A REPORT ON SEASONAL VARIATION IN SPM, SO\textsubscript{x} AND NO\textsubscript{x} IN JHARIA COALFIELDS

MADHU JHA*, SANJOY MISRA\textsuperscript{1} AND S. K. BHARATI\textsuperscript{2}

Central Institute of Mining and Fuel Research, Ranchi Unit, Ranchi-834010, Jharkhand
\textsuperscript{1}Department of Chemistry, Ranchi University, Ranchi - 834 008, Jharkhand
\textsuperscript{2}Environmental Management Division, Central Institute of Mining and Fuel Research
Digwadih Campus, Dhanbad - 828 108, Jharkhand.
E-mail: madhu_jha2002@yahoo.com

ABSTRACT
Continuous air monitoring studies in and around Jharia coalfields were carried out to understand the seasonal variation of SPM, SO\textsubscript{x} and NO\textsubscript{x}. Five sampling sites were selected in and around Jharia coalfields. Annual average concentration of SPM varied from site to site. SO\textsubscript{x} and NO\textsubscript{x} also shows seasonal variations and their presence varied from site to site. It was found that annual average concentration of SPM varied from site to site, highest was at Jharia followed by GT Road, ISM Dhanbad, Sindri and CFRI campus respectively. The annual average SO\textsubscript{x} concentration was highest at Jharia site followed by CFRI campus, GT road, Sindri followed by ISM Dhanbad. The NO\textsubscript{x} annual average concentration was highest at GT Road followed by Jharia, Sindri, ISM Dhanbad and CFRI campus respectively. Air monitoring studies thus have manifold practical applications of varied significance in and around coalfields and coal-based industries.

INTRODUCTION
India ranks among the top 10 countries in its coal resources. The existing coal resources in the country are 70 billion tones and accounts for 5.7% of the proved resources of the coal in the world, which may ensure supply of coal for more than a century at the rate of 560Mt year (Mathur, 1996). India has already emerged as third largest coal producing country next to China and the USA in the world. Indian coal consumption is about 5.5% of the world. With the development in industrialization, the share of coal as a source of energy in the commercial sector went up to 66% in 1994-95 (Kumar, 1995).
Clean air is considered to be a basic requirement for human health and well-being. Airborne particulate matter (PM) has been a concern for at least the last century, initially as a nuisance dust and more recently as the effects resulting in acute mortality and morbidity. (McClellan et al., 1998)
The emphasis of large-scale mechanisation of surface mining has resulted in widespread concern about deterioration of environmental quality, especially the increase in concentration of suspended particulate matter (SPM) within and around the mining site. Vehicular traffic on the haul road of mechanised opencast mines has been identified as the most prolific source of fugitive dust emitted from the surface coal mines (Cowherd, 1979).
A study conducted by Chadwick et al., (1987) on surface coal mining estimated that about 50% of the total coal dust released during the journey time of a dumper on an unpaved haul road, while 25% for both during load- ing and unloading of dumper. Cowherd (1982) estimated that 0.02% of the coal is lost as fugitive dust during
Much research on the health effects of outdoor air pollution has been published in the last decade. Some studies have found increases in respiratory and cardiovascular problems at outdoor pollutant levels well below standards set by such agencies as the US EPA and WHO. Air pollution is associated with large increases in medical expenses, morbidity and is estimated to cause about 800,000 annual premature deaths worldwide (Cohen et al., 2005). Further research on the health effects of air pollution and air pollutant abatement methods should be very helpful to physicians, public health officials, industrialists, politicians and the general public.
The Jharia coalfield is subjected to intensive mining activities and accounts for 30% of the total coal production. Coal mining in Jharia coalfields and the sources of air pollution along with the production of air pollutants have been discussed in this paper.
Study Area
The Indian reserve of coking coal (CMRS, 1961) is mainly located in Jharia coalfield.
(Fig. 1) and it is the tremendously rapid rate, which subsequently poses most important of the Indian coalfields. This is situated in the Dhanbad district of Jharkhand, about 260 kms northing west of Calcutta, in the heart of Damodar Valley, mainly with respect to opencast coal mining. But due to various along the north of the river. The field is roughly elliptical, or sickle, shaped, its longer axis running northwest to southeast, covering an area of over 460km² and extending for a maximum of about 38 km east-west and 19 km north-south.

