iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** VII **Month of publication:** July 2021

DOI: https://doi.org/10.22214/ijraset.2021.36386

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VII July 2021- Available at www.ijraset.com

Ambient Air Quality Monitoring in Industrial Areas of Lucknow City

Utkarsh[1], Dr. A.K. Shukla[2]
[1]*Student, M.Tech Environment Engineering, Department Of Civil Engineering, IET Lucknow -226024, U.P., India*
[2]*Professor, M.Tech Environmental Engineering, Department Of Civil Engineering, IET Lucknow -226026, U.P., India*

Abstract: ***Clean air is the basic requirement of living organism, but due to unplanned growth, industrial developments and vehicular boom the air has become polluted. This paper presents the air quality data interpretation and air quality index of 4 industrial locations of Lucknow city in the month of February 2021. Pollutants of major health concern include particulate matter and gaseous pollutants sulphur dioxide and nitrogen dioxide which can cause serious health issues to human beings. In this study prime air pollutants PM_{10}, $PM_{2.5}$, CO, SO_2, NO_2 and O_3 were calculated at 4 locations of Lucknow city. The concentrations of PM_{10}, $PM_{2.5}$, SO_2, NO_2 andO_3 were 135.65-230.6, 84.27-138.14, 9.3-18.6, 30.4-40.38, 18.1-36.37 ($\mu g/m^3$) respectively and CO ranged from 0.0-1.42 (mg/m^3). The mathematical calculations and laboratory testing are based on USEPA. PM_{10} and $PM_{2.5}$ at all station were higher than the CPCB recommendations while SO_2, NO_2, O_3 and CO was within the permissible limits. The AQI ranged from 182 to 308 which are categorised as moderate to very poor as per IND-AQI standards. Health impacts in these categories are breathing discomfort to sensitive people as well as to people with lungs, asthma and heart diseases.***

Keywords: Air quality, Air Pollution, Lucknow city, Air Quality Index, IND-AQI

I. INTRODUCTION

Air is a prime resource for survival of life, in addition to land and water. Clean air is required for better health and well-being of humanity J Arunkumar Patel et al., 2017. Ambient air pollution has emerged as one of the major challenge globally particularly in urban areas Neha Mumtaz et al., 2017. Clean air gets polluted in many ways like motor vehicle emissions, industrial effluents, forest fires etc. The problem has become more complex due to multiplicative increase in industries, automobiles, domestic fuel burnings, construction activities, road side dust etc SP Shukla et al., 2015. The pollution depends on the concentration of pollutants emitted from these sources. The pollution occurring depends not only on the pollutant concentration but also on the ability of atmosphere to either disperse or absorb those pollutants. Air quality can be described in a way to report the concentrations of all the air pollutants with standard acceptable limits.

The unplanned growth, industrial developments and vehicular boom has led to deterioration of air quality. Air pollution has severly affected lives of people and caused greater damage to ecosystem and society Prakash B.M et al., 2017. The most common air pollutants that affect the human health include particulate matter, carbon monoxide, sulphur dioxide, nitrogen dioxide and ozone Di et al.,2017; Sibel Mentese et al.,2020. Gaseous pollutants SO_2 and NO_2 undergo chemical transformation in atmosphere and form sulphates and nitrates Mugdha Nayak et al., 2016. The concentrations of these atmospheric pollutants from human polluting activities influence the atmospheric structure Banwari Dandotiya et al., 2020. These pollutants can pose a serious threat if they exceed the permissible limits either of CPCB or USEPA. As per WHO more than 4.2 million deaths worldwide occur as a result of exposure to ambient air pollution. More than half of the air pollution borne disease is burdened by the developing nations. The relationship between occurrence of respiratory and cardiovascular diseases and cardiopulmonary mortality with the exposure to air are well stated in the P Sicard et.al 2019.

The major effects due to NO_2, SO_2, O_3, CO and particulate emission on human health are popularly known Yadav et.al 2012. Among these air pollutants particulates are of major concern due to its adverse health effects, visibility reduction and soiling of buildings DH KIM et.al 2020. Many studies in past have documented the short term and long term effects on human health due to exposure of polluted air A Manju et al., 2018. Considering children, short term effect on exposure on them is higher as compared to adults of urban areas as the lungs of children are not fully developed Dandotiya B 2019.

