



Sampling of Air Quality in Amravati City

¹Prof. Manish S. Deshmukh, ²Prof. Dr. Sachine S. Saraf, ³Prof. Nilesh P. Bhopale

^{1,2,3}Department of Civil Engineering, PR Pote College of Engineering & Management, Amravati, Maharashtra, India

¹manishdeshmukh20177@gmail.com, ²sachinesaraf2014@gmail.com,

³nileshbhopalnp@gmail.com

Article History

Received on: 12 Dec 2021

Final Revised on: 30 Dec 2021

Published on: 20 Jan 2022

Keywords: Air Pollution, Pollutant, High-Volume Sampler, Suspended Particulate Matter

e-ISSN: 2455-6491

Production and hosted by

www.garph.org

©2021|All right reserved.

ABSTRACT

Air pollution has become an environmental problem of public concern worldwide. Amravati city is a fast-developing city, the rural population around the city migrated towards the city. Because various facilities such as education, market, business, health, and entertainment are available in the city; increasing urbanization increases the vehicular traffic day by day. In addition to these five stars, MIDC at Nandgaonpeth which is a distance of 20km from the core Amravati city is growing tremendously. It is observed that the air quality of Amravati city is degrading day to day which affects human health in the city and adjoining areas. The Sofia thermal power station contributes a large quantity of SPM, RSPM, SO_x, NO_x, etc. In our study, the concentration of suspended particulate matter (SPM) and OZONE were monitored over periods of 24 hours at Amravati city. Pollutant concentrations were used to determine the AQI. The five location locations have for select or the assessment of SPM and OZONE based on traffic volume, locality, and availability of electricity. The High-Volume Sampler (HVS) is used to find out the concentration of SPM and O; Spectrophotometer is also used for evaluation for O; concentration. SPM is collected on filter paper. This study identifies the potential of pollutants and the degree of air pollution. Further, management strategies to minimize the effect of air pollutants have also been suggested.

1. INTRODUCTION

A large portion of India's population lives in places where levels of air pollution are dangerous to their health (1). The basic goal of pollution prevention initiatives done by authorities at various levels and promoted by the majority of the community is to reduce the danger to health. This is also part of the regional health policy for every one (2). Identifying the essential characteristics of the pollution producing the most significant or prevalent health problems in the exposed populations is necessary

for developing an efficient pollution prevention scheme. The locations of pollution sites, changes in pollution over time, and the chemical makeup of pollution are all things to be concerned about. These features are described in existing air quality measurement systems, which provide a basic view of the condition and trends in air quality in Amravati city.

Developing a pollution-reduction strategy that effectively protects public health involves more information than simply knowing where the negative health consequences may develop.

Information on the severity and degree of the consequences, in terms of the type and estimated number of instances attributed to pollution, may be required to justify and support actions that could be costly and necessitate a variety of societal initiatives. The predicted health benefits of pollution reduction may outweigh these costs, making public support for the programs more likely. Quantitative estimations of the results provide tools for assessing the health implications.

2. MATERIALS AND METHODS

2.1 Ambient Air Sampling Guide

Survey for preliminary information

During ambient air pollutants sampling, it is also necessary to collect information on qualitative and quantitative data on the local sources of air pollution, topography, population distribution land use pattern, climatology, etc, depending upon the objectives of the survey or measurement campaign. For example, an area map to locate pollution sources and monitoring locations, sources of pollution situated at far distances, etc., and other relevant data that describe the behavior of the atmosphere for a specific pollutant to be sampled may also be required.

What it includes:

- a) Selection of sampling procedures including procedures of analysis of samples
- b) Sampling locations.
- c) Period of sampling, frequency of sampling, and duration.
- d) Auxiliary measurements (including, meteorological I parameters.
- e) Processing of data

A. Sampling Procedure

There are two types of sampling - continuous and time-averaged in-situ samplings. Continuous sampling is carried out by automatic sensors, optical or electrochemical, and spectroscopic methods which produce continuous records of concentration values. The specific time-averaged concentrations of data can then be obtained from continuous records. Time-averaged data can also be obtained by sampling for a short time for the required averaging time. Samples are then analyzed by established physical chemical and biological methods for the concentration values which are the effective average throughout sampling.

B. Sampling Locations

Sampling locations are in general governed by factors like objectives, method of sampling, and

resources available. If the objective is to study health hazards and material damages, then locations should be kept close to the objects where the effects are being studied and should be kept at breathing level in the population's Centres, hospitals, schools, etc. For vegetation, it should be at the foliage level. For background concentration, the sampling location should be away from the sources of pollution. It can also be done by gridding the entire area to get statistically recommended values. The number of locations however depends upon the variability of concentration over the area under survey. A spot-checking may be done to decide the location besides considering practical factors.

