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AIR QUALITY AND EXCEEDANCE FACTOR OF ALWAR AND BHIWADI (RAJASTHAN)

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Abstract: **This study presents the concentration of air pollutants namely PM_{10}, $PM_{2.5}$, NO_2, SO_x and O_3, at two cities of Rajasthan India namely Alwar and Bhiwadi and their comparison with National Ambient Air Quality Standard to assess the air quality. The results Shows that gaseous pollutants such as SOx, NO_2, and O_3 were within the permissible limits in both the cities but particulate matter (PM_{10}, $PM_{2.5}$)was found higher than permissible NAAQS limit in both cities. The maximum concentration of $PM_{10}$and $_{PM2.5}$ was found 183.80 µg/m^3 and 121 µg/m^3respectively at Bhiwadi and Alwar. The study also shows that PM_{10} and $PM_{2.5}$ are criticaly polluting the ambient air quality of both cities. It may pose detrimental effect on human and environmental health. In this study AQI and Exeedence factor was also calculated. AQI result reveal that air quality of Bhiwadi was in poor category. Exeedence Factor also indicate that PM_{10} and $PM_{2.5}$ are the predominate cause of air pollution in Bhiwadi and Alwar cities.**

Keywords: - **Air Quality, AQI, Pollution, Exeedence Factor, PM_{10}, $PM_{2.5}$**

I. INTRODUCTION: -

Air pollution poses a worldwide threat to human health and environment. Air pollution in urban area is mainly due to emissions of industrial gases and traffic related particulates, which undergo dispersion, transport and chemical reaction in the atmosphere and are deposited as gaseous ions, solid and liquid particles. In developing countries, the air quality crisis in urban areas is attributed to vehicular emissions, which contributes 40-80% of total air pollution. There are evidences that air quality is worsening in the developing countries. (Charan and Sahel 2014)

Rapid and unsystematic industrialization has become a major environmental concern for both developed and developing countries. Long-term and short-term effects on human health have been observed due to poor air quality.

The most prominent pollutants are particulate matter (PM_{25} and PM_{10}), SO_x, NO_2, O_3, etc. and increased levels of these pollutants have a direct impact on environmental health (Gulabchandani and Sethi).Cities are hotspots of air pollution due to high population densities, resulting in greater transportation activities. Lack of proper maintenance of vehicles is also a major cause of air pollution which results in poor air quality (Ruhela et al. 2022).

Air pollution seriously damages material sources such as building, various sculptures, and also vegetation. It may be due to particulate matter dispersed in it or gaseous pollutants completely miscible with it in all proportions. Gaseous pollutants such as SO_2, NOx, CO_2, etc., dispersed in air are the major source of air pollution. (Sarasamma and Narayanan, 2014).

Fig. 1 Showing location of Rajasthan in map of India

Fig. 2 Showing Location of Alwar in map of Rajasthan

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Fig. 3 Showing location of Alwar and Bhiwadi in map of Alwar

Study Area:

Alwar is a district in the state of Rajasthan in northern India, district is situated in the north-east of Rajasthan between 27°34' and 28°4' north Latitudes and 76°7' and 77°13' east Longitudes.Bhiwadi is situated at 28.21°N, 76.87°E. It is 60 km away from New Delhi and 90 km From Alwar. Bhiwadi is a planned city located in Alwar district of the Indian state of Rajasthan. Bhiwadi is the fastest growing industrial town on the outskirts of Delhi.

The district has a dry climate with a hot summer, a cold winter and a short monsoon season. The cold season starts by about the middle of November and continues up to about the beginning of March.

Methodology: Ambient air monitoring was conducted during summer season from March 2022 to June 2022. 8-hour sampling was done for PM_{10}, $PM_{2.5}$, SO_x NO_2 and O_3. APM-460 respirable dust samplers (RDS) with provision for gaseous sampling APM-415 (Envirotech, New Delhi) was used for measuring the concentrations of PM_{10}, $PM_{2.5}$, NO_2, and SO_x, in the ambient air. The sampling inlet was placed 1-3 meter above the ground level, depending upon the site available for the RDS. Atmospheric air was drawn for 8 hours through the cyclone and 20 X 25 cm glass fiber filter (GFF) sheet at a flow rate of 1.0 to 1.2 m3min and finally the average flow rate was calculated.

