Variation of Air Pollutants In Industrial Area of Nagpur City, India

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Abstract- *Nagpur holds the distinction of being the geographical center of the Indian peninsula. Nagpur lies on the Deccan plateau at an altitude of 310m above sea level and is the 3rd largest city and a major commercial and political centre of the state of Maharashtra. It is also the seat of the annual winter session of the Maharashtra state assembly. Agriculture (in particular oranges and ayurvedic medicine processing) forms a large share of its economy. Other sectors include information technology, manufacturing, transport systems, mining and power generation.*

Large-scale industrialization, population inflow, and rapid urbanization coupled with unfavorable meteorological conditions often induce significant degradation of urban environment. In order to assess the extent of environmental impacts due to establishment of the industries in Nagpur City, ambient air was monitored from September 2010 to February 2011. Collected baseline information was normalized and interpreted with respect to air. Among the pre identified air pollutants, suspended particulate matter was found to be the principal culprit to deteriorate ambient air quality, with a maximum annual concentration of 270µg/m3 . Monthly average concentrations of respirable particulate matter (aerodynamic diameter < 10 µm) also persist at a critical level with an annual maximum of 150 µg/m3 .Monthly variation of air pollution parameters which indicates a mild control over few pollutants throughout the study period with rising in quality of analytical sampling and analysis. The result had been found to be effectively below the Central Pollution Control Board (CPCB) standards.The document presents a review CONTRIBUTION AND VARIATION OF AIR POLLUTANTS IN INDUSTRIAL AREA OF NAGPUR CITY, INDIA.

Keywords- Air Pollution, Pollutants, Particulate Matter, Industrial Area, Sampling, SOX, NOX

I. INTRODUCTION

The natural composition of the atmosphere has been gradually changing over the past few years, due to ever increasing anthropogenic activities, such as burning of fossil fuels like crude oil, coal, natural gas for ever growing industrial and transport sectors, resulting in Air pollution. As per the Air (Prevention and Control of Pollution) Act, 1981 "Air Pollution" is the presence of air pollutants in the atmosphere5 . Air pollutants can be defined as any solid, liquid or gaseous substance (including noise) present in the atmosphere in a concentration which may tend to be injurious to human beings, plants, property, environment or other living creatures. As per the report of State of Global Air 2019, published by the Health Effects Institute (HEI), India witnessed around 1.2 million deaths due to exposure to outdoor and indoor air pollution6 . Also, according to a report published by the World Health Organization (WHO) in 2016, 14 Indian cities have been included among the 20 most polluted cities in the world in case of PM2.5 levels, while 13 Indian cities were listed among the most polluted in case of PM10 levels7.

Phenomenal growths in population, use of energy, economic transformation, rapid urbanization and industrialization have made enormous complications upon the habitability on earth. To assess the extent of environmental impacts in any locality or regions, researchers have developed various environmental tools.

Nagpur is a city, located at the heart place of India, hosting various ancient, historical as well as beautiful places and spots that greatly enjoyed by the tourists. Nagpur is now a fast growing centre for business & industries. Continuous technological advancement leads to generation of huge amount of baseline data related to ambient air and water quality, but these may not provide a clear picture of the surrounding environment (Sharma et al, 2003).

In fact, decision makers and the general public need information in a simple and understandable format regarding the levels and potential health risks associated with pollution. Moreover, inefficiency of the raw data to provide sufficient information often results in lowering of public interests regarding environmental friendly practices.

Furthermore, the success of commitment of a nation to improve environmental quality depends exclusively on the obligation of the citizens who should be well informed about

the current status of the environment. Therefore the prime importance should be to provide adequate information in a simple format. The CPCB, Delhi has introduced several air quality standards and guidelines in order to regulate environmental quality.

Therefore, current approaches for evaluating environmental quality are based on the comparison of monitored values with the respective standards. However, it often becomes difficult to incorporate these standards into a reference scale (Ghosh, S. K et al, 1982). Moreover, by providing an upper threshold concentration value in the form of standards, environmental quality tends to get categorized either as good or bad, depending on whether the standards have been exceeded or not (Sahoo, B. N et al, 1981). Even the frequency with which concentrations of pollutants exceed the national standards is not found sufficient by the citizens to assess the actual environmental quality.

It is suggested that use of standards is only imperative in administrating or to enforce any desired policy, not to appraise environmental quality (Sharma, P. K et al, 1990). Therefore, in this experiment, an attempt has been made to evaluate the status of ambient air with the impacts of air pollutants in industrial and rapid urbanization on the adjacent environment of Nagpur, Maharashtra, India.

1.1 Effects of Air pollutants :

Air toxins may cause a broad range of health effects depending on the specific pollutant, the method and duration of exposure. People who inhale high levels of certain air toxins may experience eye, nose and throat irritation, and difficulty in breathing. Long term exposure to these air toxins can cause cancer and long-term damage to the immune, neurological, reproductive, and respiratory systems. Some toxic air pollutants accumulate in the food chain after getting deposited in soil and surface water and even contribute to ozone and particle pollution with associated environmental and climatic effects 9 . Wildlife and livestock may also be harmed with prolonged exposure. In order to monitor the air quality, a network of Air monitoring stations have been established across the state, with several situated in every region. These stations monitor the criteria pollutants like – Sulphur Dioxide, Oxides of nitrogen, Carbon monoxide, Particulate matter and secondary pollutants like Ozone and so on. The data from these monitoring stations is then used to calculate the Air Quality Index (AQI). AQI is a common and convenient way to represent the air quality status and present the same for public consumption by government agencies, in both developed and developing countries.AQI is constructed in order to match the air quality standards of the country where it is used.

II. STUDY AREA

Hingna Industrial Area established in 1962, it is located 7 Km. from Nagpur city. In this Industrial area, several engineering Industries, Electrical based Industries, food based industries were located. The Nagpur industries have played a major role in providing economic stability to the city of Nagpur. As a matter of fact, the government had decided to put a huge sum of money estimated to be around 5000 crores into the development and growth of the industrial infrastructure of Nagpur. To make this Industrial Estate a Model one, the Maharashtra Industrial Development Corporation (MIDC) has also identified Residential and Commercial Zones, with their attendant facilities within the Industrial Area, to take care of the Workers and the Executives' housing needs, as transit accommodations, dormitories and residential quarters have already been constructed by MIDC for use of the industry. Additionally the City and Industrial Development Corporation of Maharashtra (CIDCO) too has started its housing scheme in the area.