C. Period of Sampling, Frequency, and Duration

The period, frequency, and duration of sampling should be appropriate to the objectives of the study. It should be such that the measurable quantities are trapped in the sample at the end of the sampling. It is preferable to observe a sampling period consistent with the averaging times for which air quality standards of the given pollutants are specified.

2.2 Ambient Air Sampling And Analysis

The pollutants for which sampling and analytical techniques are discussed are SO₂, NO_x, O₃, NMHC, CO, BTX, SPM, and RSPM. In addition, methods for meteorological parameters such as wind speed, direction, temperature, solar radiation, and relative humidity are also discussed along with wind rose plotting methods. The rationale for selecting these pollutants in this manual is that they are ubiquitous in urban air, widely recognized as posing a potential risk to population health, and are commonly regulated at national and international levels.

A. Suspended Particulate Matter (SPM)

A sampling of suspended particulate matter in ambient air and the determination of its concentration

1. Method of measurement

Volumetric-filtration - sampling a volume of air through a filter medium at a known flow rate for a specified time.

2. Instrument: High volume sampler with SPM filter manifold

3. Auxiliaries: High volume sampler with airflow manometer for measuring flow rate, microfiber filter (8" x 10" size)

4. Chemicals: Nil

2.3 Sampling location guidelines

Sampling stations should be located depending upon the objectives of the measurement campaign and be kept at an altitude depending upon the type of study region (roadways, industrial area,

disposal site, residential tract. etc). Generally, it is kept at a height of about 8 to 10 m from the ground level and sufficiently away from the disturbance or direct obstacle from the source under consideration.

2.4 Sampling frequency guidelines

Sampling is carried out for various purposes. The regular monitoring campaign of national ambient air quality includes measurement of SPM typically for 20 hours at least twice a Week making about 100 samples a year.

2.5 Steps for sampling

- Condition filter paper in the oven.
- Prepare a sampling assembly by uncorking screws of the bracket
- Take the tare (initial) weight of filter paper (W_i).
- Place the filter in the sampling system securely and tighten the screw of the bracket.
- start the sampler and adjust the flow rate to about 2 lit/min for 20 hours of sampling the flow rate at the end of the des}
- Note the flow rate at the end of the desired sampling period and stop the simple transit of the sampling train to the environmental laboratory carefully with scientific precaution.
- condition the filter Paper again for the same period as was done before sampling.

2.6 Laboratory analysis — method:

Gravimetric — by weighing the mass of particles
 μ Weighing of exposed samples:
 Take the final weight of the exposed filter ith standard balance (w_f, mg)

Calculations

i. Average flowrate (initial and final flow rates) in lit/min

$$\frac{\text{Initial low rate} + \text{final flowrate}}{2}$$

ii Total volume of same sampled (TVA) in m³

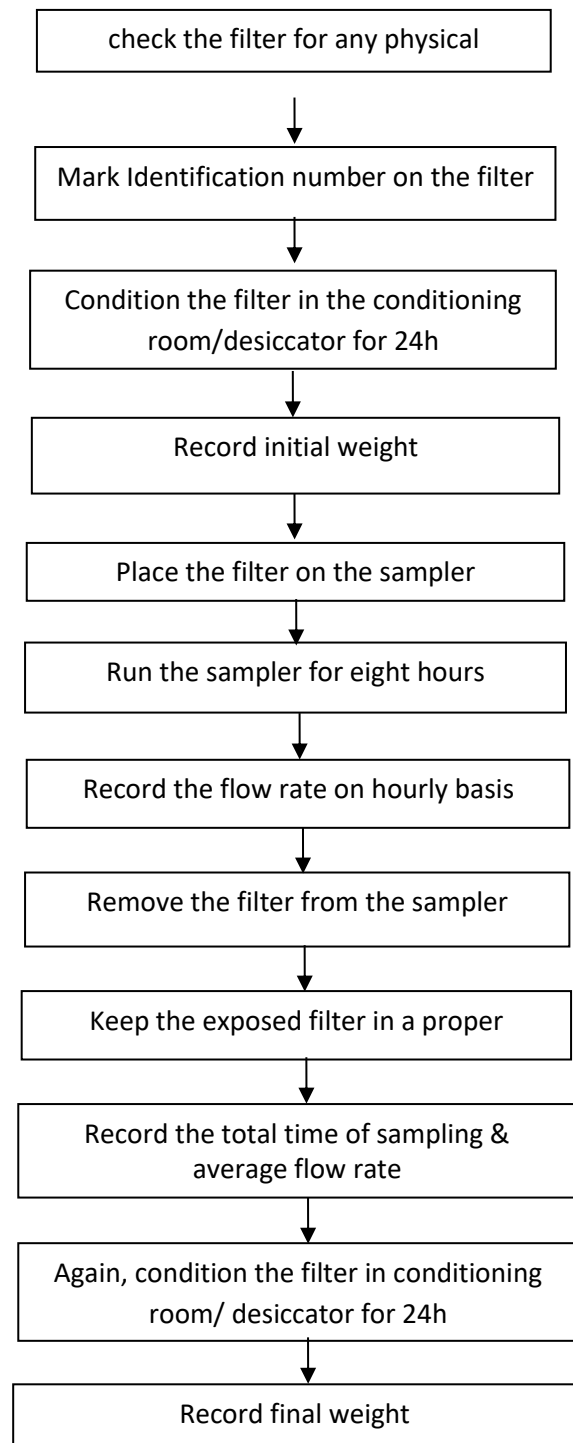
$$= \text{Avg, flow rate (lit/min)} * 10 - 3 (m^3) / \text{litmg sampling time (hr)} * 60(\text{min/hr})$$

iii Concentration of SP Minyg/m

$$iv. = (w_f - w_i) (mg) / TVA (m^3) * 106 \mu g / m^3$$

v. Calculate the concentration of SPM in μ

3. FLOW CHART FOR DETERMINING SPM



A. OZONE (O₃)

Guidelines for sampling and analysis Protocol for ozone in ambient air (Chemical method)

1. PURPOSE

The purpose of this protocol is to provide guidelines for monitoring ozone in ambient air.

2. Standard

The national ambient air quality standards for ozone are presented in the table.

Table 1: The national ambient air quality standards for ozone

Pollutant	Time-weighted Average	Concentration in ambient air	
		Industrial, Residential, Rural, and other areas	Ecologically Sensitive Area (Notified by Central Government)
Ozone (O ₃)	8 Hours	100	100
	1 Hour	180	180

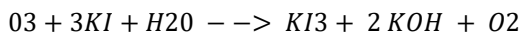
*Annual Arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals.

** + 24 hourly or 8 hourly or 1 hourly monitored value, as applicable, shall be complied

| with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.

B. Principle of the method

Method 411, Air Sampling and Analysis, 3rd Edition (Determination of oxidizing substances in the atmosphere) Micro-amounts of ozone and the oxidants liberate iodine When absorbed in a 1% solution of potassium iodine buffered at pH 6.8 + 0.2. The iodine is determined spectrophotometrically by measuring the absorption of the tri-iodide ion at 352nm: The stoichiometry is approximated by the following reaction.



- Instrument/Equipment:

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

C. Analytical Balance

Vacuum pump: Any suction pump capable of drawing the required sample flow rate of 1 to 2 litre per minute

The calibrated flow measuring device to control the airflow from 1 to 2l/min

absorber: All glass midget impinger

Spectrometer: Capable of measuring absorbance at 352 nm

Glassware's: low actinic glassware must be used for analysis

Reagents / Chemicals:

All the chemicals should meet the specifications of ACS Reagent grade.

D. Distilled Water

Absorbing Solution (1% KI in 0.1 m Phosphate Buffer) - Dissolve 13.6 g of potassium dihydrogen phosphate (KH₂PO₄).14.2g of disodium hydrogen

phosphate (Na₂HPO₄) or 45.8 g of the dodecahydrate salt (Na₂HP₂. 12 H₂O), and 10.0 g of potassium iodide in sequence and dilute the mixture to 1 L with water. Keep at room temperature for at least 1 day before use. Measure pH and adjust to 6.8 + 0.2 with NaOH or KH₂PO₄. This solution can be stored for several months in a glass stoppered brown bottle at room temperature without deterioration. It should not be exposed to direct sun.

Stock Solution 0.025 M I₂ (0.05N) - Dissolve 16 g of potassium iodide and 3.173 sublimed iodine successively and dilute the mixture to exactly 500 ml with water. Keep at room temperature at least 1 day before use. Standardize shortly before use, against 0.025 M Na₂S₂O₃. The sodium thiosulfate is standardized against primary standard biodata [KH(IO₃)₂] or potassium dichromate(K₂Cr₂O₇).

MI₂ Solution - Pipette exactly 4.00 ml of the 0.025 M Stock solution into a 100 m low actinic volumetric flask and dilute to the mark with an absorbing solution. Protect from strong light. Discard after use.

