Ambient Air Quality Monitoring Study around the Industrial Areas of Aurangabad, Maharashtra, India.

Manik Vivek S[1] and Gudadhe Swapnil K[2]*

[1] Department of Environmental Science, Gramgeeta Mahavidyalaya, Chimur, Chandrapur, MS, India
[2]Department of Environmental Science, Arts, Commerce, Science College Tukum, Chandrapur, MS, India
Email: swapnil.k.gudadhe@gmail.com

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ABSTRACT

This work deals with the study of ambient air quality monitoring carried out during 2017-2018 for compliance parameters viz; Particulate Matter less than 10 microns and 2.5 microns size (i.e. PM_{10} and $PM_{2.5}$), Sulphur Dioxide (SO_2), Oxides of Nitrogen (NO_X), Ozone (O_3), Ammonia (NH_3), and Particulate associated pollutants such as Nickel (Ni), Lead (Pb) and Arsenic (As) at different industrial areas of Aurangabad City of Maharashtra state of India. The concentration levels of these parameters were compared with National Ambient Air Quality Standard (NAAQS), 2009. The results showed that the concentration levels of above pollutants at Railway Station MIDC, Shendra MIDC, Waluj MIDC and Chikalthana MIDC industrial zones were found to be within permissible limits, however is alarming stage health point of view.

Keywords: Ambient Air quality, Aurangabad City, Particulate Matter, Gaseous Pollutants, Heavy Metals, Human health.

INTRODUCTION

In the past recent years, the air that mankind breath is complex mixture of gases and small solid/liquid particles. The concept of Air Quality Index was introduced by the Environmental protection agency (EPA) in USA to measure the pollution levels due to major air pollutants [1,2].

Air pollution may have adverse impacts on human health [3-5] as well as the health of other living entities, man-made heritage and life support system.

Both National and State Pollution Control Authorities have taken up necessary regulatory steps and reduce ambient air pollution [6].Air pollution has three main sources from human activities; stationary mobile and indoor. Air pollution occurs when air contains the contaminated substance in quantities that could harm the comfort or health of human and animals, or could called air pollutant and can be either particles, liquids or gaseous in nature [7]. Air pollutants are classified as primary or secondary pollutants. Among the most common and poisonous air pollutants are sulphur dioxide (SO_2), formed when fossil fuels such as coal, gas and oil are used for power generation; suspended particulate matter (SPM), solid and liquid particles emitted from numerous man-made and natural sources such as industrial dust, volcanic eruptions and diesel-powered vehicles; and nitrogen oxides (NOx), from natural sources such as lightning, fires [8].

Particulate matter (PM) is the generic term used for a type of air pollutants, consisting of complex and varying mixtures of particles suspended in the breathing air, which vary in size and composition, and produced by a wide variety of natural and anthropogenic activities. Major sources of particulate pollution are industries, power plants, refuse incinerators, motor vehicles, construction activity, fires and natural windblown dust. For ambient air quality monitoring particle size with aerodynamic diameter smaller than 2.5mm ($PM_{2.5}$) and 10mm (PM_{10}) are taken into consideration [9]. Nitrogen dioxide and related nitrogen oxides (NOx) are produced when fuel is burned. These compounds contribute to ozone formation and creates health problem for the humans. Health effects include coughing, shortness of breath, and decreased lung function [10]. A Sulphur dioxide is a primary air pollutant, its source is human activities, and sometimes even natural events are responsible for it. As a result of chemical reaction of primary air pollutants, secondary air pollutants like sulphuric acid are produced in the atmosphere [11]. All these particulate matter and gaseous pollutant has adverse effect on environment and human health. Worldwide epidemiological studies show a consistent increase in cardiac and respiratory morbidity and mortality from exposure to particulate matter (PM) [12]. In December 1952, a dense smog containing Sulphur dioxide and smoke particulate descended upon London, resulting in more than 3,000 excess deaths oven 3 weeks and as many as 12,000 through February 1953 [13]. Children are particularly sensitive as their lungs as well as immune system are not completely developed when compared to adult one [14]. To prevent this staggering loss of life we must understand the characteristics of toxic particles and gain insight into how these characteristics are related to adverse health effect [15]
Aurangabad is developing city of Maharashtra state in India. Aurangabad city is surrounded by four industrial areas, many urban-residential areas are located close to industrial facilities which emit large amounts of toxic substances. Thus, people who live near these industrial areas may be exposed to the pollutants. Present paper deals with the study of ambient air quality in the industrial area.