MATERIALS AND METHODS

Air quality parameters
In the present study the important air quality parameters like Suspended Particulate Matter, commonly termed as SPM and gaseous pollutants like Sulpher Dioxide and Nitrogen Dioxide are measured. Air sampling was done at different five selected sites.
1. CFRI Campus
2. Jharia coalfields-North Tisra
3. GT Road
4. ISM, Dhanbad
5. Sindri

Suspended Particulate Matter (SPM)
The sampling and analysis method of suspended particulate matter was as per Indian Standard Method for Measurement of Air Pollution; IS: 5182 (Part IV) 1973. The whatman glass fiber filter paper was used and whatman EPM-2000 for Respirable Particulate Matter was used as the filtering medium. For the collection of Suspended Particulate Matter, a High Volume Air Sampler (Envirotech APM-410) was used.

Sulphur Dioxide
The measurement of sulphur dioxide was made as per Indian Standard Method for Measurement of Air Pollution; IS: 5182 (Part II) 1969. (sodium tetrachloromercurate method).

Nitrogen Dioxides

The measurement of Nitrogen Oxide is made as per Indian Standard Method for Measurement of Air Pollution; IS: 5182 (Part VI) 1975.

Meteorological Parameters studied during the study:
Parameters like temperature, relative humidity, rainfall and wind speed were collected on daily basis. Data was collected from Indian School of Mining, (ISM) Dhanbad.

RESULTS AND DISCUSSION
Coal mining and coal based industries is one of the most important industries linked directly to the overall development of society and the country. It drastically disturbs the immediate physical, chemical and biological and socio-economical environment of the area, which includes disturbance of land, air pollution, noise pollution, water pollution and deterioration of nearby vegetation.
The fallouts from coal and coal processing industries (viz. Thermal Power Plants, Coke-oven Plants, Open-cast Mines, Ash Ponds) contaminate the immediate environment to a very large extent and have not yet been fully assessed for ecological consequences. The production, handling, storage and transport of coal related products carried out on land causing contamination of terrestrial eco-system are of special environmental concern.

The main air pollutants of interest and immediate human concern are those which when in higher concentration affects the health and well being of people are suspended particulate matter (SPM), respirable particulate matter (RSPM), sulphur dioxide (SOx), nitrogen oxides (NOx) and heavy metals in SPM. All these pollutants have strong dependence on meteorological parameters. The main atmospheric factors which determine the concentration and life span of pollutants in the atmosphere are relative humidity, temperature, wind speed, wind direction, solar flux or intensity, etc. Among these, temperature, relative humidity and rainfall have seasonal variations.

High humidity and frequent rainfall favours the particulate matter being wet to settle down easier. SOx and NOx being water-soluble get dissolved in the rainwater and washes away. Hence the concentration of these pollutants gases is found minimum in rainy season (Figs. 2 and 3). In contrary to this, in the winter season, relative humidity of the atmosphere minimum and the atmosphere is almost sluggish due to the stability of temperature; As a result, the distribution of pollutants in the winter is not so prominent.

From Figs. 1, 2 and 3 it is evident that in the winter season, relative humidity of atmosphere was less but atmosphere is almost cool and clean due to the stability of the temperature. Hence, the distribution of pollutants in winter is not as prominent as in summer.

The production, distribution and deposition of atmospheric pollutants are strongly dependent on the anthropogenic activities going in the particular area. Pollution generation is directly related with human activity. If the activity is considered uniform through the year, the seasonal variation of concentration of pollutants follows a pattern, summer season will have the maximum followed by winter and rainy season shows the minimum concentration of pollutants.