E. Sampling

Place 10 ml of absorbing solution in a standard impinger and sample for one hour at the flow rate of 1 L/min. Do not expose the absorbing reagent to direct sunlight. After sampling Measure the volume of the sample and transfer it to a sample storage bottle.

4. ANALYSIS

If appreciable evaporation of the absorbing solution occurs during sampling, add water to bring the liquid volume to 10 ml. Within 30n to 60 minutes after sample collection. Read the absorbance in a cuvette at 352 nm against a reference cuvette containing distilled water.

Calibration

A. Preparation of Standards

Calibrating Iodine solution- For calibration purposes exactly 5.11 ml of the 0.001 M I₂ solution (or equivalent volume for other molarity) is diluted with an absorbing solution just before being used to 100 ml (final volume) to make the final concentration equivalent 1µl of O₃ /ml. This solution preparation accounts for the Stoichiometry describe in section 3 at the standard conditions of 101.3 kPa and 25°C. Discard this solution after use. Obtain a range of calibration points containing from 1µl to 10 µl, of ozone equivalent per 10.0 ml of solution. Prepare by individually adding 1.0, 2.0, 4.0, 6.0, 8.0 and 10.0 mL of the calibrating iodine solution to 10.0 ml volumetric Flasks. Bring each to the calibration mark with the absorbing reagent.

Read the absorbance of each of the prepared calibration solutions at 352 nm against distilled water reference.

B. Standard Curve

Plot a curve absorbance (Y-axis) versus concentration (X-axis). Draw a line of best fit and determine the slope. The reciprocal of the slope gives the calibration factor (CF).

C. Calculation

$$c(O_3\mu g) = (A_s - A_b) * CF * 1.962 / V_a$$

Where,

CNH₃ =Concentration of Ammonia in µg/m³

A_s= Absorbance of sample

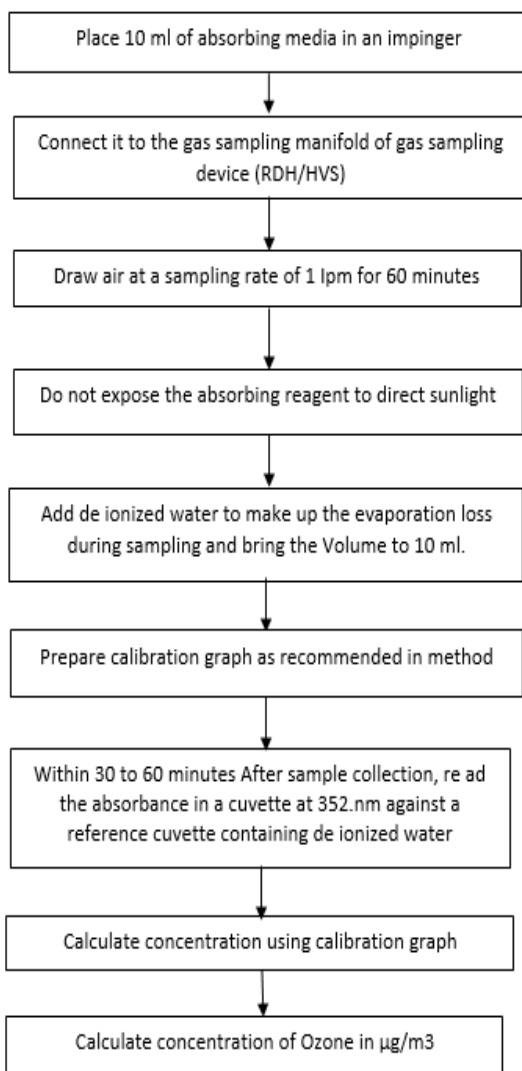
A_b= Absorbance of the reagent blank

CF= Calibration factor

V_a=Volume of air sampled in m³

1962 conversion factor µl to µg

D. flow chart for determining O₃



5. QUALITY CONTROL

Quality Control (QC) is the technique that is used to fulfil requirements for quality. The QC procedures for the air sampling and monitoring sections of this protocol include preventative maintenance of equipment, calibration of equipment. Analysis of field blanks and lab blanks. Method 411, Air Sampling and Analysis, 3rd edition (Determination of oxidizing substance in the atmosphere).

Calculations For SPM (Dust)

A. Reading No. 1

Name of site: Kothari stone crusher

Table 2: Kothari stone crusher reading

Test No	Manometer		Time totalizer		Weight of filter Paper (gm)		Weight of cup (gm)	
	M ³ /min		(hr)					
1	Initial F1	Final F2	Initial R1	Final R2	Initial W1	Final W2	Initial C1	Final C2
	1.4	0.77	11.00	5.00	2.659	5.179	12.715	17.515

Calculation

Weight of filter paper with dust WF = W₂ – W₁

= 5179 – 2.659

WF = 2.52 gm.

Flow rate FF = f₁– f₂

1.4 – 0.77

FF = 0.63 M³/min

Time Taken R = R₂ – R₁

11.00 – 5.00 = 6 hours

R = 6 * 60 = 360 min

Calculate the sample of air sample

Q_{avg} = 1.08m/min

Time(T) = 360 min

V_{avg} = Q_{ave} * Time

= 1.08 * 360

= 390.60 m³

Calculate the concentration of SPM

$$\frac{W_f - W_i}{V_{avg}}$$

$$\frac{(5179 - 2659) * 1000}{390.6}$$

= 6451.61µg/m3

B. Reading No 2

Name of the site: Road Under Construction Morshi Road Khandelwal Poultry form near Nandgaopeth Observation table 2 of Road Under Construction Morshi Road Khandelwal Poultry form near Nandgaopeth

Table 3: Road Under Construction Morshi Road Khandelwal Poultry form near Nandgaopeth reading

Test No	Manometer M ³ /min		Time totalizer (hr)		Weight of filter Paper (gm)		Weight of cup (gm)	
	Initial F1	Final F2	Initial R1	Final R2	Initial W1	Final W2	Initial C1	Final C2
1	1.4	0.9	11.00	5.00	2.659	3.839	12.715	16.668

Calculation

Weight of filter paper with dust WF = W2 - W1

= 3.839 - 2.659

WF = 1.18 gm.

Flow rate FF = f1 - f2

1.4 - +0.91/2

FF = 1.155 M3/min

Time Taken R = R2 - R1

11.00 - 5.00 = 6 hours

R = 6 * 60 = 360 min

Calculate the Volume of air sample

Qavg = 1.15m3/min

Time(T) = 360 min

Vavg = Qavg * Time

= 1.15 * 360

= 415.8m3

«) Calculate the Concentration OF SPM

$$\frac{W_f - W_i}{V_{avg}} \times 1000$$

$$\frac{(3839 - 2659) * 1000}{415.8}$$

= 2837.90 µg/m

C. Reading No 3

Name of the site: old bypass road near Sakha mangal karyalay

Table 4: old bypass road near Sakha mangal karyalay reading

Test No	Manometer M ³ /min		Time totalizer (hr)		Weight of filter Paper (gm)		Weight of cup (gm)	
	Initial F1	Final F2	Initial R1	Final R2	Initial W1	Final W2	Initial C1	Final C2
1	1.4	0.9	11.08	5.00	2.659	3.755	12.715	15.14

Calculation

Weight of filter paper with dust WF = W2 - W1

= 3.755 - 2.659

WF = 1.096 gm.

Flow rate FF = f1 - f2

1.4 - +0.98/2

FF = 1.19 M3/min

Time Taken R = R2 - R1

11.00 - 5.00 = 6 hours

R = 6 * 60 = 360 min

Calculate the Volume of air sample

Qavg = 1.19m3/min Time(T) = 360 min

Vavg = Qave * Time

= 1.19 * 360

= 428.4 m3

Calculate the concentration of SPM

$$\frac{W_f - W_i}{V_{avg}} \times 1000$$

$$\frac{(3755 - 2659) * 1000}{428.4}$$

= 2558.35 µg/m3

D. Reading No 4

Name of the site: Brick making Plant old bypass road near Nimbhora

Table 5 of Brick making Plant old bypass road near Nimbhora reading

Test No	Manometer M ³ /min		Time totalizer (hr)		Weight of filter Paper (gm)		Weight of cup (gm)	
	Initial F1	Final F2	Initial R1	Final R2	Initial W1	Final W2	Initial C1	Final C2
1	1.4	1.0	11.08	5.00	2.659	3.579	12.715	13.895

Calculation

Weight of filter paper with dust WF
 = W2 – W1

= 3.579 – 2.659

WF = 0.92 gm.

Flow rate FF = f1— f2

1.4 – 1.08

FF = 0.32 M3/min

Time Taken R = R2 – R1

11.00 – 5.00 = 6 hours

R = 6 * 60 = 360 min

Calculate the Volume of air sample

Qavg = 1.24m3/min Time(T) = 360 min

Vavg = Qave * Time

= 1.24 * 360

= 446.4 m3

Calculate the concentration of SPM:

$$\frac{W_f - W_i}{V_{avg}} \cdot 1000$$

$$\frac{(3579 - 2659) * 1000}{446.4}$$

= 2060.93 µg/m3

E. Reading No 5

Name of the site: Jayastambh square near Aradhana shop Amravati

Table 6: of Jayastambh square near Aradhana shop Amravati

Test No	Manometer M ³ /min	Time totalizer (hr)	Weight of filter Paper (gm)	Weight of cup (gm)
	Initial F1	Initial R1	Initial W1	Initial C1
1	1.4	1.0	11.2	5.0
	Final F2	Final R2	Final W2	Final C2
	1.0	2.00	2.6	4.1
			07	15
			15	74

Calculation

Weight of filter paper with dust WF
 = W2 – W1

= 4.107 – 2.659

WF = 1.511 gm.

Flow rate FF = f1— f2

1.4 – 1.02

FF = 0.38 M3/min

Time Taken R = R2 – R1

11.00 – 5.00 = 6 hours

R = 6 * 60 = 360 min

Calculate the Volume of air sample

Qavg = 1.21m3/min Time(T) = 360 min

Vavg = Qave * Time

= 1.21 * 360

= 435.6 m3

Calculate the concentration of SPM:

$$\frac{W_f - W_i}{V_{avg}} \cdot 1000$$

$$\frac{(4107 - 2659) * 1000}{435.6}$$

= 3324.15 µg/m3

The absorbance of O₃ from unknown Sources

Table No 7: Absorbance of Os from unknown sources

Sr. No.	Types Of Areas	Absorbance
1	Commercial Area	0.170
2	Residential Area	0.12
3	Commercial Area	0.20
4	Industrial Area	0.15
5	Industrial Area	0.23

F. Calculation for O₃

Table No. 8 Absorbance at different areas

Sr No.	Type of Area	Absorbance	C.F	The volume of Air (m ³ /second)	Concentration of O ₃ (µg/m ³)
1	Commercial Area	0.170	0.086	0.465	8.34
2	Residential Area	0.12	0.086	0.504	5.43
3	Commercial Area	0.2	0.086	0.506	9010
4	Industrial Area	0.15	0.086	0.504	6.78
5	Industrial Area	0.23	0.086	0.460	11.406