METHODOLOGY

Study area:
Aurangabad is named after the Mughal Emperor Aurangzeb. The city is a tourism hub, surrounded by many historical monuments. Aurangabad is titled "The city of Gates" and was declared "Tourism Capital of Maharashtra". By population it is 5th largest city in Maharashtra after Mumbai, Pune, Nagpur and Nashik. The city is situated at a latitude of 19°53'59'' North and longitude 75°20'59'' East. Aurangabad's area is about 138 km^2. Annual mean temperatures in Aurangabad range from 17 to 33°C. Most of the rainfall occurs in the monsoon season from June to September. The relative humidity is extremely low in this region ranges between 35 to 50% [16]. Ambient Air Quality monitoring was carried out in 8 different locations from each industrials zones of Aurangabad viz. Shendra MIDC, Waluj MIDC, Railway Station MIDC and Chikalthana MIDC.

Experimental setup:
The sample collected for 24 hours. Whatman's filter papers are used for sampling of PM_{10} with Respirable Dust Sampler. For sampling of NO_x and SO_2 dust sampler is attached with gas analyzer.

Gaseous pollutants were done by wet analysis. SO_2 and NO_x and NH_3 were analyzed as per the improved West and Gaeke's method and Modified Jacob, Hochheiser (Na-Arsenite), Indophenol blue method respectively followed by spectophotometic analysis. Ozone was done by UV photometric method. (Guidelines for the Measurement of Ambient Air Pollutants).

The samples of PM_{10} and $PM_{2.5}$ were collected with an eight-stage cascade impactor during summer seasons (2017-2018). The cascade impactor system was placed on the roof of a local official building at a height of 9 m from ground. The Glass fiber filters for PM sampling were used to collect the particles. Filters were weighed before and after sampling using a micro analytical electronic balance. PM concentrations of each stage with different particle size ranges were calculated gravimetrically. Heavy metals such as Pb, Ni, As was done by digesting the samples with HNO_3 and after digestion samples were analyzed on AAS. All the methods for the analysis of and for monitoring were followed according to the CPCB manual for NAAQM [17].

Statistical method used:
Statistical analysis is an indispensable tool of research. Most of the advancements in knowledge has taken place because of experiments conducted with the help of statistical methods [18].

Standard deviation:
Standard deviation is the positive square root of the arithmetic mean of the squares of the deviations of the given observation from their arithmetic mean. It is the most important for statistical predictions for various results of research and widely used measure of dispersion. It serves as a basis for measuring the correlation coefficient and statistical influences. [19]

RESULTS AND DISCUSSION

***Particulate Matter in Ambient Air*:**
Particulate matter (PM) consists of many organic and inorganic compounds with a variety of size and component characteristics [20]. The average PM_{10} concentration at Railway Station MIDC, Shendra MIDC, Waluj MIDC and Chikalthana MIDC were found to be of 66±5 μg/m³, 76±3 μg/m³, 78±5 μg/m³ and 75±4 μg/m³ respectively. The average $PM_{2.5}$ concentration at above mentioned locations were found to be 42±2 μg/m³, 47±4 μg/m³, 53±3 μg/m³ and 48±3 μg/m³ respectively. The PM_{10} and $PM_{2.5}$ concentrations for all locations were observed to be below stipulated standards for NAAQS (Table 1) (24 hourly PM_{10}=100 μg/m³ and 24 hourly $PM_{2.5}$ =60 μg/m³) (Figure 1).

All these observed results were within the permissible limits among them Waluj MIDC was contains higher concentration of Particulate matter. These might be due to the higher vehicular activities and other anthropogenic activities.

