

Study on Gaseous Pollutants SO₂ and NO₂ Concentration of Kalaburagi city

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ABSTRACT: This study reports the ambient air quality status in sensitive and residential areas of Kalaburagi City. Two sampling stations viz ; Government Hospital and LalBahadurShastri Nagar were Selected to determine the concentration of Sulphur dioxide (SO₂), Nitrogen dioxide (NO₂). The results reported pertain to analysis of air Quality data at 2 Locations. The concentration of gaseous pollutant SO₂ & NO₂ was very low and within the permissible standard limit Specified for sensitive and residential Area of NAAQS. Air Quality data obtained clearly indicates that Kalaburagi city has no serious air pollution in respect of Sulphur Dioxide and Nitrogen Dioxide.

KEYWORDS: SO₂, NO₂, AQI, NAAQS.

I. INTRODUCTION

Air Pollution is a complex mixture of gases, particles, aerosols, water vapour which has originated due to human development and other natural/anthropogenic activities. Its close relation to human development, complex structure containing infinite proportions of Particles and more challenging towards its management. Human beings are exposed to great number of potentially harmful pollutants in ambient air. Pollutants in the atmosphere arise from two major sources: natural and anthropogenic. It may be surprising to learn that globally, the largest source sources of many air pollutants are natural. Combustion from motor vehicles and industrial processes by far the major producer of air pollutants. Rapid industrialization, urbanization and development of transport have added impetus to economic development at the cost of environment. Although such development is integral to economic growth, the problem lies in their unfettered proliferation in India, leading to severe environmental degradation. Unplanned rapid industrialization causing deterioration of the environment and quality of life in developing countries. It is essential to assess the spatial distribution of air quality and its impact on human beings in the urban region. Particulate and gaseous emission of pollutants from industries and auto-exhausts is responsible for rising discomfort, increasing air way diseases, decreasing productivity and deterioration of artistic and cultural patrimony in urban centers. Urban air pollution is a major focus of public health concern and regulatory activity.

II. LITERATURE REVIEW

1) Punith Y. N and D. P Nagarajappa done a project on " Monitoring of SPM, SO₂, NO₂, and AIR Quality Index in Selected Areas of Davangere City during Summer Season". The concentration of Sulphur dioxide and Nitrogen dioxide is within the NAAQS limit in all the stations. But Air Quality Index (AQI) values of the PB road old bus stand, Gandhi circle, Pooja international hotel, and Bapuji hospital stations were severely polluted and it is very unhealthy for the public and causes some various health problems. The concentration of SPM, SO₂ and NO₂ at this station is found to be 591.78, 22.74 and 58.97 µg/m³ respectively. This station includes BSNL office, hotels, government offices, municipalities etc. The concentration of SPM, SO₂ and NO₂ at this station is found to be 581.23, 14.39 and 43.29 µg/m³ respectively.

2) S. B. Mangalekar, A. S. Jadhav and P. D Raut carried out "Studies on Ambient Air Quality Status of Kolhapur City, Maharashtra, India during Year 2013". Three sites viz. Shivaji University (SU), Dabholkar Corner (DC) and Mahadwar Road (MR) were selected to spotlight an overview of the total air quality of this region. SO₂ µg/m³ values at three sites in the Kolhapur city were well below the prescribed standards of CPCB. However, the highest value (42.09 µg/m³) was recorded at DC during the month of January, 2013 and the lowest value (5.13 µg/m³) was observed at Shivaji University during July 2013. The concentrations of NO_x determined were below the prescribed limit set by the CPCB at all the three locations. The highest average concentration of NO_x (78.12 µg/m³) was found at DC site, near central bus stand where highest traffic density is observed.