According to USEPA, some criteria pollutants (PM_{10}, $PM_{2.5}$, SO_2 and NO_x) occur from a source directly in the atmosphere such as from construction sites, dusty and unpaved roads, smokestacks or fires, chimney towers etc. Most particles in the atmosphere form as result of complex reaction of chemicals such as sulphur dioxides and nitrogen dioxides, which are pollutants mostly emitted from power plants, industries and automobiles. The major sources responsible are SPM, RSPM, SO_2, NO_x and other inorganic and organic pollutants in environment was motor vehicle emission, Barman et.al 2010.

For the citizens to be well informed about the national and local air pollution problems and the related mitigation efforts, the concept of air quality index (AQI) has been developed. AQI in India was launched on September 17, 2014 in New Delhi. An AQI is defined as a scheme that converts weighted values of individual air pollutant into a single number or set of numbers M Sharma et.al 2013.

The National Ambient Air Quality Monitoring (NAAQM) programme was initiated by the Central Pollution Control Board in the year 1984. Subsequently, 1998-99 NAAQM was renamed as National Air Monitoring Programme (NAMP). The aim of this study is to assess the ambient air quality with respect to PM_{10}, $PM_{2.5}$, SO_2, NO_2, O_3 and CO in the industrial areas of Lucknow, Uttar Pradesh.

II. MATERIALS AND METHOD

A. Study Area

Lucknow is the capital and the largest city of Uttar Pradesh, India. Lucknow is a fast growing city as the area of Lucknow was 48 sq. km in 1951 which has now increased to 631 sq. km in 2021. The city has a population of 28.15 lakh as per 2011 census. In the proposed plan 2031 (Lucknow Development Authority) area of city will increase to 710 sq. km by inclusion of 197 villages and the population is projected to increase up to 65 lakh. The city lies between 26° 52′ latitude and 80° 56′ longitude at 126m above sea level. It is a rapidly growing and emerging as a manufacturing, commercial and retailing hub and this feature is responsible for the deteriorating air quality of the city. Industrial operations, construction activities, poor traffic control are some factors responsible for poor air quality. It is important for people especially of urban areas to understand the vehicular and industrial pollution along with its health impacts in short and long term. The study sites were chosen with respect to site selection criteria and keeping minimum interference of the local public with the devices used for the study. Four monitoring stations were chosen in order to measure the concentration of repairable suspended particulate matter, suspended particulate matter, sulphur dioxide, oxides of nitrogen, ozone and carbon monoxide in the surrounding environment.

B. Sampling Sites

Four sampling sites were chosen in the industrial area of Lucknow city after proper investigation to determine the criteria pollutants in ambient air. The criteria pollutants considered are PM_{10}, $PM_{2.5}$, NO_2, SO_2, CO and O_3. The locations where the air quality was monitored are Nadarganj, Talkatora, Parag Dairy (Butler Road), Amul Dairy (Sultarpur Road).

