Analysis of NO_2 and SO_2 Gas Concentration of Sedam Town

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***Abstract*- The primary goal of this study is to evaluate the NO_2 (Nitrogen dioxide) and SO_2 (Sulphur dioxide) concentration. The concentration of NO_2 and SO_2 were measured at three locations in Sedam Town that are mentioned: Bus stand, Vidya Nagar and Industrial area. The NO_2 and SO_2 concentration was carried out from June to August 2024 with a time interval of 15 days for each station. Sampling time was 8 hours. NO_2 concentration of Bus stand and Industrial station were slightly higher than Residential area, but all 3 stations of NO_2 and SO_2 concentrations are below NAAQS standards.**

***Index Terms*- NAAQS (National Ambient Air Quality Standards), NO_2 (Nitrogen dioxide), SO_2 (Sulphur dioxide).**

1. INTRODUCTION

In addition to water and soil, air is a crucial resource for life. One of the most crucial requirements for improving human health and welfare is clean air. This has a negative effect on the biotic environment and modifies the composition of the atmosphere. Polluter emission levels and the atmosphere's capacity to absorb or disperse such emissions dictate pollutant levels.

A major worldwide problem, air pollution has an impact on the environment, public health in many different ways. Significant pollutants that are released from both natural and man-made sources, nitrogen dioxide (NO_2) and sulfur dioxide (SO_2) have a profound impact on climate systems, ecosystems, and human health.

1.1. Understanding NO_2 and SO_2:

NO_2 is a reddish-brown gas with a characteristic sharp odor, primarily generated through combustion processes, including vehicle emissions, industrial activities, and power generation. It is a key component of nitrogen oxides (NO_x), which also include nitric oxide (NO) and nitrogen trioxide (N_2O_3). NO_2 plays a significant role in forming ground-level ozone and particulate matter.

SO_2 is a colorless gas with a pungent odor, predominantly emitted during the combustion of fossil fuels containing Sulphur, such as coal and oil. Industrial processes like metal smelting and volcanic eruptions release substantial SO_2 into the atmosphere. Once in the air, SO_2 can transform sulphate aerosols, posing health risks and contributing to acid rain formation and ecosystem damage.

1.2. Sources of NO_2 and SO_2:

NO_2:

NO_2 is a highly reactive gas primarily emitted during the combustion of fossil fuels at high temperatures. It is a significant component of vehicle emissions, mainly from diesel engines and industrial processes such as metal refining and electricity generation. NO_2 is formed through nitrogen oxide (NO) oxidation in the presence of sunlight and other atmospheric pollutants.

SO_2:

SO_2 is predominantly produced by the combustion of Sulphur-containing fossil fuels, such as coal and oil, in power plants, industrial boilers, and residential heating systems. Other sources include volcanic eruptions, wildfires, and industrial processes like metal smelting. When Sulphur-containing fuels are burned, Sulphur dioxide is released into the atmosphere as a primary pollutant.

1.3. Importance of NO_2 and SO_2 Analysis:

Analyzing the presence and behavior of NO_2 and SO_2 in the air is crucial for several reasons. Firstly, both pollutants are known to have adverse effects on respiratory health, particularly among vulnerable populations such as children, the elderly, and individuals with pre-existing conditions. Secondly, NO_2 and SO_2 play significant roles in forming secondary pollutants, including particulate matter and ground-level ozone, further exacerbating air quality issues and associated health risks.

2. OBJECTIVES

- To determine the concentrations of NO_2 and SO_2 in the environment.
- To identify the sources contributing to the pollution levels of NO_2 and SO_2.
- To analyse and compare the measured concentrations of NO_2 and SO_2 to the NAAQS.

3. LITERATURE REVIEW

I. Sadhana Chaurasia, Anand Dev Gupta "Assessment of ambient air quality status and air quality index of Bhopal city (Madhya Pradesh), India", 2013.

This paper presents ambient air quality status of industrial, commercial and residential area of Bhopal city (M.P.). The Air quality was assessed based on New National Ambient Air Quality Standards. Bhopal city situated along 77025' E longitude and 23025' N latitude and has an altitude of 550/600 meters above mean sea level.

The ambient air quality survey was carried out in February and March, 2012. Sampling time was 24 hrs. at three different locations with respect to SO_2, NO_x, PM10 and PM2.5. PM10 and PM2. 5 was always found beyond the permissible limit at all the sampling site.