3) Shivangi Nigam, B. P. S Rao, N. Kumar and V. A Mhaisalkar published a research article on "Air Quality Index – A Comparative Study for Assessing the Status of Air Quality". The average concentration of PM₁₀, PM_{2.5}, SO₂ and NO₂ are in 82.59, 61.61, 27.19 and 3.92 µg/m³ in was observed in May-June respectively. Similarly the levels in June-July 2014 were observed as 57.96, 43.27, 14.24 and 2.54 µg/m³ respectively while the concentration in July-August 2014 were found as 39.37, 32.89, 10.44 and 2.92 µg/m³ respectively, in August-September 2014 were 30.08, 32.53, 12.18 and 2.90 µg/m³ respectively and the levels in Sept-Oct 2014 were found as PM₁₀, PM_{2.5}, SO₂ and NO₂ are in 93.66, 94.04, 23.39 and 6.85 µg/m³ respectively.

4) S. Harinath, and Usha N Murthy, "Air quality index in Industrial Areas of Bangalore city – A case study, India". The ambient air quantity survey was carried out at 12 stations with respect to SPM, SO₂, and NO_x. Most of the sampling stations exceed the residential standards limits of 140 µg/m³ but within the range of 300 µg/m³ for commercial areas in 24 hours. The AQI at Bommasandara was 176.62 which is severe, Jigane 162.89, Electronic city 120.12. The Air quality Index at all stations is severe and exceeding 140 µg/m³.

5) Sadhanachaurasia, pragya Dwivedi, Ravindrasingh and Anand Dev Gupta done study on "Assessment of ambient air quality status and air quality index of Bhopal city (Madhya Pradesh), India". SO₂ and NO_x values were found within limit (80 µg/m³) at all selected stations in study period. The relative AQI was found in severe air pollution range. It may cause serious aggravation of heart or lung disease, it is indication of increased risk of cardio respiratory symptoms in general population.

III. METHODOLOGY

STUDY AREA

Kalaburagi was known as 'KALBURGI' in former days which means stony land in Kannada. Kalaburagi district is situated in the northern part of Karnataka State. In the earlier days, Kalaburagi was a district of Hyderabad Karnataka area and became a part of Karnataka State after re-organization of states. Kalaburagi is situated in Deccan Plateau located at 17.33°N 76.83°E and the general elevation ranges from 300 to 750 meters above mean sea level. The weather in Kalaburagi consists of 3 main seasons. The summer which spans from late February to mid June. It is followed by the south west monsoon which spans from the late June to late September heavy rainfall may go up to 750mm.

Two sampling stations were selected to determine the Sulphur dioxide (SO₂), Nitrogen dioxide (NO₂) and also to calculate the Air Quality Index (AQI) of Kalaburagi city. One sampling station is sensitive area and another is Residential area.

1. Government Hospital
2. Lal Bahadur Shastri Nagar

SAMPLING AND ANALYSIS OF SULPHUR DIOXIDE (SO₂) : IMPROVED WEST AND GAEKE METHOD

Principle of the method

Modified West & Gaeke Method (IS-5182 Part-2 Method of Measurement of Air Pollution: Sulphur dioxide). Sulphur dioxide from air is absorbed in a solution of potassium tetrachloro-mercurate (TCM). A dichlorosulphito-mercurate complex, which resists oxidation by the oxygen in the air, is formed. Once formed, this complex is stable to strong oxidants 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 para-rosaniline and formaldehyde to form the intensely coloured pararosaniline-methylsulphonic acid. The absorbance of the solution is measured by means of a suitable spectrophotometer.

Instrument/Equipment

The following items are necessary to perform the monitoring and analysis of nitrogen dioxide in ambient air:

- Analytical balance
- Vacuum pump : Capable of maintaining an air pressure differential greater than 0.7 atmosphere at the desired flow rate
- Calibrated flow-measuring device to control the airflow from 0.2 to 1L/min. · Absorber: all glass midge impinger.
- Spectrophotometer: Capable of measuring absorbance at 560nm equipped with 1cm path length

- Glass wares: low actinic glassware must be used.

Sampling

Place 30mL of absorbing solution in an impinger and sample for four hours at the flow rate of 1L/min. After sampling measure the volume of sample and transfer to a sample storage bottle.