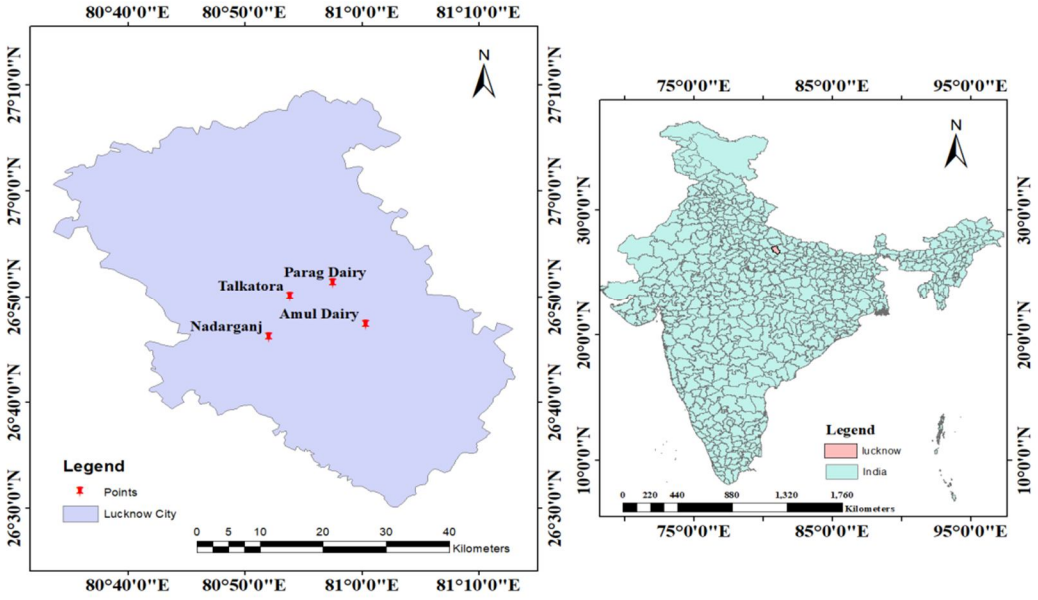


FIG. 1 Sampling Locations

C. Monitoring and Analysis

The monitoring of PM_{10} and $PM_{2.5}$ was carried out by Respirable Dust Sampler (Model- APS113) and Fine Particulate Monitor (Model- APS302) respectively. The flow rate for PM_{10} and $PM_{2.5}$ was 1.0-1.2 m^3/min for 24hours. The sampling of gaseous pollutants viz nitrogen dioxide, sulphur dioxide and ozone was done by the gaseous sampler attached to Respirable Dust Sampler. The flow rate for SO_2 and NO_2 was kept 0.2L/min and for ozone at 1l/min. Carbon Monoxide was measured directly by an electronic CO meter (GD101).

The sampling instrument was kept at a height of 1.5m above the ground level. Whatman (EPM- 2000) filter paper of 20x25 cm size for PM_{10} and 46.2mm diameter for $PM_{2.5}$ was used. The filter paper was weighed before and after the sampling to calculate the amount of particles collected. The concentration of PM_{10} and $PM_{2.5}$ was calculated by divding the weight of particles collected on the filter paper by volume of air sampled. The analysis of SO_2, NO_2 and O_3 was done by passing air through an impinger containing 30ml of absorbing solution. For SO_2, sodium tetrachloromercurate absorbing solution was used. A dichlorosulphitomercurate complex was formed which was reacted with para rosaniline and methysulphonic acid and therefore the absorbance of the solution was measured at wavelength of 560nm on spectrophotometer. For NO_2, sodium hydroxide and sodium nitrite was used as absorbing solution by reacting with hydrogen peroxide, sulphanilamide and N (1-naphthyl) ethylenediamine dihydrochloride. The absorbance of solution was read at 540nm. Potassium iodide absorbing solution was used for O_3 and the absorbance was read at 352nm.

D. Calculation of AQI

The AQI (air quality index) is a referential tool to describe the air quality of an area and provides information about real-time ambient air quality. The main purpose of AQI is to measure the quality of air in relations to its impact on human health Priyanka Agarwal et al., 2018. AQI is a widely used concept to create public awareness on air quality that good or bad it is for their health. It also provides a helping hand in data interpretation in decision making process related to pollution mitigation and environment management. The major advantages of AQI are its simple calculation with scientific basis. There are different equations and methodologies by which AQI can be calculated. In this study we used the CPCB method that uses USEPA method to calculate the Air Quality Indices in which the sub-indices and breakpoint concentrations of each pollutant depend upon the Air Quality Index proposed by the CPCB, New Delhi. The AQI of that location is taken as the maximum value of the sub-indices.

The general equation for the calculation of sub-index (Ii) for a given pollutant concentration (Cp); as based on 'linear segmented principle' is calculated as:

$$\mathbf{I_i = [\{(I_{HI} - I_{LO})/ (B_{HI} - B_{LO})\} * (C_p - B_{LO})] + I_{LO}}$$

Where,

B_{HI}= High breakpoint concentration ≥ given concentration.

B_{LO}= Low breakpoint concentration ≤ given concentration.

I_{HI} =AQI value commensurable to B_{HI}

I_{LO} = AQI value commensurable to B_{LO}

C_p = Concentration of pollutant

The higher the value of an index means higher the level of pollution and consequently higher is the health risk. To present the status of air quality, the descriptive categories adopted by IND-AQI. With respect to these AQI categories, the health impacts are described in Table I. Indian national ambient air quality standards for different pollutants.