From the results (Fig. 1) obtained, it was found that annual average concentration of SPM varied from site to site, highest was at Jharia followed by GT Road, ISM Dhanbad, Sindri and CFRI campus respectively. Singh Gurdeep, et al., (2004) Studied the overall ambient status in the coalfield was found not satisfactory. In the indoor microenvironment, RSPM levels were found higher than expected. Concentration levels of trace elements in the particulates varied greatly. Geological rocks in the coalfield, coal burning, wear and tear of tyres and metallic parts of HEMM and other machines operating in the coalfield were found to contribute to air pollution.

Ghose Mrinal et al., (2004), also studied the status of air pollution due to OC mines. Four seasons monitoring data revealed that SPM, RPM, SOx and NOx concentrations at different locations (industrial, residential and sensitive exceeded the permissible limit. The study reveals that high coal production associated with heavy mechanization led to more air pollution problem in areas.

Reddy et al., (2003), investigated the ambient air quality with respect to suspended particulate matter (SPM), sulphur dioxide (SOx) and oxide of nitrogen (NOx) at four sites in the Raniganj-Asansol area in West Bengal, India. It has been observed that the concentrations of the pollutants are high in winter in comparison to the summer or the monsoon seasons. Results indicates that industrial activities, indiscriminate open air burning of coal by the local inhabitants for cooking as well as coking purposes, vehicular traffic, etc. are responsible for the high concentration of pollutants in this area.

It is revealed from Fig.6 that the annual average SOx...
concentration was highest at Jharia site followed by CFRI campus, GT road, Sindri and ISM Dhanbad respectively. Sulfur oxides (SO$_2$, SO$_3$), hydrogen sulfide (H$_2$S), acid gases (HF, HCl) Sulfur dioxide is produced by burning of coal, vehicle emissions and emissions from oil/gas fields and refineries (Godish, 2003). Hydrogen sulfide is produced by many industrial processes and by decomposition of oil or dead vegetation. Sulfur containing compounds like sulfur dioxide and mercaptans are produced in papermaking, rayon manufacturing, coke ovens, other industries and from volcanic emissions (Godish, 2003). Sriman et al., (2004) analyzed air quality in respect of sulphur dioxide and suspended particulate matter in the ambient air in the neighbourhood of Neyveli Thermal Power Corporation. The finding are in support of this work carried out.

Fig. 5 shows that the NOx annual average concentration was highest at GT Road followed by Jharia, Sindri, ISM Dhanbad and CFRI campus respectively. Das SK, Tripathy et al., (2003) studied the ambient air quality of Tantra-Raikela-Bandhal iron ore mines with respect to suspended particulate matter, sulphur dioxide (SO$_2$) and oxides of nitrogen (NOx) and their level of concentration in different seasons of the year. Though the concentration of SO$_2$ and NOx remained below the prescribed limits, it exceeded the limit at few places of the study area.

The rapid industrialization leading to urbanization, unplanned and excessive exploitation of natural resources have been causing pollution problems in cities and towns of developing countries. Man made and natural sources of emissions have polluted the air with toxic substances. The problem of air pollution is mainly affecting the urban environment all over the world. Emissions (Alam et al., 1999) may be categorized mainly as stationary and mobile sources which include all the activities in an urban environment. The ambient air quality is being monitored regularly in several cities and town throughout the world. The data on the air quality in and around Jharia coalfields will help taking appropriate step to control the increasing concentration of pollutants.

REFERENCES


APHA. 1977. Methods of Air Sampling and Analysis (2nd Edn.).


Indian Standard Method for Measurement of Air Pollution; IS: 5182 Part II 1969

Indian Standard Method for Measurement of Air Pollution; IS: 5182 Part IV 1973

Indian Standard Method for Measurement of Air Pollution; IS: 5182 Part VI 1975