Analysis

Replace any water lost by evaporation during sampling by adding distilled water up to the calibration mark on the absorber. Mix thoroughly, pipette out 10 ml of the collected sample into a 25 ml volumetric flask. Add 1 ml 0.6% sulphamic acid and allow reacting for 10 minutes to destroy the nitrite resulting from oxides of nitrogen. Add 2 ml of 0.2% formaldehyde solution and 2 ml Pararosaniline solution and make up to 25 ml with distilled water. Prepare a Blank in the same manner using 10 ml of unexposed absorbing reagent. After a 30 min colour development interval and before 60 minutes, measure and record The absorbance of samples and reagent blank at 560 nm. Use distilled water; not The reagent blank, as the optical reference.

Calculation

$$C (\text{SO}_2 \mu\text{g}/\text{m}^3) = (A_s - A_b) \times CF \times V_s / V_a \times V_t$$

Where,

C SO₂ = Concentration of Nitrogen dioxide, $\mu\text{g}/\text{m}^3$;A_s = Absorbance of sample ;A_b = Absorbance of reagent blankCF = Calibration factor ; V_a = Volume of air sampled, m³ ;V_s = Volume of sample, ml, V_t = Volume of aliquot taken for analysis, ml.

SAMPLING AND ANALYSIS OF NITROGEN DIOXIDE (NO₂): MODIFIED JACOB AND HOCHHEISER METHOD

Principle of the method

Modified Jacobs & Hochheiser Method (IS 5182 Part 6 Methods for Measurement of Air Pollution: Oxides of nitrogen).Ambient nitrogen dioxide (NO₂) is collected by bubbling air through a solution of sodium hydroxide and sodium arsenite. The concentration of nitrite ion (NO₂) produced during sampling is determined colorimetrically by reacting the nitrite ion with phosphoric acid, sulfanilamide, and N-(1-naphthyl)-ethylenediamine di-hydrochloride (NEDA) and measuring the absorbance of the highly coloured azo-dye at 540nm.

Instrument/Equipment

The following items are necessary to perform the monitoring and analysis of nitrogen dioxide in ambient air:

- Analytical balance
- Vacuum pump : Capable of maintaining an air pressure differential greater than 0.7 atmosphere at the desired flow rate
- Calibrated flow-measuring device to control the airflow from 0.2 to 1L/min. · Absorber: all glass midget impinger.
- Spectrophotometer: Capable of measuring absorbance at 560nm equipped with 1cm path length
- Glass wares: low actinic glassware must be used.

Sampling

Place 30 mL of absorbing solution in an impinger and sample for four hour at the flow rate of 0.2 to 1L/min. After sampling measure the volume of sample and transfer to a sample bottles.

Calculation

$$C (\text{NO}_2 \mu\text{g}/\text{m}^3) = (A_s - A_b) \times CF \times V_s / V_a \times V_t \times 0.82$$

Where,

C NO₂ = Concentration of Nitrogen dioxide, $\mu\text{g}/\text{m}^3$;A_s = Absorbance of sample;A_b = Absorbance of reagent blank CF = Calibration factor ; V_a = Volume of air sampled, m³;V_s = Volume of sample, ml ;V_t = Volume of aliquot taken for analysis, ml ;0.82 = Sampling efficiency



IV. RESULTS

RESULTS OF SAMPLING STATION 1: GOVERNMENT HOSPITAL

The sampling station 1 is Ecologically sensitive area. The result of the measurements during the year 2018 (data collected) Fig. 1 and Fig.2 shows that ;

The Monthly Average concentration of SO₂ was very low about 2.0(µg/m³) which is within the permissible standards of NAAQS i-e ; 80µg/m³.

The Monthly Average concentration of NO₂ was minimum of 6 µg/m³ during the month of August 2018 and maximum of 25 µg/m³ which is also within NAAQS i-e; 80 µg/m³.

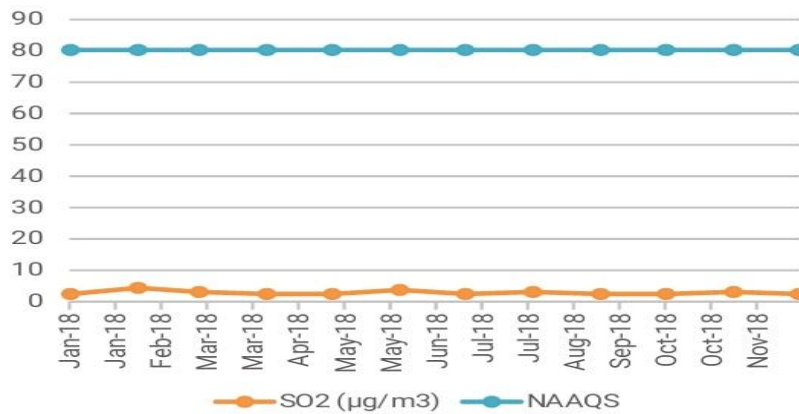


Fig. 1. Monthly variations in SO₂ concentration during the year 2018 @ Government Hospital

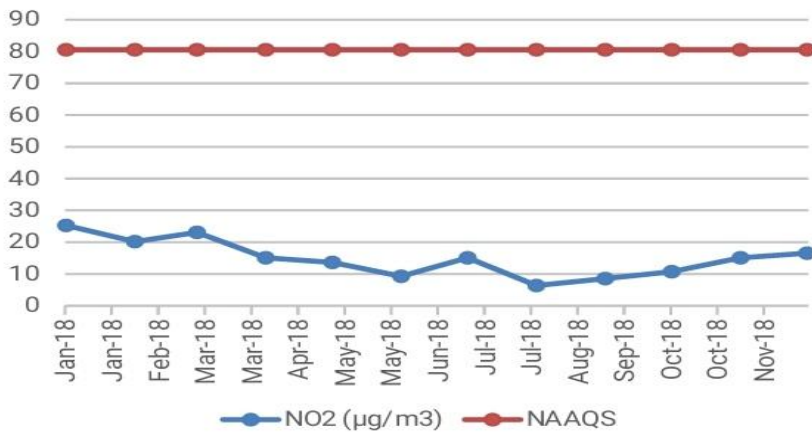


Fig.2. Monthly variations in NO₂ concentration during the year 2018 @ Government Hospital

The result of the analysis carried out during the year 2019 Fig.3 and Fig. 4 shows that;

The Monthly Average concentration of SO₂ was very low about 2.0µg/m³ which is within the permissible standards of NAAQS i-e ; 80µg/m³.

The Monthly Average concentration of NO₂ was minimum of 9 µg/m³ and maximum of 22 µg/m³ which is also within NAAQS limit i-e; 80 µg/m³.

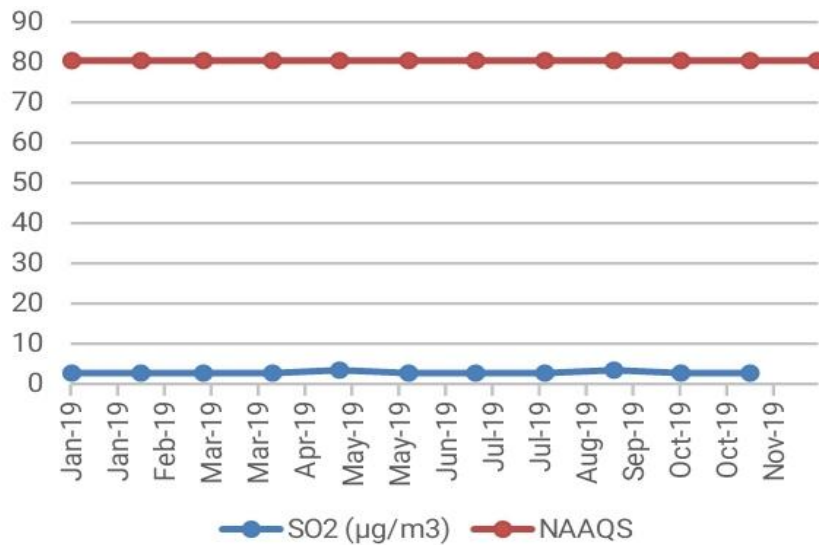


Fig. 3. Monthly variations in SO2 concentration during the year 2019 @ Government Hospital