In the present study, an attempt has been made to assess the prevailing concentration of the PM_{10}, $PM_{2.5}$, SO_x and NO_2, in the fast-growing cites of Rajasthan (CPCB: 2003). AQI is calculated as per steps given in the CPCB report and computed on Microsoft Excel software and Exceedance factor is used to identify the level of pollution (critical, high, moderate, and low). Following is the equation to find the exceedance factor.

$$\text{Exceedance Factor} = \frac{\text{The annual average concentration of critical pollutant}}{\text{The annual standard for a particular pollutant}}$$

II. RESULTS AND DISCUSSION:

The sampling and analysis of ambient air quality parameters for two selected station was done for summer season in monthly interval. The results of ambient air quality of two different locations Alwar and Bhiwadi in Rajasthan.

Table: 1 Air Quality data of Alwar

S. No.		Parameter				
	Sampling	**PM2.5**	**PM10**	**SOx**	**NO2**	**O3**
1	**S1**	58.12	134.63	30.78	68.11	39.08
2	**S2**	62.99	129.70	33.61	62.78	44.21
3	**S3**	69.37	137.44	29.20	68.92	48.23
4	**S4**	65.75	143.29	31.82	71.24	47.58
5	**Mean**	**64.06**	**136.27**	**31.35**	**67.76**	**44.78**
6	**±SD**	**4.74**	**5.67**	**1.85**	**3.58**	**4.19**

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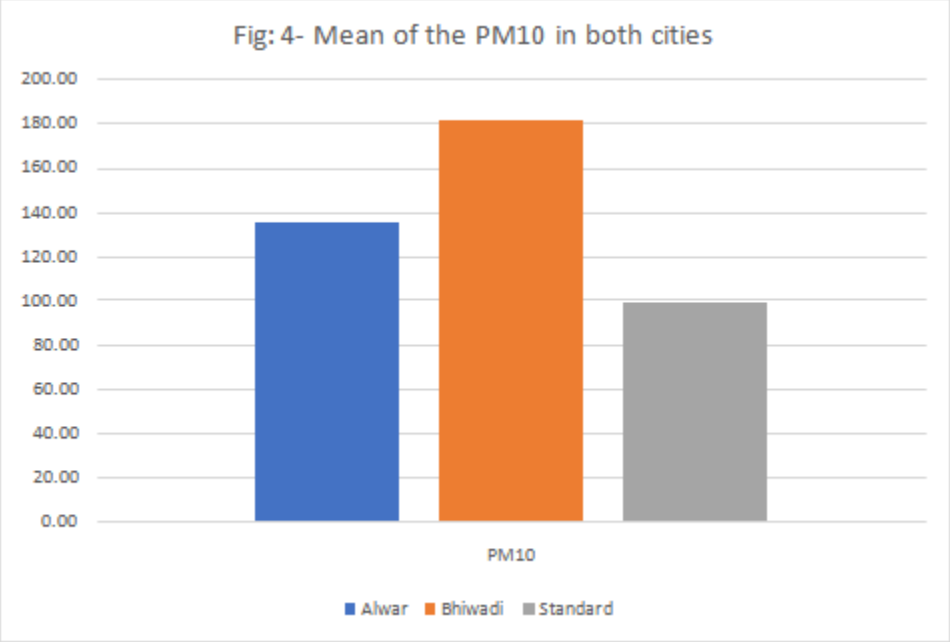
Table: 2 Air Quality Data of Bhiwadi

S. No.		Parameter				
	Sampling	**PM2.5**	**PM10**	**SOx**	**NO2**	**O3**
1	**S1**	113.83	182.68	26.19	56.47	78.82
2	**S2**	118.36	177.92	27.88	58.12	77.29
3	**S3**	111.52	183.80	26.32	57.18	79.02
4	**S4**	121.00	181.92	28.81	61.11	80.17
5	**Mean**	**116.18**	**181.58**	**27.30**	**58.22**	**78.83**
6	**±SD**	**4.29**	**2.56**	**1.27**	**2.04**	**1.18**