Table I
Health Alert Description Of Ind-Aqi

IND-AQI Range	Category	Cautionary Statement
0-100	Good	Air quality is considered satisfactory and the pollution poses little or no risk
101-200	Moderate	Sensitive people with respiratory diseases are at greater risk.
201-300	Poor	Everyone may begin to experience health issues. Sensitive people may experience much more serious health effects.
301-400	Very Poor	This range may trigger a health alert, meaning everyone may experience more serious health issues.
401-500	Severe	This range triggers health warnings of emergency conditions. The entire population is more likely to be affected.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VII July 2021- Available at www.ijraset.com

III. RESULTS

The calculated values of the criteria pollutants (PM_{10}, $PM_{2.5}$, SO_2, NO_2, O_3 and CO) for the 4 sampling stations in February month are given in Table II and in the month of March are given in Table III. The PM_{10} and $PM_{2.5}$ concentration increased in the month of March due to high wind speed during that period.

Table II
Values of air Pollutants in February month

Station	PM_{10}	$PM_{2.5}$	SO_2	NO_2	O_3	CO
Nadarganj	158.08	107.0	15.2	36.1	22.1	1.28
Talkatora	171.02	122.4	17.1	37.3	25.5	1.42
Parag Dairy	140.41	93.3	12.2	30.4	18.1	1.04
Amul Dairy	135.65	85.0	11.6	35.4	19.2	0.0

Table III
Values of air Pollutants in March Month

Station	PM_{10}	$PM_{2.5}$	SO_2	NO_2	O_3	CO
Nadarganj	180.1	103.2	18.6	38.0	25.3	2.0
Talkatora	230.6	138.14	15.19	40.38	36.37	1.08
Parag Dairy	144.7	96.2	11.8	32.07	19.3	0.98
Amul Dairy	138.35	84.27	9.3	33.16	18.6	0.0

From Table II and III it is clear that PM_{10} and $PM_{2.5}$ concentration are higher than the recommended limit at all the sampling stations. Other pollutants SO_2, NO_2, O_3 and CO are all within the limits defined by NAAQS. The PM_{10} concentration varied from 138.35-230.6 $\mu g/m^3$ (Fig. 2), $PM_{2.5}$ concentration varied from 84.27-138.14 $\mu g/m^3$ (Fig. 3), SO_2 concentration varied between 9.3-18.6 $\mu g/m^3$ (Fig. 4), NO_2 concentration varied from 30.4-40.38 $\mu g/m^3$ (Fig. 5), O_3 concentration varied from18.1-36.37 $\mu g/m^3$ (Fig. 6) and CO concentration varied between 0-1.42 mg/m^3 (Fig. 7). From the above calculated concentrations of the criteria pollutants, AQI calculated by the IND-AQI method used by CPCB is listed in Table IV.

Table IV
Air quality Category Based on IND-AQI

Station	AQI	AQI Category
Nadarganj	250	Poor
Talkatora	308	Very Poor
Parag Dairy	216	Poor
Amul Dairy	182	Moderate

The AQI of Talkatora was categorized as very poor which meant serious health affects for everyone in surrounding. AQI of Nadarganj and Parag Dairy was poor and that of Amul Dairy was moderate which meant health of normal people will be affected but sensitive people will be prone to higher risk.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VII July 2021- Available at www.ijraset.com

