

Studies of air pollution in Bokaro Steel City, Jharkhand

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Abstract : Air pollution is a serious problem these days and it is increasing rapidly globally day-by-day due to industrialization, population growth, increase in number of vehicles, use of fossil fuels, bad transportation systems, poor land pattern and overall ineffective environmental regulations. Sulphur dioxide, nitrogen dioxide and particulate matter are some of the common pollutants which are contributing to environmental pollution. In this paper, the ambient air quality of B.S. City has been analysed and it has been compared with Indian National Ambient Air Quality Standards (NAAQS). The seasonal variation in concentration of air pollutants has also been analysed.

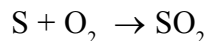
(Keywords : SO₂, NO₂, Particulate matter)

Introduction

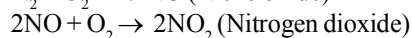
Air Pollution is one of the serious problems in the world especially in industry-based cities of the world. The main reason of this is due to industrialization, rapid growth of population and increase in number of vehicles. Motor vehicles have been regarded as the primary cause of air pollution in industrial based cities. An average account for 60% to 70% of the environmental pollution found in industry-based city is due to vehicles. SO₂, NO₂ and suspended particulate matter (SPM) and respirable suspended particulate matter (RSPM) are major air pollutants which are considered to affect life of the concerned city. The studies on air pollution in various cities of India showed that ambient air pollution concentrations are at such levels where serious health issues could be possible. Continuous rise of population along with the lack of suitable measures for air pollution control means that there is a great possibility that the conditions may

worsen in future. These all pollutants may pose harmful effects on human health such as cardiovascular and respiratory disorders, neurological impairments as well as increased risk of preterm maternity delivery issues¹. Even mortality and morbidity get affected due to air pollution². Various studies conducted in India at various locations suggest that pollution levels vary significantly in different areas with respect to its location, time, period of sampling and climatic conditions.

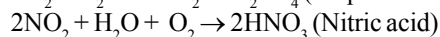
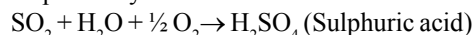
Sulphur dioxide (SO₂) is produced mainly by the combustion of coal³.



Nitrogen dioxide is emitted to the atmosphere mainly by automobile engines³⁻⁵.



Sulphur dioxide and nitrogen dioxide dissolve in rain water producing sulphuric acid and nitric acid respectively^{7,8}.



It makes rain water highly acidic. The particulate matter is the sum of solid and liquid particles in the air. This complex mixture contains organic and inorganic particles such as dust, pollen, soot, smoke and liquid droplets. Many of these are harmful and cause serious health issues. These particles vary greatly in size, composition and origin. The particulate matter may come in the atmosphere from naked soil, factories, plants, etc. The particulate matter is classified mainly into two categories on the basis of size- PM_{2.5} and

PM₁₀, PM_{2.5} are very small particles and these are found generally in smoke. They have a diameter of 2.5 micrometre (μm) or even smaller which is about 3% of the diameter of human hair (50-70 μm). They cannot be seen even by ordinary microscope. Exposure to PM_{2.5} over a few hours to weeks can trigger cardiovascular disease-related mortality and nonfatal events; longer-term exposure increases the risk for cardiovascular mortality to an even greater extent than exposures over a few days and reduces life expectancy within more highly exposed segments of the population by several months to a few years. PM₁₀ are small particles with diameter of 10 micrometre (μm). These are small enough to get into our throat and lungs. High levels of PM₁₀ can cause nose run, cough and eyes stings.

In this research paper, the level of SO₂, NO₂ and particulate matter in the atmosphere will be analysed at eight different places of Bokaro Steel city and their season variation will be discussed.

Bokaro Steel City is basically an industrial based city which could be considered as industrial belt as many small-scale industries are running successfully in the vicinity of Bokaro Steel City. This resulted in additional air pollution in B.S.City.

Materials and methods

This article is about primary and secondary particulates with respect to their size distribution, origin and chemical composition. Primary particulates are particles that are injected directly into the atmosphere. Usually their sizes are within the range 1 to 20 μm . Common sources are wind, lawn soil, industrial emissions and combustion systems. e.g. dust, fly ash, pollen, soot. Secondary particulates are relatively small; their size range is 0.01 to 1.0 μm . They can be classified as sulphates, nitrates or hydrocarbons. Secondary particulates are formed as a result of atmospheric reactions involving gaseous species such as SO₂, NO₂, NH₃, and hydrocarbons.

Particulates can be defined as dispersed matter that exists in the condensed phase i.e. either solid or liquid state in which the individual units have sizes that range from 0.005 μm to about 500 μm . These particulates are produced as direct result of the chemical and physical processes particular to emission source.

Since Bokaro Steel City is an industrial city. There are big chances of pollution in air. But there are only traces or within the specified norms by CPCB, NAAQS and JPCB. To assess these norms, sampling has been done in the Sector -9 at a fixed regular interval. Data has been taken by setting machine i.e. "Respirable dust sampler" of Lata Envirotech Services APM 860 at Sector 9 (23.7015°N, 86.11117°E) of B. S. City of Jharkhand state of India which is a densely populated and highly active zone.



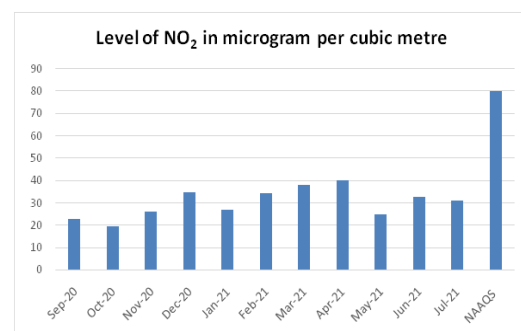
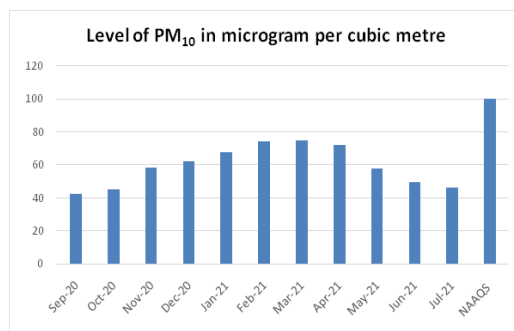
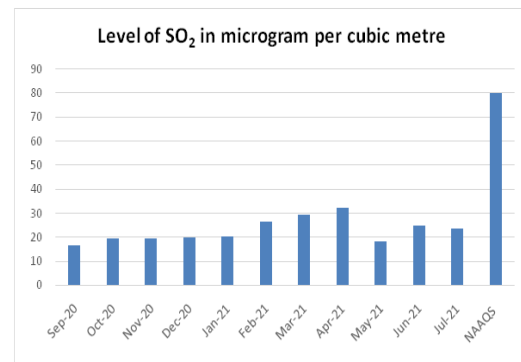
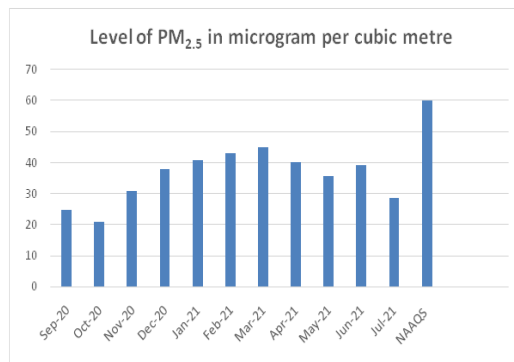
Results and Discussion

The data for SO₂, NO₂, PM_{2.5} and PM₁₀ levels at above mentioned place have been collected monthly average wise from September 2020 to July 2021 and these are summarised in table given table 1.

Table-1
PM_{2.5}, PM₁₀, SO₂ & NO₂ levels in City Centre, Sector-4, of B. S. City from Sept.2020 to July 2021

Month & Year	PM _{2.5}	PM ₁₀	SO ₂	NO ₂
September 2020	24.6	42.4	16.4	22.6
October 2020	20.8	45.2	19.2	19.6
November 2020	30.77	58.43	19.3	26.2
December 2020	37.77	62.11	19.9	34.5
January 2021	40.82	67.52	20.1	26.9
February 2021	43.17	74.08	26.4	34.2
March 2021	45.08	75.13	29.2	38.16
April 2021	40.25	72.09	32.0	40.25
May 2021	35.67	58.04	18.0	24.7
June 2021	39.24	49.5	24.8	32.7
July 2021	28.72	46.18	23.6	31.1
NAAQS (in $\mu\text{g m}^{-3}$)	60	100	80	80

These experimental data are represented in the form of bar graph below:



The following facts are noteworthy from the above experimental data:

1. The level of particulate matter $PM_{2.5}$ and PM_{10} is the highest in the month of March.
2. The levels of SO_2 and NO_2 are at the highest point in the month of April.
3. The level of $PM_{2.5}$ is the lowest in the month of October while that of PM_{10} is the lowest in the month of September.
4. The level of SO_2 is the lowest in the month of September while that of NO_2 is the lowest in the month of October.
5. The levels of air pollutants under consideration viz. particulate matter, SO_2 and NO_2 in Sector-9 of B.S. City, Bokaro are well below the Indian National Ambient Air Quality Standards (NAAQS) which are given in the bottom of the table and on the right-hand side of bar graphs.

These experimental findings can be explained by saying that the particulate matter, SO_2 and NO_2 precipitate along with rain and, therefore, their

concentration in the atmosphere is lower after the end of rainy season. On the other hand, during the start of summer season, the concentration of air pollutants in the atmosphere increases.

Although, the levels of air pollutants under consideration viz. particulate matter, SO_2 and NO_2 in Sector-9 of B.S. City, Bokaro are well below the Indian National Ambient Air Quality Standards (NAAQS), there is a great need to control air pollution as it is impacting the environment and human health seriously. The concentration of air pollutants like have to be controlled to save environment. To control air pollution proper rules and regulations should be implemented by the Government. As well as awareness among the people, control the growth of population, number of vehicles, industries and energy consumption. We need to take pollution issue seriously because ignorance is certainly not the proper way to go. The stakes are really high and world needs to wake up and start acting right now because environmental issues are constantly growing in number and size.

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