Air pollution and air quality was measured at Bhopal city indicates that PM10 and PM2.5 always found beyond the permissible limit but SO_2 and NO_x were always below the permissible limit at all the sampling site in both the months.

II. Hiren B. Soni and Jagruti Patel "Corridor of Gujarat, India: A Case Study of Dahej Port"

In this study, seven stations in and around Dahej Port, Gujarat, India, were used to estimate gaseous pollutants (SO_2 and NO_2) and primary particle pollutants (PM10, PM2.5). On the southwest coast of Gujarat, India, Dahej Port (21°68′ 35″ N and 72°49' 65″ E) is a cargo port located approximately 45 kilometers from Bharuch Town.

In all seven of the study sites, the obtained values of PM10, PM2.5, SO2, and NO2 varied from 67.39 to 98.75, 29.57 to 45.79, 17.76 to 22.29, and 28.29 to 32.42 μg/m^3, respectively. While SO_2 and NO_2 levels were within an acceptable range, the levels of PM10 at all sample locations and PM2.5 at Station A3 (Lakhigam) were found to be slightly higher than the CPCB standards mandated tolerable limits.

III. Sadhana Chaurasia and Ashok Tiwari "Assessment of ambient air quality in the Vicinity of Cement Industries" 2016.

The Air quality was assessed based on New National Ambient Air Quality Standard and outcome of the study has been presented in to the form of Air Quality Index.

The study was conducted for a period of three months at the interval of 01 month. At each site 08 hrs samples were collected in each location. One sampling site for ambient air monitoring was selected for each industrial unit.

Concentration of SO_2 was observed in the range of 10-17μg/m3 and concentration of NO_x was found in the range of 22.6-30.6 μg/m^3 (Table-1), which was also under the permissible limit 80μg/m^3.

4. MATERIALS AND METHODOLGY

4.1. Study Area: Sedam Town

Sedam Town is located in the eastern part of the Kalaburgi District. The town is spread over 5.5 square kilometers (2.1 sq mi) shown in fig.I. Sedam Taluk shares borders with three Talukas in the Kalaburagi district: Chitapur Taluka to the west, Chincholi Taluka to the north, and Yadgir District to the south. It also borders Tandur Taluk of the Rangareddy District of Telangana to the east.

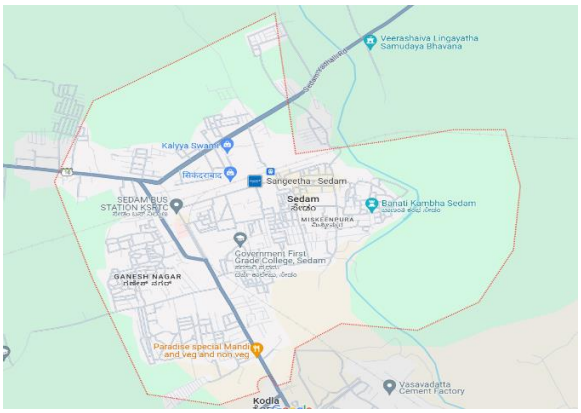

Fig.I Sedam Town Map

4.2. Methods of measuring NO_2 and SO_2 [CPCB, NAAQS]

Table: I

Pollutants	Concentration of ambient air		Methods of measurements
	Industrial, residential, rural, and other areas	Ecologically sensitive area (notified by central government)	
SO_2 µg/m^3	80	80	Improved West and Gaeke method.
NO_2 µg/m^3	80	80	Jacob and Hochhesier modified method.

4.3. Materials and method used:

Instruments used:

- High-volume air sampler device.
- Calibrated flow measuring device (to control the airflow of 1 LPM) or Rotameter.
- A midget impinger.
- Storage container.
- Spectrophotometer (to measure absorbance at 540nm).

Reagents used for NO_2:

- Distilled water.
- Sodium hydroxide.
- Sodium arsenite.
- Sulphanilamide.
- N-(1-Naphthyl)-Ethylenediamine Di-hydrochloride (NEDA).
- Hydrogen peroxide.
- Phosphoric acid.
- Sodium Nitrite.