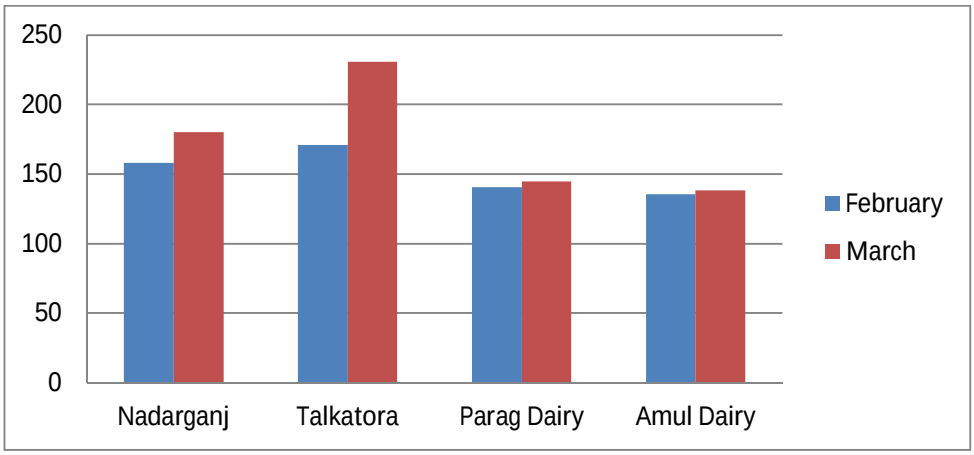


Fig. 2 Calculated value of PM_{10} µg/m^3 for February and March 2021

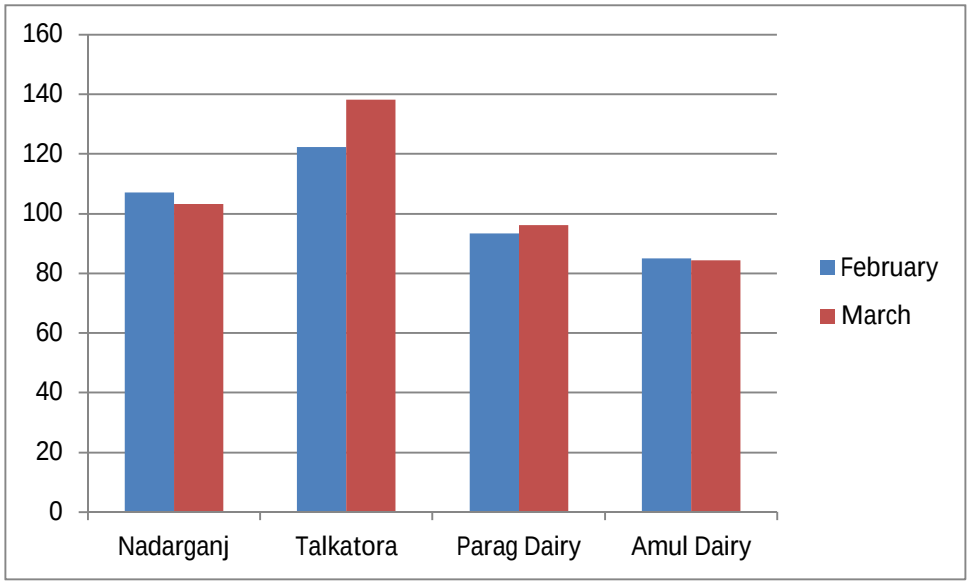


Fig. 3 Calculated value of $PM_{2.5}$ µg/m^3 for February and March 2021

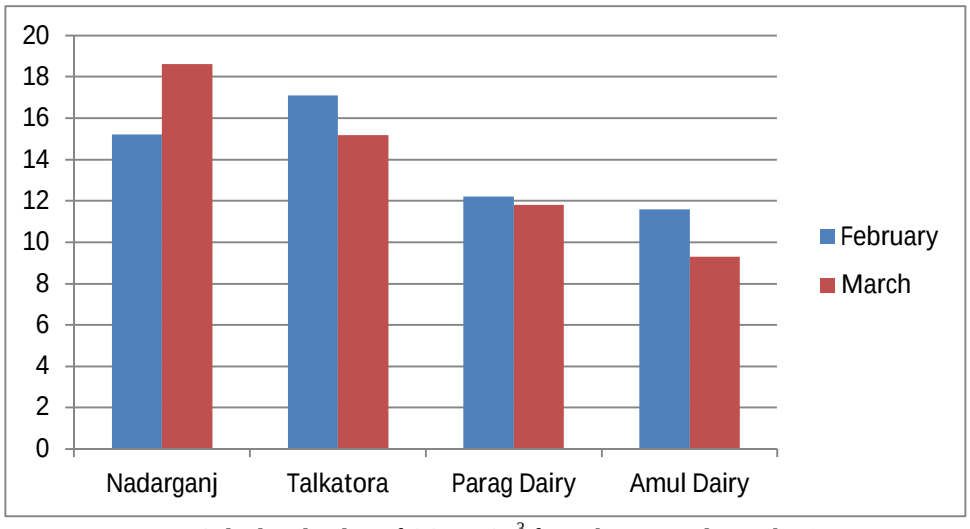


Fig. 4 Calculated value of SO_2 µg/m^3 for February and March 2021

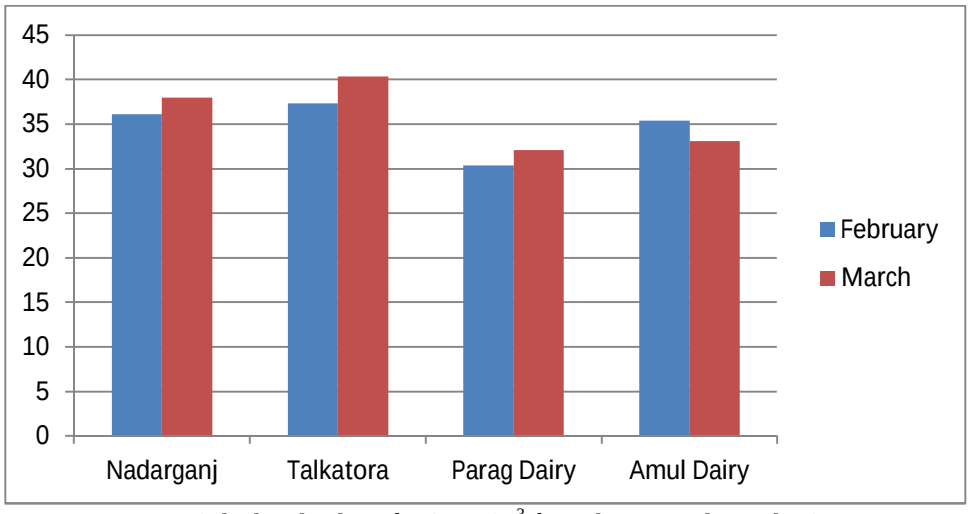


Fig. 5 Calculated value of NO_2 µg/m^3 for February and March 2021

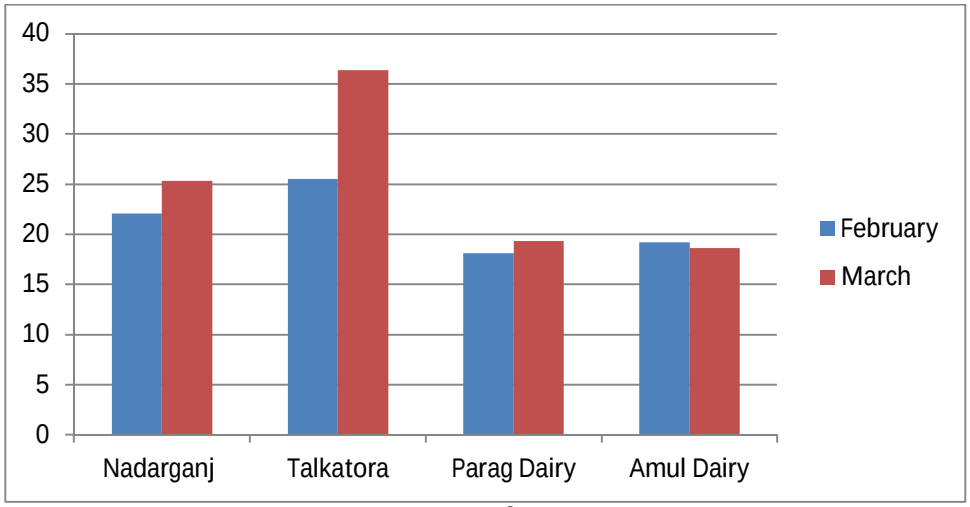


Fig. 6 Calculated value of O_3 µg/m^3 for February and March 2021

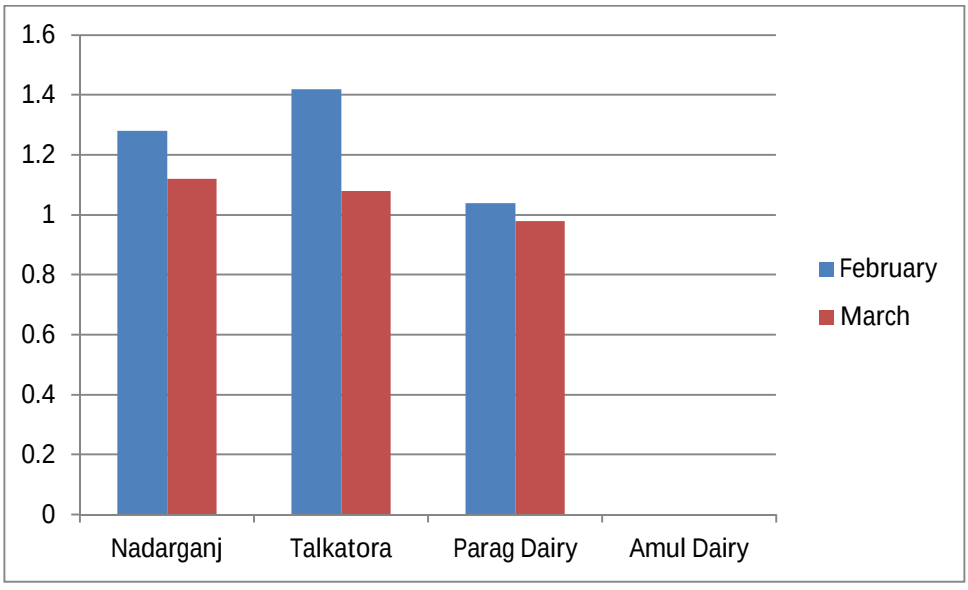


Fig. 7 Calculated value of CO mg/m^3 for February and March 2021

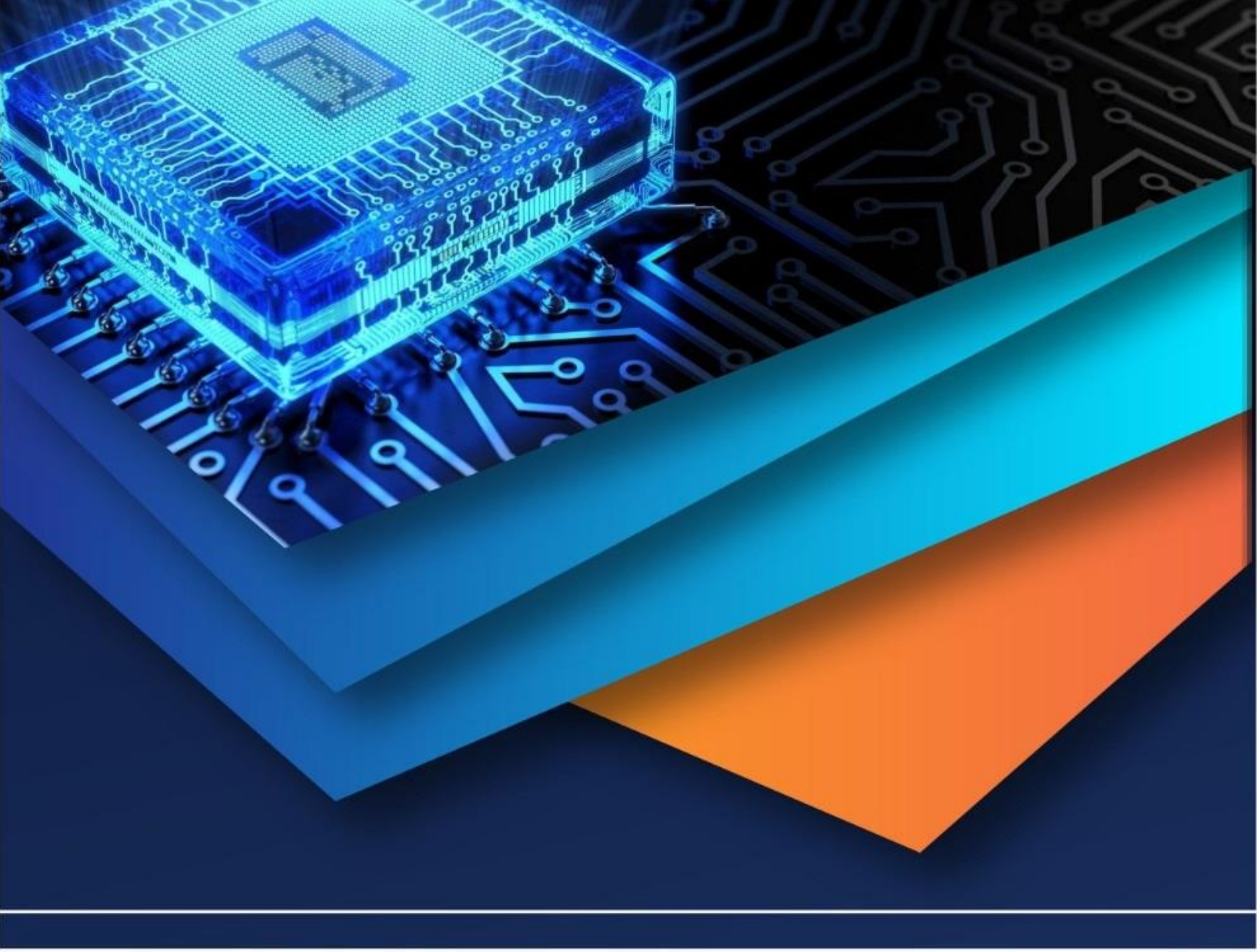
IV. CONCLUSION

Air pollutants such as PM_{10}, $PM_{2.5}$, NO_2, SO_2, CO and O_3 were measured for in the months of February and March for the assessment of ambient air quality. The results revealed are as follows –

A. The PM_{10} concentration at all sampling stations were higher than NAAQS.
B. The concentration of $PM_{2.5}$ was higher than NAAQS at all sampling stations.