Table: 3 Mean data of Study Area

Station	**Alwar**	**Bhiwadi**	**Standard**
PM2.5	64.06	116.18	60
PM10	136.26	181.58	100
Sox	31.35	27.30	80
NO2	67.76	47.47	80
O3	44.77	78.82	100



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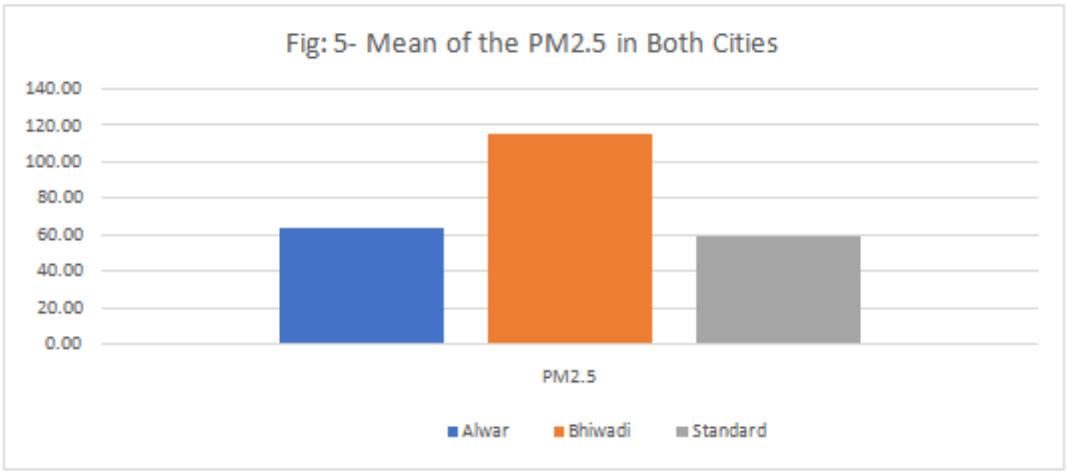