Initially for preparation of NO_2, above reagents is prepared according to IS 5182-6 (2006): Methods for Measurement of Air Pollution, Part 6: Oxides of nitrogen, and National Ambient Air Quality Standards (NAAQS).

Calibration Factor is obtained by using Standard graph mentioned in National Ambient Air Quality Standards (NAAQS).

Calculation of Concentration of NO_2 (µg/m^3):

$$C\ (NO_2) = \frac{[(As - Ab)\ x\ C.F\ x\ Vs]}{(Va\ x\ Vt\ x\ 0.82)}$$

C (NO_2) = Concentration of nitrogen dioxide in µg/m^3

A_s = Absorbance of sample.

A_b = Absorbance of reagent blank.

C.F = Calibration factor.

V_s = Volume of sample in ml.

V_a = Volume of air sample in m^3.

V_t = Volume of aliquot taken for analysis in ml.

Reagents used for SO_2:

- Distilled water
- Potassium tetrachloromercurate (TCM) – 0.04M
- Sulphamic Acid
- Formaldehyde
- Working Para Rosaniline Solution
- Iodine Solution
- Starch Indicator Solution
- Working Sulphite – TCM Solution

Initially for preparation of SO_2, above reagents is prepared according to IS 5182-2 (2001): Methods for Measurement of Air Pollution, Part 2: Sulphur Dioxide and National Ambient Air Quality Standards (NAAQS).

Calibration Factor is obtained by using Standard graph mentioned in National Ambient Air Quality Standards (NAAQS).

Calculation of Concentration of SO_2 µg/m^3:

$$C\ (SO2)\ = \frac{[(As\ -\ Ab)\ x\ C.F\ x\ Vs]}{(Va\ x\ Vt)}$$

C (SO_2) = Concentration of Sulphur dioxide in µg/m^3
A_s = Absorbance of sample.
A_b = Absorbance of reagent blank.
C.F = Calibration factor.
V_s = Volume of sample in ml.
V_a = Volume of air sample in m^3.
V_t = Volume of aliquot taken for analysis in ml.

V_a calculation is common for both NO_2 and SO_2.

Calculation of V_a (Volume of air sample in m^3).

$V_a = \frac{(fi + ff)}{2}\ x\ (tf\ -\ ti)\ x\ 60\ x\ 10^{-3}$
V_a = Volume of air sample in m^3.
f_i = Airflow rate before sampling LPM.
f_f = Airflow rate after sampling LPM.
t_f = Final time in hours.
t_i = Initial time in hours.
60 = Conversion of hours to minutes.
10^{-3} = Conversion of liter to m^3.

4.4. Summary
For each station 8-hour sampling is done with 4-hour change of chemicals in impinger. 15-day time interval is maintained for each station.
High-Volume air sampler is maintained at 1LPM.
After the solution is taken to the laborartory and analysed as per NAAQS procedure.