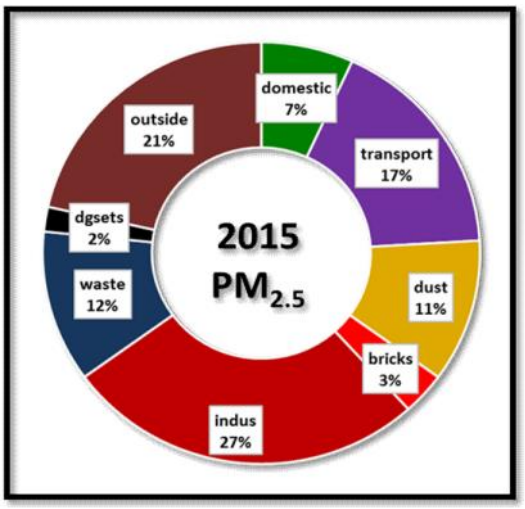
III. DISCUSSION & RESULTS

3.1 Behavior of Air Pollutants in Nagpur:

Air pollutants show short term, seasonal and long term variations. Atmospheric conditions determine the fate of the air pollutants after their release into the atmosphere. The mean transport wind velocity, turbulence and mass diffusion are the three important and dominant mechanisms in the air pollutant dispersal. Meteorology plays a major role in study of air pollution. The wind speed and direction play a major role in dispersion of air pollutants. The wind direction is the measurement of direction from which the wind is blowing, measured in points of compass viz. North, South, East, and West or in Azimuth degrees (0-360). Wind direction has an important role in distributing and dispersing pollutants from stationary and mobile sources in horizontally long downwind areas. The effect of wind speed on air pollution is two-fold. It determines the travel time from a source to a given receptor while on the other causes dilution of pollutants in downwind direction. The frequency distribution of wind speed and direction varies considerably during the study period as compared to other seasons and atmospheric dispersion is typically at a minimum and therefore the pollutants will not be as widely dispersed.

During the summer months, the average mixing height is typically at its greatest resulting in increased mixing

through a greater volume of the troposphere, and hence lower pollutant concentrations. The monsoons results in large amount of precipitation, high wind velocities and changes in general wind direction. The large amounts of precipitation reduce atmospheric pollution via associated wet deposition processes. Further higher wind velocities allow for pollutant transport away from sources, increase mixing processes and the winds coming from the environment have less background concentrations than that of continental air masses.



(Fig 1: Nagpur City, $PM_{2.5}$)

3.2 Major manmade sources of Particulate Matter are:

- Emission from coal based power station
- Emission from oil fired furnace/boiler
- Emission from stone crusher, hot mix plants, lime kilns, foundry
- Hospital waste incinerator
- Emission from stationery DG sets/portable DG sets
- Emission from diesel vehicles (bus, trucks, locomotives)
- Emission from 2- stroke vehicles (2T oil used)
- Re suspension of road dust
- Burning of biomass/ tire, tube
- Emission from waste oil reprocessing industries

Particulate matter has been implicated in various respiratory, cardiopulmonary diseases, and even cancer. Many Indian cities find place among the world's worst polluted cities. Rapidly growing Indian cities have high concentration of particulates which is attributed to automobiles, industries, biomass burning, and resuspension of road dust. In most cases, this concentration even exceeds the permissible limits set up by the regulatory agencies. High particulate concentration would make particularly the urban population vulnerable to various forms of respiratory diseases.

3.3 METHODS AND MATERIALS:

The study was carried out during 2010 and 2011 on the gaseous pollutants and particulate pollutants concentration in the ambient air of Nagpur City, Maharashtra State, India. Ambient air monitoring for the analysis of PM10 and associated gaseous pollutants and particulate pollutants was carried out at Hingna Industrial Area in the Nagpur City.

The sampling station is situated within 10 km area around the centre of Nagpur City i.e. Zero milestone near Reserve Bank of India Square. Using high volume air sampler (Envirotech's APM 415, Envirotech instruments, Upkaran Pvt. Ltd., New Delhi), (Gadgil, A. S. et al, 2004) samples for 24 h were collected from sampling station. The sampling details and average flow rate were recorded and carefully maintained constant throughout the study. All the collected samples were packed in polyethylene covers and transported immediately to the laboratory and analysed for PM10 and heavy metals in PM10 using standard laboratory procedures (USEPA 1999b). SO2 NOX, NH3 and H2S were collected by bubbling the sample in a specific absorbing (sodium tetracholoromercurate for SO2, sodium hydroxide for NOX, Nesseler method for NH3) solution at an average flow rate of 0.2-0.5 min1.The impinger samples were put in ice boxes immediately after sampling and transferred to a refrigerator until analyzed. The concentration of NOX was measured with standard method of Modified Jacobs - Hochheiser method. SO2 was measured by Modified West and Geake method, PM2.5 and PM10 using filte paper methods.

The apparatus was kept at a height of 2 meters from the surface of the ground. However air pollutants data for site was collected from Andhra Pradesh Pollution Control Board, Hyderabad. The street level concentration of nitrogen dioxide and suspended particulate matter observed in Hong- Kong (C. Cowherd Jr et al 1980). A respirable dust sampler (RDS APM 460BL, Envirotech, New Delhi, India) was used to monitor SO2, NO2, suspended particulate matter (SPM), and respirable particulate matter (RPM; aerodynamic diameter < 10 μm). The RPM was measured by using Glass fibre filter paper (Whatman) of 8 × 10'' in size, while the non-RPM (nRPM, >10 μm) was measured by collecting the heavier particles in hopper attached at an outlet of cyclone.

The concentration of the SPM was computed by aggregating the concentration of the RPM with the nRPM (Sharma, P. K. et al, 1990). The filter paper was conditioned in a desicator for 24 h and weighed on a balance with the sensitivity of 0.001 g, both before and after air quality monitoring. The conditioned and weighed filter paper was placed in desiccator's and taken for monitoring to avoid any

possibilities of contamination and moisture absorption. The PM monitoring was performed at an average flow rate of 1 m3 /min. In order to maintain the specific flow rate, the manometer reading was taken 3 or 4 times in a day so that the flow rate variations were within 1–1.3 m3 /min. The average flow rate was finally considered for computing the total amount of air sampled. Air quality monitoring was done twice in a week continuously for 24 h. Adequate preventive measures were taken to avoid any sort of moisture absorption to the filter paper, and concentrations of the PM were calculated gravimetrically.

The Gaseous Sampler attached with a RDS was used to monitor the gaseous pollutants. For both SO2 and NO2, the monitoring was done at a constant flow rate of 1 liter per minute (lpm) by bubbling ambient air through the liquid absorbing medium. The improved West and Geake method with potassium- tetracholoromercurate as the absorbing medium was used to determine the ambient SO2 concentrations. However, for determination of NO2, the modified Jacob and Hocheiser method with a solution of sodium hydroxide and sodium arsenite was used. Gaseous pollutants present in the ambient air were absorbed in the respective absorbing medium and analyzed spectrophotometrically at 560, 540 425 and 650 nm for SO2, NO2, NH3 and H2S respectively.

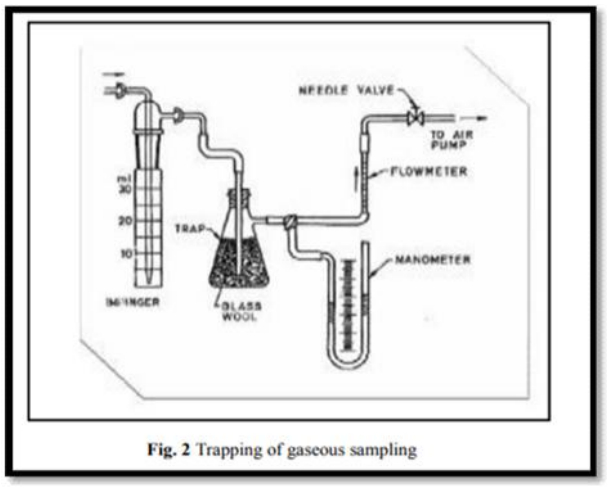


Fig. 2 Trapping of gaseous sampling

IV. CONCLUSION

The critical air pollutant will not necessarily be SPM; hence, information on other pollutants is also required for proper presentation of air quality through the AQI. The green Nagpur may not stay as green if the polluting sources are not controlled. Since the maximum ground level concentration of NO2 from the Industrial sources is found much closer to the Central Pollution Control Board (CPCB) standard limits.

Various measures are suggested to control air pollution from industries in Nagpur:

- Shifting of Industries from non- conforming zones.
- Switching over to clean technologies.
- Using clean fuels.
- Installation of Pollution control Devices.
- Development of green belt around the industries.
- Suggestions:
- Implementation of the emission norms as well as fuel quality in Accordance with the road map proposed by the Auto Fuel Policy.
- Switching over to clean alternate fuels like CNG, LPG & Bio-fuels. Augmentation in Public Transport system.
- Better traffic management Implementation of fiscal measures,

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