 7 m above the ground level
BA1	Coal washery	Centre	On the roof top of the plant building which is about 5 m above ground level
BA2	Coal washery	NE	On the roof top of the CISF Camp which is about 10 m above ground level
BA3	Coal washery	NW	On the roof top of the hospital which is about 5 m above the ground level
PA1	Coal washery	Centre	On the roof top of canteen which is about 5 m above the ground
PA2	Coal washery	NE	On the roof top of the water filtration plant which is about 10 m above the ground level
PA3	Coal washery	SW	On the roof top of the hospital which is about 6 m above the ground level
BjA1	Coal washery	Centre	On the roof top of the plant building which is 7 m from ground level
BjA2	Coal washery	N	On the roof top of the shed near intake well which is about 5 m above the ground level
BjA3	Coal washery	S	On the roof top of the hospital which is about 5 m above the ground level

important aspect in the area. Hence not only the mass concentration but also the particle size distribution of SPM is an important factor in coal washeries.

3. Experimental

3.1. Selection of Air-Monitoring Stations

During the selection of air-monitoring stations, the approach was to place the stations in industrial, residential and sensitive areas like hospitals to discover the impact on air environment in various areas because different standards have been fixed for different areas. The locations of the ambient air-monitoring stations at the four washeries are given in Table I.

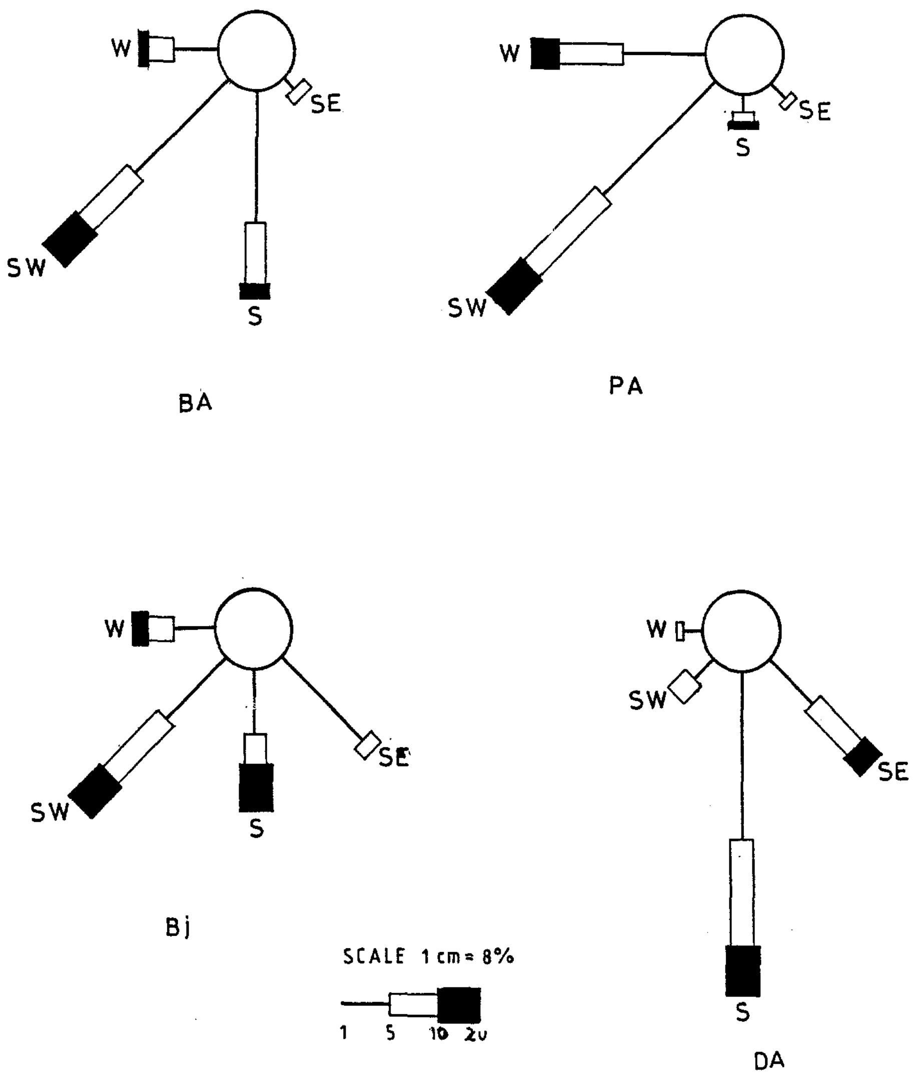

Fig. 2. Windrose diagram on monitoring days at different washeries.