O₃ Calculation

C O3(µg/m3) = (As – Ab) * CF * 1.962/ Va

Where,

CO3 = Concentration of Ozone in µg/m3

A_s = Absorbance of sample

A_b = Absorbance of the reagent blank

CF = Calibration factor

V_a = Volume of air sampled in m^3

1.962 = Conversion factor μl to μg

Industrial Area

a) Volume of Air Sample in $m^3 V$

$$V_a = \text{Average Discharge} * 24 * 60 * 0.001$$

$$V_a = 0.97 * 60 * 8 * 0.001$$

$$= 0.465 m^3/sec$$

b) Concentration of Ozone in Industrial Area

$$C = (A_s - A_b) * CF * 1.962 / V_a$$

$$= (0.170 - 0) * 1 / 0.086 * 1.962 / 0.465$$

$$= 8.34 \mu g/m^3$$

2) Residential Area-

a) Volume Air sampled in $m^3(V_a)$

$$V_a = \text{Average Discharge} * 24 * 60 * 0.001$$

$$V_a = 1.051 * 60 * 8 * 0.001$$

$$= 0.504 m^3/sec$$

b) Concentration of Ozone in Industrial Area

$$C = (A_s - A_b) * CF * 1.962 / V_a$$

$$= (0.12 - 0) * 1 / 0.086 * 1.962 / 0.504$$

$$= 5.43 \mu g/m^3$$

Commercial Area

a) Volume Air sampled in $m^3(V_a)$

$$V_a = \text{Average Discharge} * 24 * 60 * 0.001$$

$$V_a = 1.055 * 60 * 8 * 0.001$$

$$= 0.5064 m^3/sec$$

b) Concentration of Ozone in Industrial Area

$$C = (A_s - A_b) * CF * 1.962 / V_a$$

$$= (0.20 - 0) * 1 / 0.086 * 1.962 / 0.5064$$

$$= 9.010 \mu g/m^3$$

Industrial Area

4) Volume Air sampled in $m^3(V_a)$

$$V_a = \text{Average Discharge} * 24 * 60 * 0.001$$

$$v_a = 1.05 * 60 * 8 * 0.001$$

$$= 0.504 m^3/sec$$

b) concentration of Ozone in Industrial Area

$$C = \{A_s - A_b\} * CF * 1.962 / V_a$$

$$= (0.15 - 0) * 1 / 0.086 * 1.962 / 0.504$$

$$= 6.78 g/m *$$

5) Commercial Area-

a) Volume Air sampled in $m^3(V_a)$

$$V_a = \text{Average Discharge} * 24 * 60 * 0.001$$

$$V_a = 0.96 * 60 * 8 * 0.001$$

$$= 0.460 m^3/sec$$

e) Concentration of Ozone in Industrial Area

$$C = (A_s - A_b) * CF * 1.962 / V_a$$

$$= (0.23 - 0) * 1 / 0.086 * 1.962 / 0.460$$

$$= 11.406 \mu g/m^3$$

G. Calculation Of Air Quality Index

For Industrial Area

$$AQI = \frac{1}{2} * \left(\frac{I_{spm}}{S_{spm}} + \frac{I_{nox}}{S_{nox}} \right) * 100$$

$$AQI = \frac{1}{2} * \left(\frac{406.64}{200} + \frac{8.34}{100} \right) * 100$$

$$= 105.83\%$$

$$AQI = \frac{1}{2} * \left(\frac{178.43}{200} + \frac{5.43}{100} \right) * 100$$

$$= 47.32\%$$

For Commercial Area

$$AQI = \frac{1}{2} * \left(\frac{291.46}{200} + \frac{9.010}{100} \right) * 100$$

$$= 77.37\%$$

For Residential Area

$$AQI = \frac{1}{2} * \left(\frac{193.187}{100} + \frac{6.78}{30} \right) * 100$$

$$= 12.7087\%$$

For Commercial Area

$$AQI = \frac{1}{2} * \left(\frac{584.92}{500} + \frac{11.406}{100} \right) * 100$$

$$= 64.195\%$$

6. RESULTS AND DISCUSSION

Table 9 Locations of different areas with concentrations of SPM, O₃ and AQI

Station No	Type of Area	Location	SPM	O ₃	AQI (%)
1	Industrial Area	Stone Crusher Near Wadgaon	6451	8.34	105.83
2	Residential area	Near Sakkha Mangal Karyalay Amravati	2558.3	5.43	12.7087
3	Commercial Area	Jaystambh Chowk	3324.15	9.010	77.37
4	Industrial Area	Brick Factory Nimbhora	2060.9	6.78	47.2
5	Commercial Area	Shegao Naka	2837.9	11.406	64.195

Throughout the study period it has been observed that station (Institutional area), 3 (Commercial area), and 5 (Industrial) SPM was found above the permissible limits i.e. (406.64 $\mu\text{g}/\text{m}^3$, 291.46 $\mu\text{g}/\text{m}^3$ and 584.92 $\mu\text{g}/\text{m}^3$) respectively. The average SPM values at stations 1, 3, 5 exceeded the permissible limit of the National Ambient Air Quality Standard (NAAQS) while at the remaining two locations i.e. at stations 2 and 4 (Residential and Hospital area) SPM level was good within standard limits set by CPCB. Actually, from a knowledge point of view SPM level is relatively high during winter i.e. November-February in comparison to monsoon i.e. July-October, and summer i.e. March-June. This trend was because, in winter, anti-cyclonic conditions prevailed which was characterized by the calm or very slow wind. There was little dispersion or dilution of pollutants which was caused a higher level of SPM. This high particulate emission at station 1 is because the location was near the Industrial area. Also, the whole "assembly was Put at the parking area which is very near to NH6. Station 3 i.e., at Jaystambh is a very core commercial area of the city as traffic volume is considerably high and hence emission of particulate matter is high. Station 5 i.e., Chaitanya Nagar is very near to Bus Depot and is highly affected by vehicular traffic and hence emission of particulate matter is very high.

The detected concentration of O₃ was far below the Prescribed limits set by the NAAQS at all the locations. The highest average concentration of O₃ OF only 11,406 $\mu\text{g}/\text{m}^3$ was found at station 5 (MIDC area). The lowest value of O₃ WAS observed was 5.43 $\mu\text{g}/\text{m}^3$ at station 4 i.e., Hospital area.

From per knowledge point of view, the O₃ level is a bit high in winter in comparison to summer and monsoon. This is due to the prevalence of high-speed wind and no Precipitations.

The average AQI for different stations are depicted in the table 9-The highest (105.83%) and lowest (12.7087%) AQI were observed at location (Institutional Area) and Location 4 (Hospital Area) respectively. It is Seen that the AQI values at Location 1 are more than 100 indicating severe pollution of the ambient air. Heavy air pollution is found at Location 1 location 5 and light air pollution is noticed at Locations 2 and 4. High values of AQI are due to mainly SPM emission.

CONCLUSION AND FUTURE SCOPE

Computed and analyzed data prevailed that suspended particulate matter (SPM) were having the major air pollutant is at three locations. However, gases pollutants (O₃) within the permissible Limits at all stations, the following points concluded that,

1. The value of SPM at stations 1, 3, 5 is more than prescribed by NAAQS (National Ambient Air Quality Standard), and at stations 2& 4 is within the permissible limit
2. The value of O₃ at all the stations is within the permissible limit.
3. It can be suggested that ambient air at Institutional, Commercial, and Hospital areas is not safe for people who are suffering from heart and lung diseases. Similarly, old people and children should reduce heavy exertion at these locations. The prolonged or heavy exertion at these intersections may create an adverse physiological effect on the people.
4. For maintaining the SPM concentration within an acceptable level, it is suggested that massive green plantations must be taken up in the entire area. Trees have high dust trapping efficiency so that they can be grown alongside of the roads and water is to be sprinkled continuously at the sources of generation of particulate matter immediately,
5. Measures, like limiting vehicle speed at vulnerable locations, conducting public awareness, campaigns about the harmful effects of air pollution, and educating drivers to be more eco-friendly, must be taken.
6. Moreover, regulatory authorities must ensure that industries should discharge their moral and social responsibilities to protect the environment.
7. Severe pollution is found in Industrial areas, Heavy air pollution is found in commercial areas, Light air pollution is found in Residential areas.

It is observed that the air quality of Amravati city is degrading day to day which affects human health in Amravati City and adjoining areas. This is due to urbanization, vehicular traffic, and the Sofia power

plant in Amravati City. The present study is concerned with quantity having the O₃ and SPM concentration in the air. Other parameters of air pollution like RSPM, CO, SO₂, Lead, O₃, HCL, HF, HBr etc, can calculate to know the air quality of the city. These parameters can verify by the modeling part of air pollution.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

FUNDING SUPPORT

The author declares that they have no funding support for this study.

REFERENCES

- [1] Mozghan Moghtaderi, Marjan Zarei, Shirin Farjadiarjadian, Shahrooz Shamsizadeh (2016) prediction of the Impact of Air Pollution on Rates of Hospital spitalization for Asthma in Shiraz based on air Pollution Indices in 2007-2012
- [2] B. K. Chaudhuri, D.K. Markandey and 8. K, Tyagi (2016)- Quantification of Microbial population at Various Locations in Delhi In Indoor and Outdoor Environment
- [3] Sushil K. Tyagi, Vinay Kumar Upadhyay, Dolly Kulshreshtha, Surender Kumar P. Krishnamurthy, A. K. Sen (2016)- Study of Background Ambient Air Quality in Norther Himalayan Regions: Uttrakhand and Himachal Pradesh, India.
- [4] Dr. Kamal Kishore AND Dr. M. D. (2016)- Impact of Air Pollution on Health- Recent advances
- [5] Akanksha Shukla, S K Tyagi, Indra Thanaya (2016)- Investigations of Missing Values of air Pollution Data Set using Mathematical Regression Model and Correlation Study of pollutants in Delhi City
- [6] Anunay A. Gour, Santosh K. Singh, Sushil K. Tyagi, Anubha Manda (2015)- Variation in parameters of Ambient Air Quality in National Capital Territory (NCT) of Delhi (India)
- [7] Khaiwal Ravindra, Maninder Kaur, Siby John, Suman Mor and Saumyadipta Pyne (2015). air pollution in India: Bridging the Gap between Science and Policy
- [8] Lomate Varsha U (2015)- Studies on Air quality of Maharashtra, India.
- [9] Goverdhan Rathla K.S., Sankarappa T, Ashwajeet J.S. and Ramanna R (2015)- Effect of Temperature, humidity and other physical parameters on Air Pollution in and Around Belagavi Karnataka, India.
- [10] Ngele S. O. and Onwu F. K (2015)- Ambient Air Particulate Matter Levels in Selected urban Centers of Niger Delta Region. Nigeria.
- [11] Nair Neelima, Bamniya B. R. Mahecha G.S and Saini Dhavan (2015) Analysis of Ambient Air Pollution and Determination of Air quality Quality Status Udaipur Rajasthan, India.
- [12] Prof Somesh Jena et.al.(2015) Monitoring and assessment of Respirable Particulate and Matter (RSPM or PM₁₀), Fine particles(PM_{2.5}) and trace metals Lucknow city.