5. RESULTS

Station 01

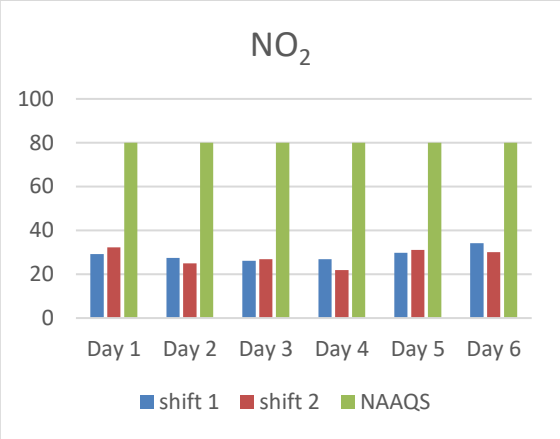

Chart. 01

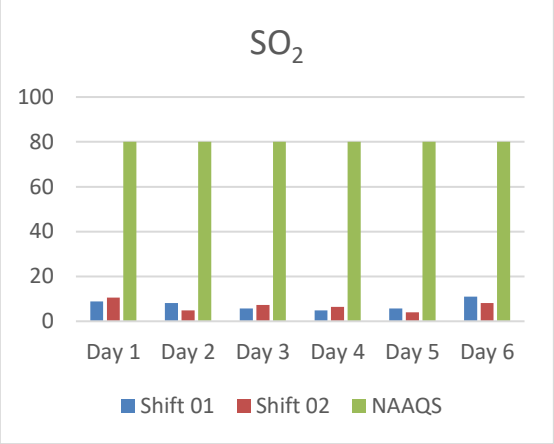

Chart. 02

Station 02

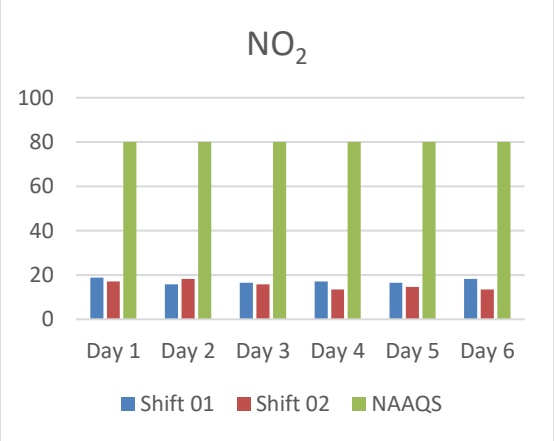

Chart. 03

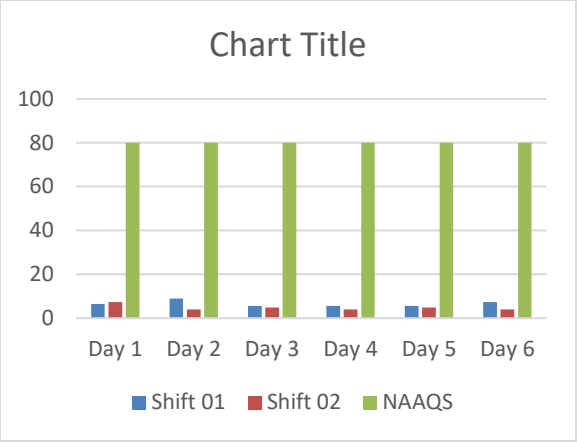

Chart. 04

Station 03

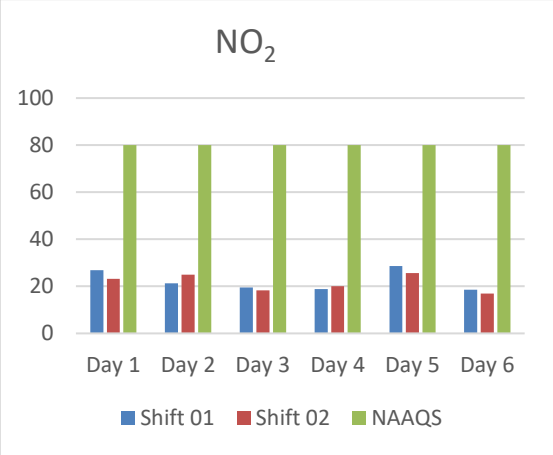

Chart. 05

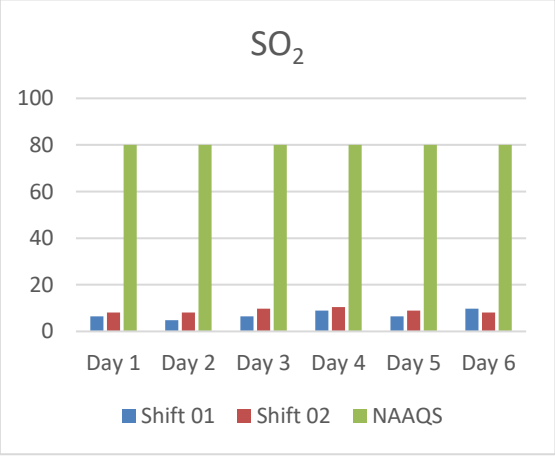

Chart. 06

6. CONCLUSION

- The SO_2 and NO_2 concentrations at all stations are below the NAAQS threshold.
- Automobiles are the main sources of NO_2 pollutant in Sedam Town.

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REFERENCE

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[2] IS 5182-6 (2006): Methods for Measurement of Air Pollution, Part 6: Oxides of nitrogen.

[3] IS 5182-2 (2001): Methods for Measurement of Air Pollution, Part 2: Sulphur Dioxide.

[4] Sadhana Chaurasia, Anand Dev Gupta "Assessment of ambient air quality status and air quality index of Bhopal city (Madhya Pradesh), India", 2013.

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