3.2. Sampling and Analysis

Ambient air samples were collected in the pre-monsoon season. Samples were collected on an 8-hourly basis for 24 hours' duration in three shifts: day, evening and night. Micro-meteorological conditions were also recorded on monitoring days.

SPM was collected over GF/A Whatman filter paper by using a high volume air sampler at a flow rate of 1.0–1.5 m^3/min, SO_2 and NO_x were collected by bubling the air samples in a specific absorbing solution at an average flow rate of 0.5 l/min. The impinger samples were put in ice boxes immediately after sampling

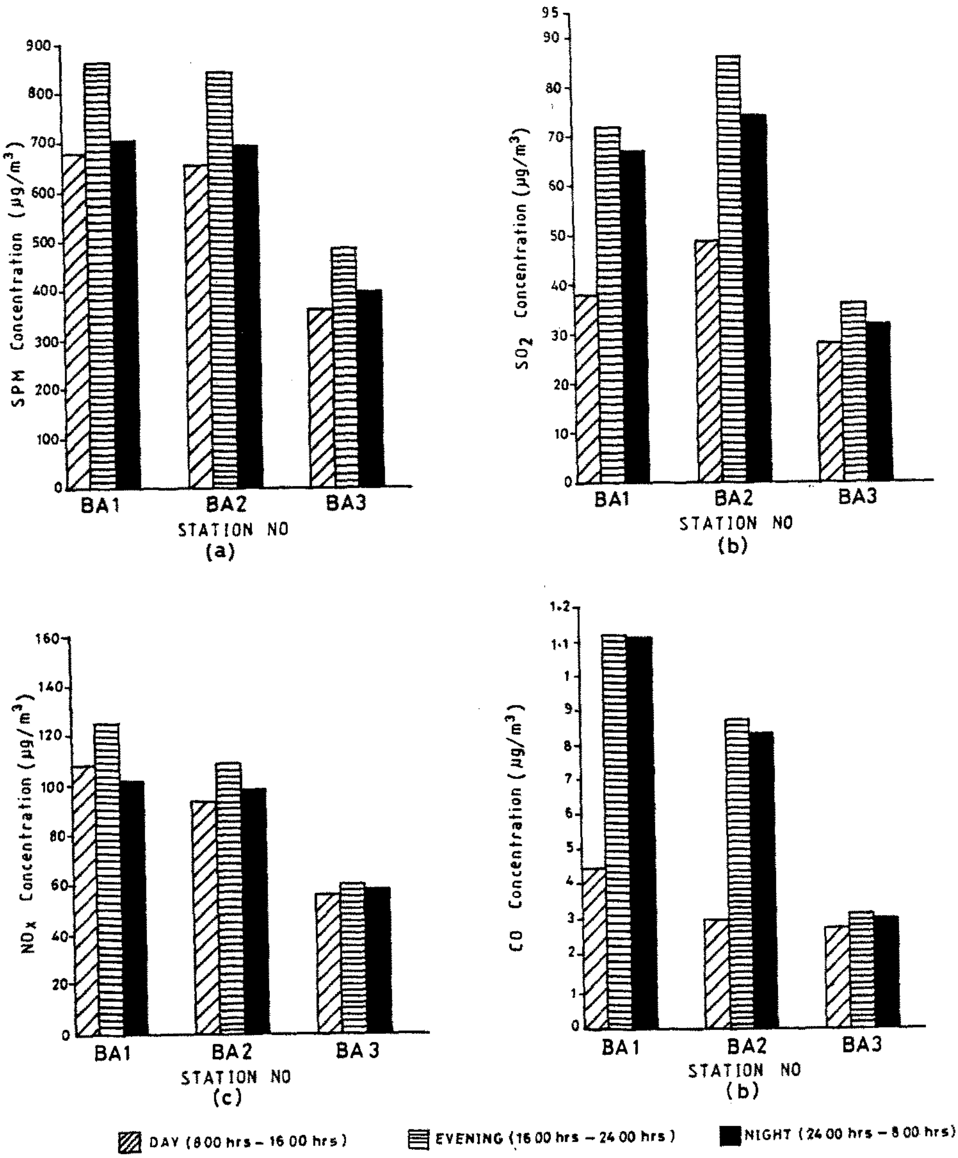

Fig. 3. Diurnal variation of (a) SPM; (b) SO_2; NO_x; (d)) CO in coal washery.

and transferred to a refrigerator until analysed. These were analysed spectrophotometrically using the West and Gake methods (APHA, 1977) and Jackob and Hochier modified methods for analysis of SO_2 and NO_x respectively. SPM was computed as per standard methods after weighing the filter paper before and after sampling in a Meltler AE/163 electronic balance. The concentration of carbon monoxide (Morris, 1960) (CO) was measured with an automatic CO-Monitoring instrument ('Environment S.A.' CO/11 M, France) which is based on the principle

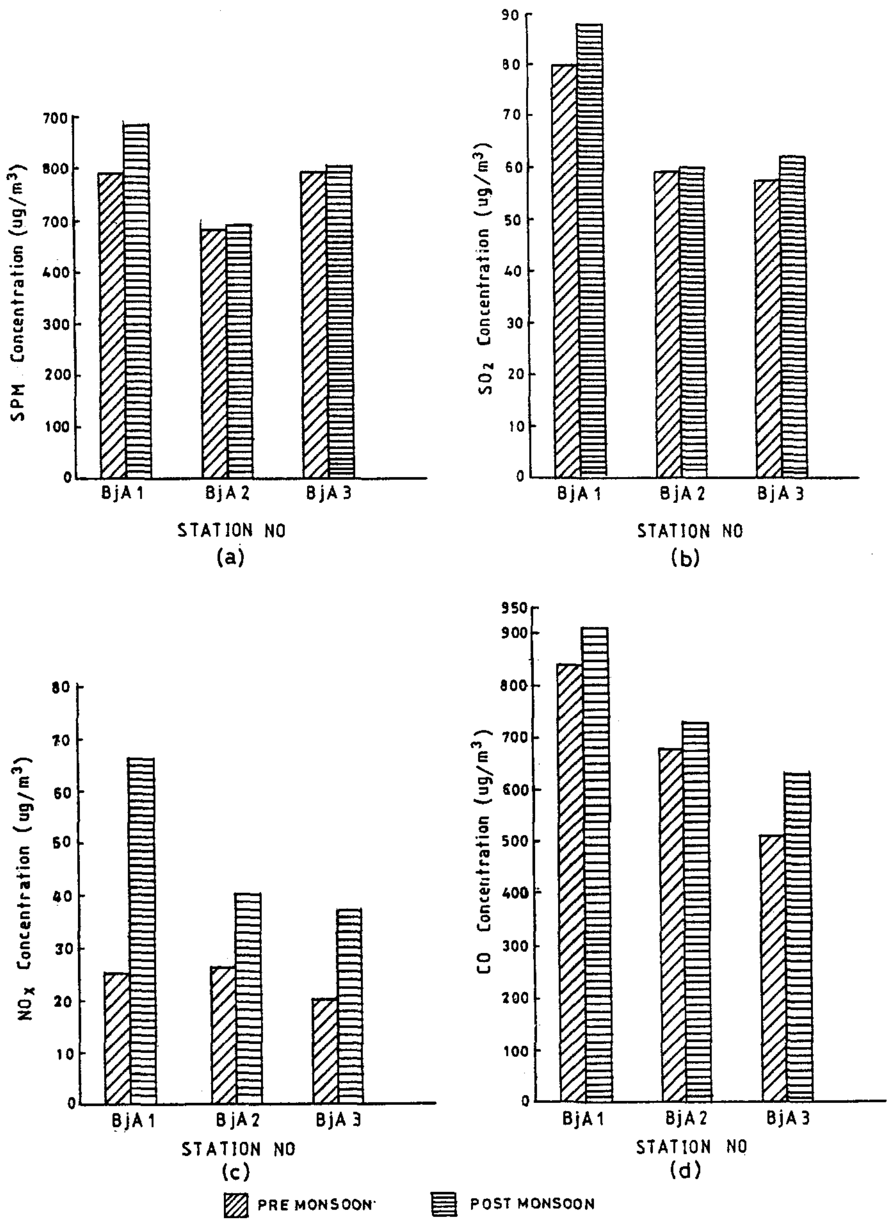

Fig. 4. Seasonal variation of (a) SPM; (d) SO; (c) NO; (d) CO in coal washery.

of 'Non-Dispersive Infrared Absorption' gas analysis. This instrument was used at different time intervals and the average mean value was indicated in the result.

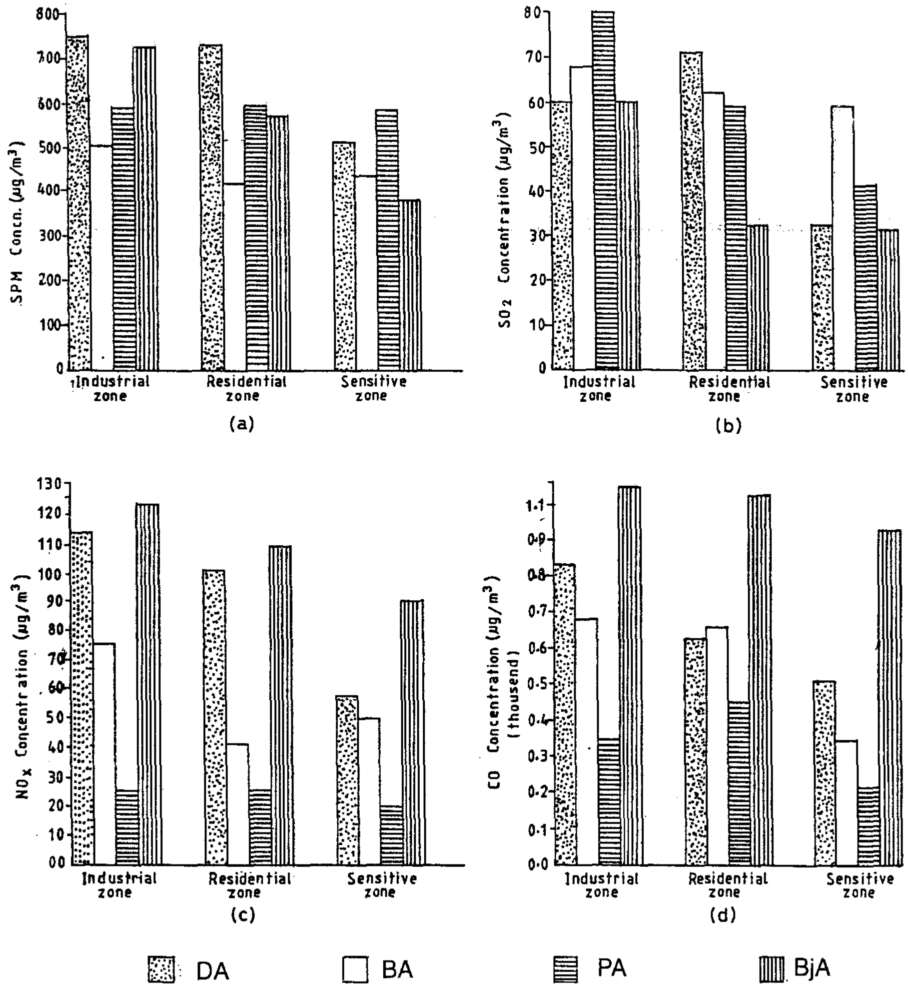

Fig. 5. Status of air pollution due to washery. (a) SPM; (b) SO_2; NO_x; (d) CO.

4. Results and Discussion

The analytical data revealed that at all the washery locations the concentration of the air pollutants in the night time were found to be higher than those of day-time value but lower than evening-time value. The lowest concentration during the day time could be attributable to non-operation of the washery during maintenance. The washery operation starts in the evening shift and continues up to the night shift. Suspended particulate matter in the industrial zone, domestic and hospital areas were found to exceed the limit specified by the Central Pollution Control Board. SO_2, and NO_x were also found to exceed the limit in the residential and hospital areas. However, CO concentrations were found to be within the permissible limit. SPM collected from the ambient air were subjected to particle size distribution

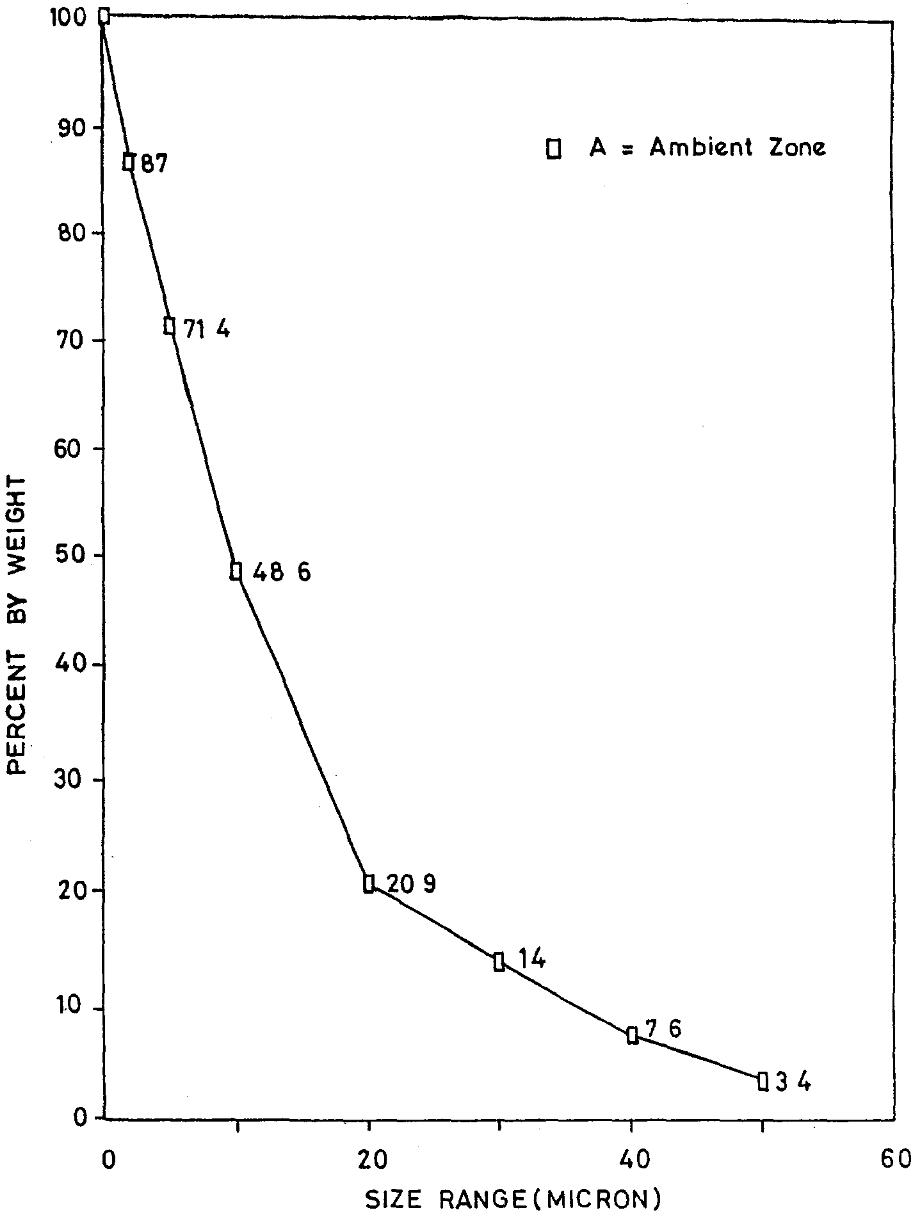

Fig. 6. Average particle size distribution of SPM.

analysis (Allin, 1968). It was observed that about 50% of the dust particles were found to be less than 10 μm in diameter. This indicated a higher percentage of respirable dust concentration in the area. The frequency distribution of particle size for ambient air showed that the median diameter of SPM was ca. 10 μm which indicated the fineness of the particles. This also indicated the health hazardness and suggests that due consideration has to be given for particle size distribution while adopting any control measures (Ghose, *et al.*, 1990). Benzenesoluble materials in the ambient air SPM ranged from 45–62%. This indicates a probable health hazard due to particulates emitted by washeries which are carcinogenic in nature.

5. Conclusions

The present study shows that coal washeries emit huge amounts of particulate matter into the atmosphere due to the various operations like tipping, crushing, screening, etc. A lot of dust is also generated due to the loading and unloading of the washed coal, middlings, rejects and vehicular movement along dusty roads. This study has identified that to control the main pollution problem in the washery areas due to dusting, dust control measures should be adopted to check this problem.

Acknowledgments

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