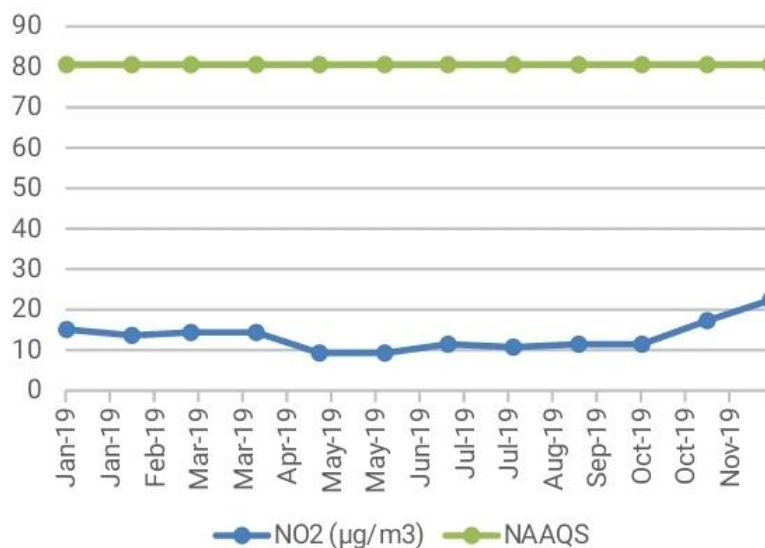


Fig. 4. Monthly Variation in NO2 Concentration during the year 2019 @ Government Hospital

RESULTS OF SAMPLING STATION 2: LAL BAHADUR SHASTRI NAGAR

The sampling station 2 is Residential area. The result of the measurements during the year 2018(datacollected) Fig. 5 and Fig. 6 shows that;

The Monthly Average concentration of SO2 was very low about 3.0(µg/m3) which is within the permissible NAAQS i-e ; 80µg/m3.

The Monthly Average concentration of NO2 was minimum of 2µg/m3 during the month of August 2018 and maximum of 10µg/m3 which is also within CPCB Standards i-e; 80 µg/m3.



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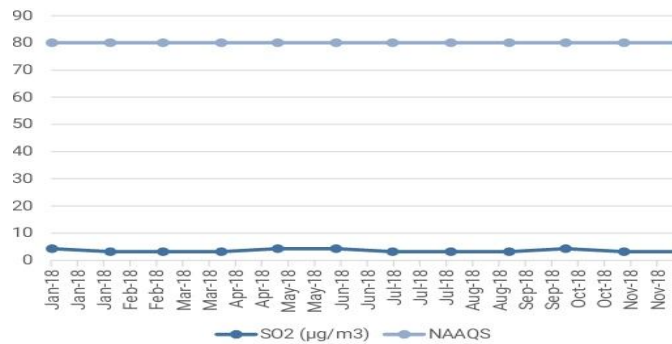


Fig. 5. Monthly variations in SO2 concentration during the year 2018 @ Lal Bahadur Shastri Nagar

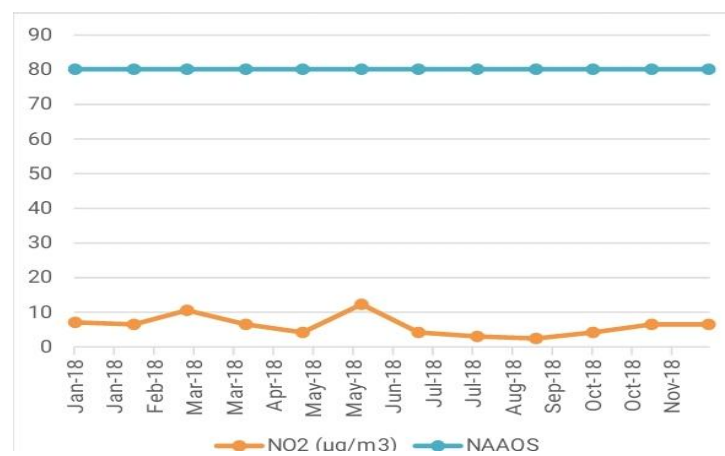


Fig. 6. Monthly variations in NO2 Concentration during the year 2018 @ Lal Bahadur Shastri Nagar

The result of the measurements during the year 2019 (data collected) Fig. 7 and Fig. 8 shows that;

The Monthly Average concentration of SO2 was very low about 3.0(µg/m3) which is within the permissible NAAQS i-e ; 80µg/m3.

The Monthly Average concentration of NO2 was minimum of 8µg/m3 during the month of August 2018 and maximum of 17µg/m3 which is also within CPCB Standards i-e; 80 µg/m3.

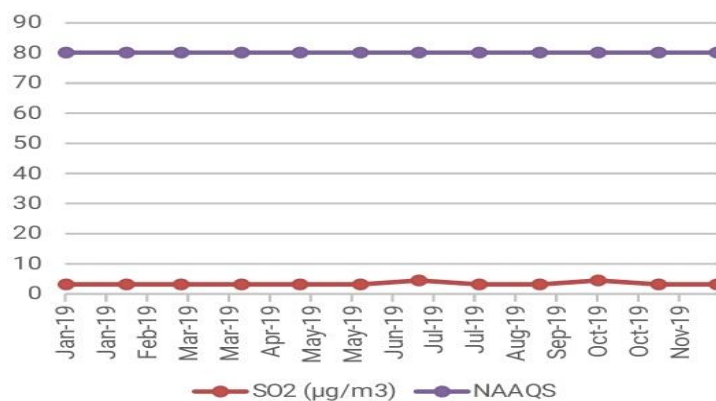


Fig. 7. Monthly Variation in SO2 concentration during the year 2019 @ Lal Bahadur Shastri Nagar

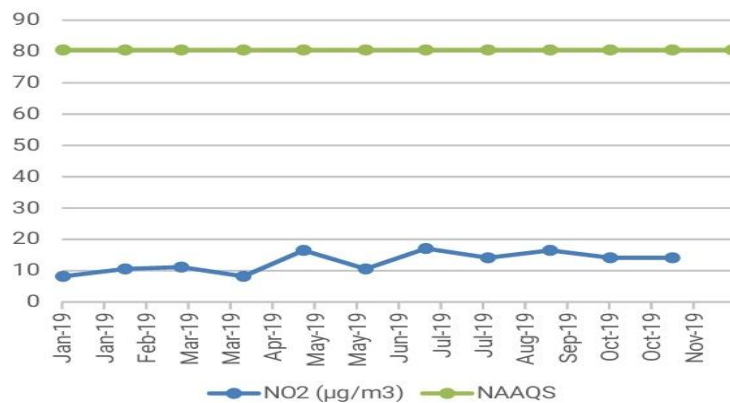


Fig. 8. Monthly Variation in NO2 Concentration during the year 2019 @ Lal Bahadur Shastri Nagar

V. CONCLUSION

The concentration of gaseous pollutant SO₂ was very low and within the permissible standard limit Specified for sensitive and residential area.

The concentration of gaseous pollutant NO₂ was also very low and within the standard limits of NAAQS.

Air Quality data obtained clearly indicates that Kalaburagi city has no serious air pollution in respect of Sulphur Dioxide and Nitrogen Dioxide.

The study can be used for knowing the status of ambient air quality and effects pollution on air quality in urban environment.

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