C. The concentrations of gaseous pollutant, NO_2, SO_2, CO and O_3 were below the NAAQS at all sampling stations.
D. AQI at monitoring stations indicate that air pollution level at all stations were higher than NAAQS.
E. Overall study suggests that the level of air pollution in industrial areas of Lucknow is higher than the standards set by NAAQS and is more dangerous to sensitive people who are exposed to it.

REFERENCES

[1] Dandotiya, Banwari, Harendra K. Sharma, and Nimisha Jadon. "Ambient Air Quality and Meteorological Monitoring of Gaseous Pollutants inrban Areas of Gwalior City India." Environmental Claims Journal 32.3 (2020): 248-263.
[2] Hemavani, Bhavana, and GVR Srinivasa Rao. "A Comparative Study on Seasonal Variations of Air Quality Index (AQI) in Sanathnagar area of Hyderabad City, India." ILO 7.01 (2020).
[3] Mentese, Sibel, et al. "A comprehensive assessment of ambient air quality in Çanakkale city: emission inventory, air quality monitoring, source apportionment, and respiratory health indicators." Atmospheric Pollution Research 11.12 (2020): 2282-2296.
[4] Sicard, Pierre, et al. "Effect of O 3, PM 10 and PM 2.5 on cardiovascular and respiratory diseases in cities of France, Iran and Italy." Environmental science and pollution research 26.31 (2019): 32645-32665.
[5] Dandotiya, Banwari. "Health Effects of Air Pollution in Urban Environment." Climate Change and Its Impact on Ecosystem Services and Biodiversity in Arid and Semi-Arid Zones. IGI Global, 2019. 96-115.
[6] Manju, A., et al. "Spatio-seasonal variation in ambient air pollutants and influence of meteorological factors in Coimbatore, southern India." Air Quality, Atmosphere & Health 11.10 (2018): 1179-1189.
[7] Patel, Jagrutiben Arunkumar, Bhavesh I. Prajapati, and Viralben Panchal. "Assessment of ambient air quality and air quality index (AQI) in Dahej area, Gujarat, India." Nature Environment and Pollution Technology 16.3 (2017): 943.
[8] Mumtaz, Neha, Anshika Yadav, and Tabish Izhar. "Assessment of Ambient Air Quality of Lucknow City, Uttar Pradesh: A." (2017).
[9] Prakash, B. M., et al. "Assimilative capacity and air quality index studies of the atmosphere in Hebbal industrial area, Mysuru." International Journal of Innovative Research in Science, Engineering and Technology 6.10 (2017): 20651-20662.
[10] Agarwal, Priyanka, and Uma Melkania. "Assessment of the Ambient Air Quality at the Industrial Area using the Air Quality Index Metho (AQI)." International Journal of Agriculture, Environment and Biotechnology 11.2 (2018): 227-233.
[11] Shukla, S. P., et al. "Air Quality Index for Uttar Pradesh with a focus on Lucknow." International Journal of Scientific and Innovative Research 3 (2015): 134-151.
[12] Rao, S. Srinivasa, N. Srinivasa Rajamani, and E. U. B. Reddi. "Assessment of Ambient Air Quality at Gajuwaka Industrial Hub in Visakhapatnam using IND-AQI method." International Journal of Engineering and Applied Sciences 2.9: 257831
[13] Lawrence, Alfred, and Nishat Fatima. "Urban air pollution & its assessment in Lucknow City—the second largest city of North India." Science of the total environment 488 (2014): 447-455.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY