Biolife 1(4):189-194
AN INTERNATIONAL QUARTERLY JOURNAL OF BIOLOGY & LIFE SCIENCES
ISSN (online): 2320-4257
www.biolifejournals.com
BIOLIFE ORIGINAL ARTICLE

ASSESSMENT OF AMBIENT AIR QUALITY OF PURULIA TOWN, PURULIA DISTRICT, WEST BENGAL, INDIA

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ABSTRACT

This paper presents data on the concentration of air pollutants at different places of a newly developed industrial estate in a highly growing city of State of West Bengal, India. The ambient air quality assessment was carried out at four different locations with respect to SO_2, NO_x, Suspended Particulate Matter (SPM) and Respirable Suspended Particulate Matter (RSPM), and monthly air sampling was carried out for a period 24 hours (3 x 8 hours) at each of the site. It is revealed that even the average concentrations of SPM, NO_x, and SO_2 were in highest level in all sampling sites as observed during winter followed by summer and the rainy season. It is also observed that out of four sampling sites, concentration of all parameters was highest at Bongabari and the minimum value was at South Lake Road, during winter.

Key words: Air Quality, Monitoring, Air pollutants, RDS, SO_2, NO_x, SPM, RSPM.

INTRODUCTION

Starting from the Vedic times, it is a very well acknowledged fact that nature and mankind form an indivisible component of life support system, which has five elements air, water, land, flora and fauna. These are all interconnected and inter-dependent. Amongst all, air is the most essential component, without which the matter of survival does not arise beyond a few minutes. In normal, air contains about 78% nitrogen and 21% oxygen, the remaining 1% is made up of carbon dioxide and some other trace gases. Depending upon the meteorological, typographical and industrial performance of the areas under assessment many other compounds are also present in variable level than those particulars, in varying amounts and sizes, are present in air. Air pollution has acquired a great concern globally due to manifestation of technological and scientific innovations in various fields in addition to diverse activities of human beings for their sophistication. Air pollutants such as sulphur dioxide, nitrogen dioxide, carbon monoxide, unburned hydrocarbon, hydrogen fluoride and particulates appearing as a result of the burning of fossil fuels spread in the atmosphere and can affect the living being (Seinfeld, 1975; Gupta and Ghose, 1986; Oman and Dejonovi, 2001).

The respirable particles are liable for the Cardio-vascular as well as respiratory diseases (Sagai et al., 1996) of human being because these particles can penetrate deep into the respiratory system, and studies indicates that the smaller the particle, more severe the health impacts (Dockery et al., 1993; Pope et al., 1995; Schwartz et al., 1996). Ambient particulate matter may be carriers of acidic or toxic species (e.g., heavy metals, acids

and carcinogenic organic compounds) and may have negative effects on human health and ecosystems. Besides the effect of particulate matter, literature also suggests that there is a strong association between higher concentration of SO_2 and NOx and more than a few health effects (Curtis et al., 2006), like cardiovascular diseases (Zanobetti and Schwartz, 2002; Peters et al., 2004; Chen et al., 2005; Dockery et al., 2005) respiratory health effects such as asthma and bronchitis (Ye et al., 2001; Barnett et al., 2005) and reproductive and developmental effects such as amplified risk of preterm birth (Liu et al., 2003).

The unplanned growth, development and vehicular boom have deteriorated the ambient air quality. Vehicular emission is responsible for higher level of air pollutants like SPM, RSPM, SO_2, NOx and other organic and inorganic pollutants including trace metals and their adverse effects on human and environmental health (Caselles et al., 2002; Kaushik et al., 2006; Maitre et al., 2006 ; Curtis et al., 2006; Sharma et al., 2006; Jayaraman, 2007). Suspended particulate matter is really everywhere as urban air pollutants, is a complex mixture of small and large particles of varying origin and chemical composition. Motor vehicle has been regarded as the primary cause of air pollution in the urban areas and account for 60 to 70% of the pollution found in the urban environment (Lagerwerf, 1972; Panday *et al*., 1988; Singh *et al.*, 1995).

Purulia, also known as "Manbhum City", is a city located in West Bengal state, India, and was constituted in 1876. It is located on the north of the Kasai River and is a major road and railway junction. It has an area of 6,259 km^2. Purulia lies between 22.60 degrees and 23.50 degrees north latitudes and 85.75 degrees and 86.65 degrees east longitudes. Compass Declination 0º22'W. This district is bordered on the east by Bankura, Paschim Medinipur districts, on the north by Bardhaman district of West Bengal state and Dhanbad district of Jharkhand state, on the west by Bokaro and Ranchi districts of Jharkhand state and on the south by West Singhbhum and East Singhbhum districts of Jharkhand state.