Gaseous Pollutants:
The average concentration of SO_2 at Railway Station MIDC, Shendra MIDC, Waluj MIDC and Chikalthana MIDC were found to be 23±3 μg/m³, 26±5 μg/m³, 27±4 μg/m³ and 28±3 μg/m³ respectively, and the average concentration of NO_x were 32±2 μg/m³, 30±2 μg/m³, 30±4 μg/m³ and 31±3 μg/m³ respectively.

Table 1: Ambient Air Quality Status Average: 24 hr

Sr. No.	Sampling Location	Avg ± SD/ (min.-max.) μg/m³					
		PM_{10}	$PM_{2.5}$	SO_2	NO_x	NH_3	Ozone
1	Railway Station MIDC	66±5 (54-75)	42±2 (38-46)	23±3 (19-30)	32±2 (29-34)	25±3 (17-44)	19±5 (10-26)
2	Shendra MIDC	76±3 (72-81)	47±4 (46-51)	26±5 (10-30)	30±2 (26-38)	28±5 (18-47)	16±4 (10-29)
3	Waluj MIDC	78±5 (70-89)	53±3 (47-59)	27±4 (14-30)	30±4 (18-33)	52±4 (21-67)	21±4 (9-31)
4	Chikalthana MIDC	75±4 (70-79)	48±3 (46-50)	28±3 (15-31)	31±3 (27-32)	26±4 (14-48)	17±3 (12-24)
NAAQS (2009) 24 hr		**100**	**60**	**80**	**80**	**400**	**100**

Table 2: Levels of Particulate Associated Toxic Pollutants

Sr. No.	Sampling Location	Pb	As	Ni	CO
		$\mu g/m^3$	ng/m^3		ıg/m³
		Particulate Associated Pollutants			
1	Railway Station MIDC	0.18	BDL	1.59	0.35
2	Shendra MIDC	0.15	BDL	1.74	0.98
3	Waluj MIDC	0.18	BDL	1.6	0.89
4	Chikalthana MIDC	0.22	BDL	1.89	0.96
NAAQS (2009)		**1**	**6**	**20**	**4**

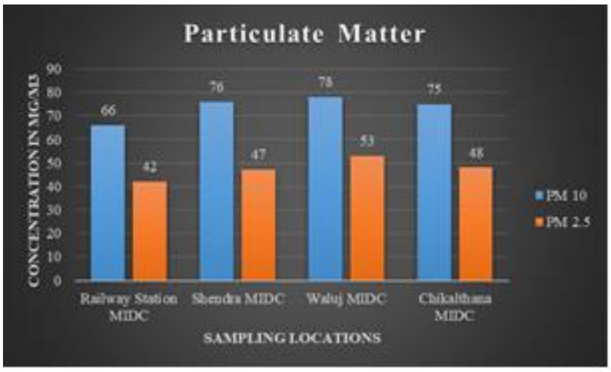

Figure 1: Particulate Matter at sampling location

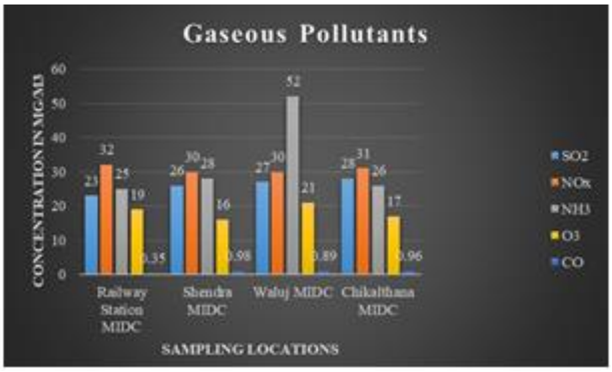

Figure 2: Levels of Gaseous Pollutants

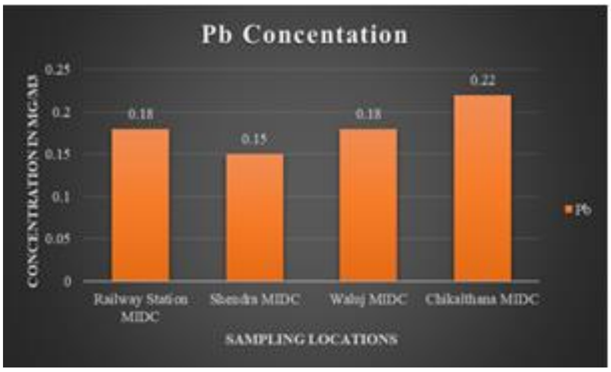

Figure 3: Pb concentration at sampling locations

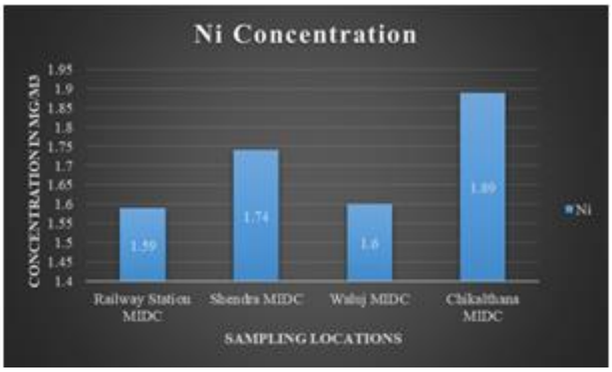

Figure 4: Ni concentration at sampling locations

The levels of gaseous pollutants were below the stipulated CPCB standards (24 hourly SO_2 is $80\mu g/m^3$ and for NOx is $80\mu g/m^3$) depicted in (Figure 2).

The average concentration of NH_3, at Railway Station MIDC, Shendra MIDC, Waluj MIDC and Chikalthana MIDC were found to be 25 ± 3 $\mu g/m^3$, 28 ± 3 $\mu g/m^3$, 52 ± 4 $\mu g/m^3$ and 26 ± 4 $\mu g/m^3$, while of O_3 were found to be 19 ± 5 $\mu g/m^3$, 16 ± 4 $\mu g/m^3$, 21 ± 4 $\mu g/m^3$ and 17 ± 3 $\mu g/m^3$ and of CO found to be 0.35 mg/m^3, 0.98 mg/m^3, 0.89 mg/m^3 and 0.96 mg/m^3 all these values are well within the stipulated standards ($400\mu g/m^3$, CO for 1 hour: 02 mg/m^3) the observed values at all the locations given in (Figure 2).

These results showed that levels of gaseous pollutants were slightly higher with the health point of view but were within the permissible limit of NAAQM standards. (Table 1)

***Particulate Associated Toxic Pollutants*:**

Heavy metals are known to be naturally occurring compounds, but due to anthropogenic activities introduce them in large quantities in different environmental components. The concentrations and size distributions of trace metals are governed by the nature of emissions to the atmosphere. The increase in heavy metal concentrations, can lead to a serious risk to human health. Lead (Pb), Nickel (Ni) and Arsenic (As) are metals found naturally in the environment as well as in manufactured products. It is observed that the average concentration of Pb were found to be 0.18 ug/m^3, 0.15 ug/m^3, 0.18 ug/m^3 and 0.22 ug/m^3 (Figure 3) and Ni were 1.5 ng/m^3, 1.74 ng/m^3, 1.60 ng/m^3 and 1.89 ng/m^3 (Figure 4) whereas arsenic was found below detectable limit. All these metals were within the permissible limits of NAAQ Standards (Pb: 1.0 ug/m^3; Ni: 20 ng/m^3; As: 06 ng/m^3) (Table 2).

CONCLUSION

The above results concluded that all the parameters of ambient air quality monitoring found to be within the permissible limits of NAAQ standards but due to continual industrialization, urbanization, vehicular pollution, there is an increase in pollution level which might be leads to the health effects of human beings residing in that particular areas. Bearing in mind the health point it is necessary to control the ongoing levels of air pollution. This is time to plantation and developing, large trees and green belt around the city or open spaces in city for to maintain the health of human beings and to minimizing the atmospheric pollution that can be increasing day by day.

Conflicts of interest: The authors stated that no conflicts of interest.

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