MATERIALS AND METHODS

This research work was carried out during 2012 – 2013 (Monsoon, Winter, Summer), and the concentrations of different air pollution viz., NO_x, SO_2, SPM and RSPM were monitored in the ambient air at four different locations with the help of RDS or Respirable Dust Sampler (ENVIROTECH APM 460) by sucking approximately 2,000m^3 of air (Anandhan *et al*., 2000) into appropriate reagent for 24 hrs. The apparatus was kept at a height of 2m from the surface of the ground. Once the sampling was over, the samples were brought to the laboratory and concentration of different pollutants was determined. The concentration of NO_2 was measured with the Griess – Saltzman method [Ambient nitrogen dioxide is collected by bubbling air through a solution of sodium hydroxide and sodium arsenite.

The concentration of nitric ion produced during sampling is determined colorimetrically by reacting the nitrite ion with phosphoric acid, Sulphanilamide and N (1naphythyl) ethylenediamine dihydrochloride (NEDA) and measuring the absorbance at 540 nm]. SO_2 was measured by modified West and Geake method [Sulphur dioxide from air is absorbed in solution of potassium tetrachloromercurate (TCM). A dichlorosulphitomercurate complex, which resists oxidation by the oxygen in the air, is formed. Once formed, this complex is stable to strong oxidation such as ozone and oxides of nitrogen and, therefore, the absorber solution may be stored for some time prior to analysis. The complex is made to react with pararosaniline and formaldehyde to form the intensely colored pararosaniline methylsulphonic acid. The absorbance of the solution is measured by means of a suitable spectrophotometer at 560 nm].

The concentration of SPM and RSPM were determined using filter paper methods by passing air at high flow rate through a high efficiency

Table 1: Particulate air pollutants observed (Mean value) from study sites during the study period

Area	SPM (in μg / m^3)				RSPM (in μg / m^3)			
	Monsoon	Winter	Summer	Yearly Average	Monsoon	Winter	Summer	Yearly Average
Ketka	202.68	243.24	228.37	224.76	106.42	118.84	112.56	118.27
Indraprastha Colony	223.61	249.32	236.20	236.38	104.58	116.24	103.74	108.19
Bongabari	372.95	392.43	384.18	383.19	111.24	126.68	118.48	118.8
South Lake Road	106.60	118.53	113.41	112.85	76.16	83.28	79.12	79.52

Table 2: Gaseous air pollutants observed (Mean value) from study sites during the study period.

Area	NO_2 (in μg / m^3)				SO_2 (in μg / m^3)			
	Monsoon	Winter	Summer	Yearly Average	Monsoon	Winter	Summer	Yearly Average
Ketka	82.53	86.89	89.39	86.27	89.21	96.78	91.58	92.52
Indraprastha Colony	86.37	95.89	88.21	90.16	84.59	99.24	86.34	90.06
Bongabari	103.46	118.01	112.59	111.35	107.27	118.54	114.86	113.56
South Lake Road	53.69	68.43	59.07	60.40	46.28	58.16	49.83	51.42

filter paper which retains the particles. The instrument measures the volume of air samples while the amount of particulate pollutants determined by measuring the change in weight of the filter paper as a consequence of sampling. The sampling sites (Four) have been chosen on the basis of categories prescribed by State Pollution Control Board, West Bengal. They are Ketka and Indraprastha Colony (Residential beside Highway, Category "B" type respectively as per SPCB recommendation.), Bongabari (lying under Category "A", i.e., Industrial and mixed areas as per SPCB recommendation), South Lake Road (Sensitive Area).

RESULTS AND DISCUSSIONS

Ketka and Indraprastha Colony are basically residential areas; here SPM, RSPM, SO_2, and NOx concentrations exceeded the Standard value. South Lake Road, sensitive (near Nurshing home, Hospital) zone shows the same fashion. In Bongabari which is industrial area, the concentration of SPM, RSPM (Table-1), SO_2, and NOx (Table-2) fall within the National Ambient Air Quality Standard. During the monsoon SPM concentration were found to be the lowest due to washing by rain water but in some places it exceeds the permissible limits as

recommended by WBSPCB. The maximum value of all parameters was observed during winter seasons at Bongabari, and lowest value was detected at South Lake Road. In this study it was also observed that concentrations of SPM, RSPM (Fig-1), SO_2, and NOx (Fig-2) of all monitoring sites have a maximum value during winter followed by summer and rainy. Actually, in winter, anti-cyclonic conditions prevailed, which was characterised by calm or light winds and restricted mixing depth due to a stable or inversion atmospheric lapse rate, resulting in little dispersion or dilution of pollutants, which, in its turn, helped in the build-up of pollution concentrations to the higher levels. The concentrations of particulate matter at most of the monitoring stations were reached maximum during winter as also studied in Lb Valley area by Chaulya (2004).

Figure-1. Particulate air pollutants observed (Mean value) from study sites during the study period

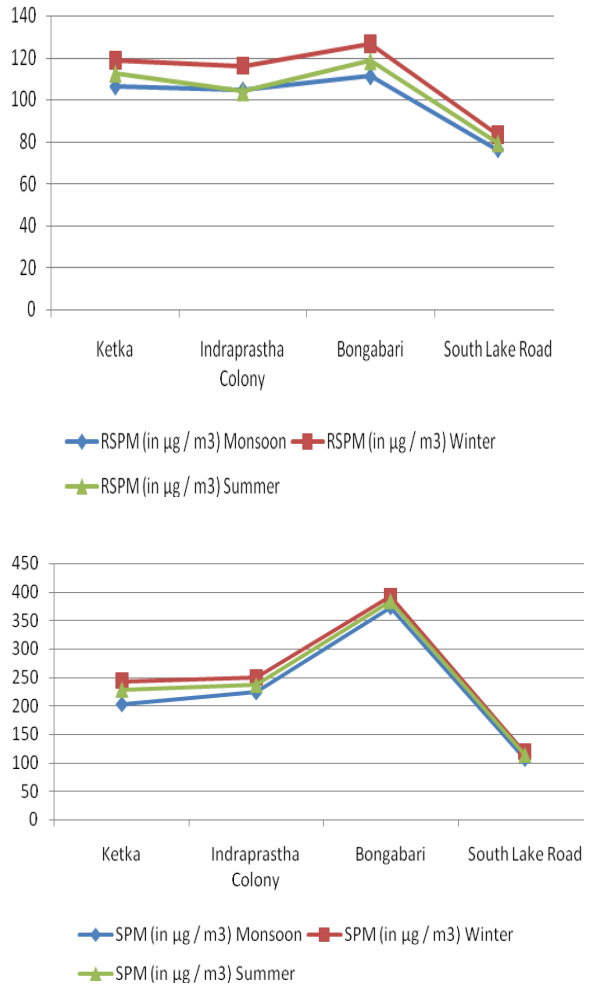
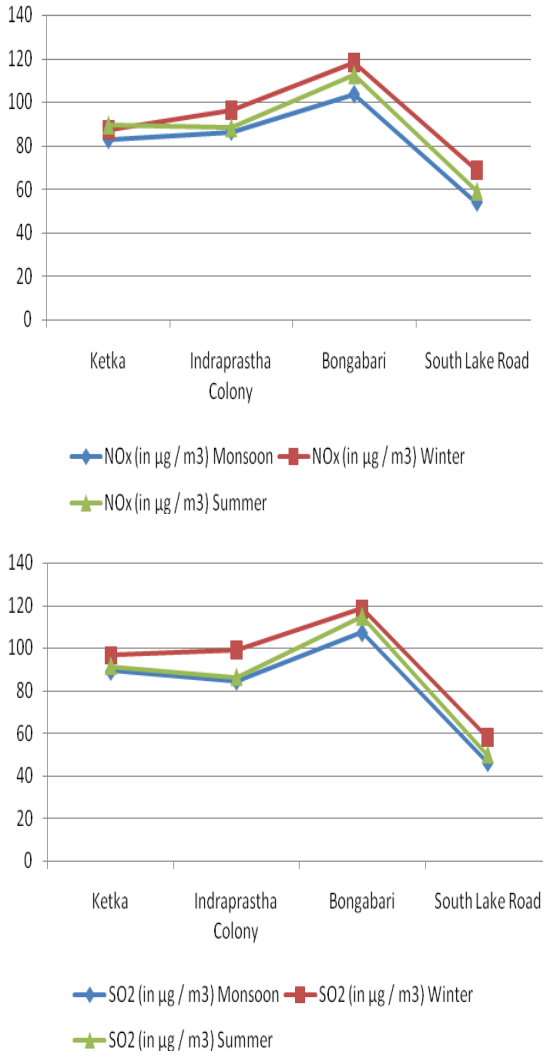


Figure-2 Gaseous air pollutants observed (Mean value) from study sites during the study period



CONCLUSIONS

From this study it may be concluded that the concentration of SO_2, NOx, SPM, and RSPM of all areas are beyond the National Ambient Air Quality Standard, Since, residential areas have higher concentration of air pollutants, so as remedial measures, plantation should be adopted. The present study revealed that the yearly average exceeded the permissible limits recommended for all zones in all three seasons.

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DOI: https://dx.doi.org/10.5281/zenodo.7193304
Received: 14 October 2013;
Accepted; 28 November 2013;
Available online : 5 December 2013