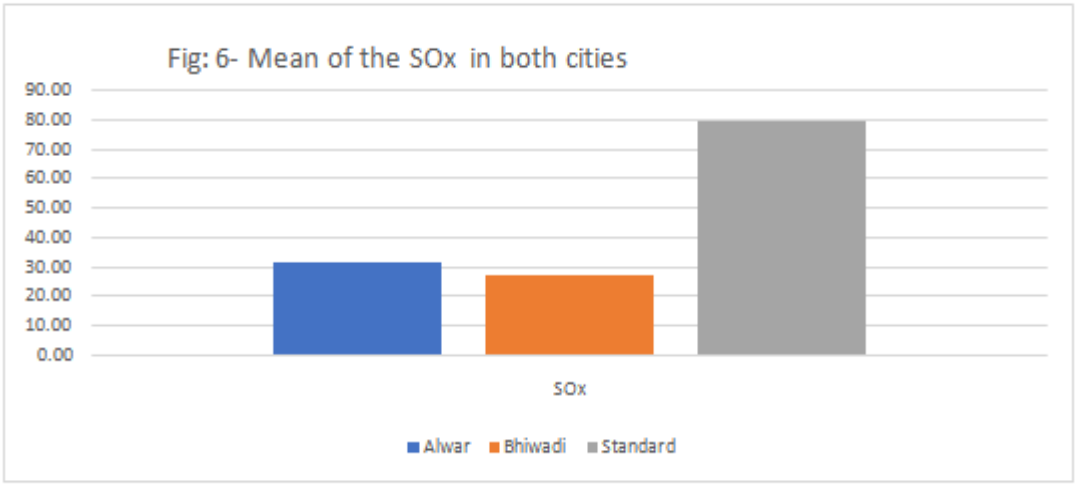

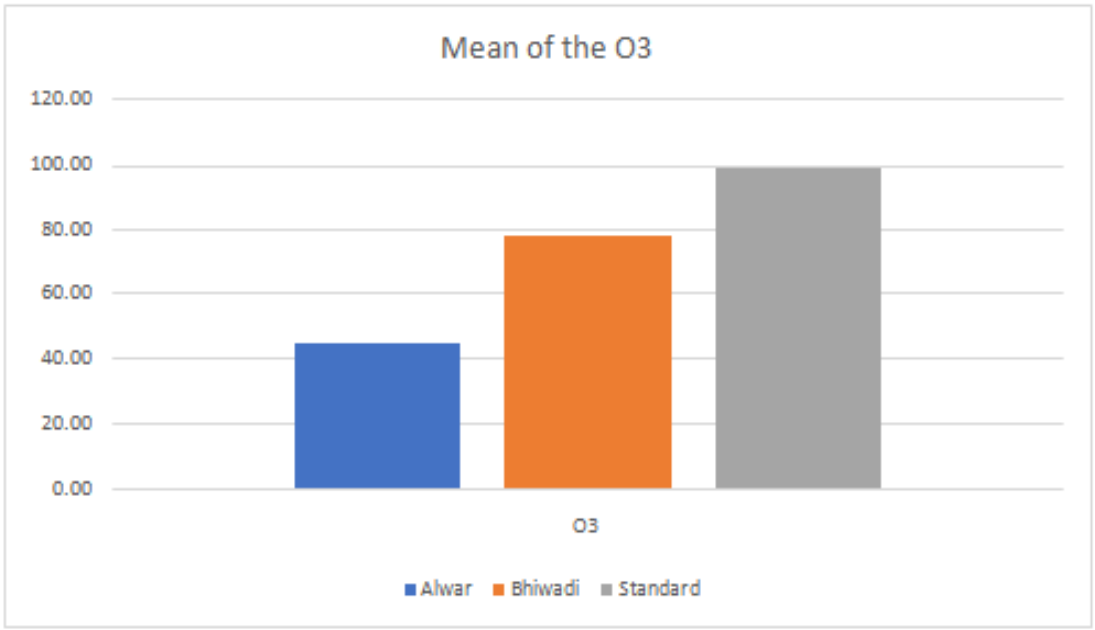

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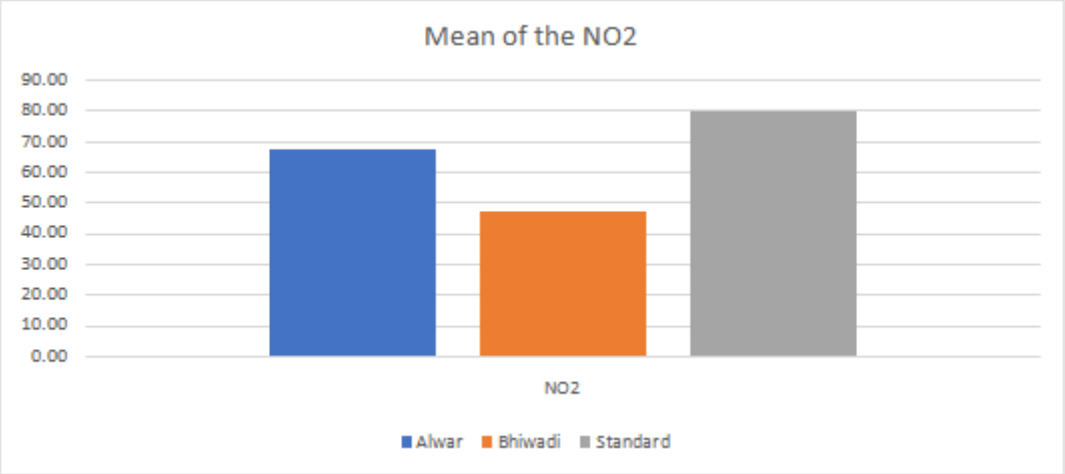

The monthly average concentration of PM10 varied from129.70 to 143.29µg/m3 at Alwar and 177.92 to 183.80 µg/m3 at Bhiwadi. The mean of PM10 at Alwar (136.27±SD.5.67) and Bhiwadi (181.58±SD.2.56) is the Value of PM10 is higher than standard limit (fig-4).

The monthly average concentration of PM2.5varied from58.12 to 69.37µg/m3 at Alwar and 111.52 to 121µg/m3 at Bhiwadi. The mean of PM10 at Alwar (64.06±SD.4.74) and Bhiwadi(116.18±SD.4.29) is the Value of PM2.5 is higher than standard limit (fig-5).

The monthly average concentration of SOx varied from 29.20 to33.61µg/m3 at Alwar and 26.19 to 28.81µg/m3 at Bhiwadi. The mean of SOx at Alwar (31.35±SD.1.85) and Bhiwadi (27.30±SD.1.27) is the Value of SOx is within standard limit (fig-6).

The monthly average concentration of NO2 varied from 62.78 to71.24µg/m3 at Alwar and 56.47 to 61.11µg/m3 at Bhiwadi. The mean of NO2 at Alwar (67.76±SD.3.58) and Bhiwadi (58.22±SD.2.04) is the Value of NO2 is within standard limit (fig-7).

The monthly average concentration of O3 varied from 39.08 to 48.23µg/m3 at Alwar and 77.29 to 80.17µg/m3 at Bhiwadi. The mean of O3 at Alwar (44.78±SD.4.19) and Bhiwadi (78.83±SD.1.18) is the Value of O3 is within standard limit (fig-8).

Table 4 National Ambient Air Quality Standard (2009)

S.NO.	Name of Pollutant	Time weighted average	Concentration in ambient air	
			Industrial, residential, Rural & other Area	Ecologically sensitive area (notified by central government
1	SOx (µg/m^3)	Annual	50	20
		24 hours	80	80
2	NO_2 (µg/m^3)	Annual	40	30
		24 hours	80	80
3	PM_{10} (µg/m^3)	Annual	60	60
		24 hours	100	100
4	$PM_{2.5}$(µg/m^3)	Annual	40	40
		24 hours	60	60

Source: CPCB, 2009

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AQI:

Station	AQI	Category
Alwar	124	Moderate
Bhiwadi	287	Poor

Table 6: - AQI of Panipat and Manesar

AQI of various selected location were calculated and given in table. Alwar was found within range of 100-200. Which indicate moderate air quality. Bhiwadi was found within range of 201-300. Which indicates poor air quality. Its May cause breathing discomfort to people on prolonged exposure and discomfort to people with heart disease

Table 5: - Air Quality Index Value Remark and Health Effects

Index Value	Remark	Health Effects
0-50	Good	Minimal Impact
51-100	Satisfactory	Minor breathing discomfort to sensitive people
101-200	Moderate	Breathing discomfort to the people with lung
201-300	Poor	May cause breathing discomfort to people on prolonged exposure and discomfort to people with heart disease
301-400	**Very Poor**	May cause respiratory illness to the people on prolonged exposure. Effect may be more pronounced in people with lung and heart disease
>401	Severe	May cause respiratory effects even on healthy people and serious health impact on people with lung/heart diseases. The health impact may be experienced even during light physical activity

Exceedance factor: The exceedance factor is the average concentration of critical pollutants and their corresponding national air quality standard. According to their critical pollution level exceedance factor divided into various categories;

Table 9 Exceedance factor with their respective range

Level of pollution	Exceedance factor
Low pollution	< 0.5
Moderate pollution	0.5-0.9
High pollution	1.0-1.4
Critical pollution	>1.5

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Parameter	Exceedance Factor		Level of Pollution	
	Alwar	Bhiwadi	Alwar	Bhiwadi
PM2.5	1.07	1.94	High pollution	Critical pollution
PM10	1.36	1.82	High pollution	Critical pollution
SOx	0.39	0.34	Low pollution	Low pollution
NO2	0.85	0.59	Moderate pollution	Moderate pollution
O3	0.45	0.79	Low pollution	Moderate pollution

Table 10: Exceedance factor

III. CONCLUSION

The results reveal that air pollution in Alwar and Bhiwadi is largely due to high PM_{10} and $PM_{2.5}$ level. This study shows that average concentration of SO_x and NO_2 and O_3 is well below the CPCB standard at both the cities. The AQI was found in moderate range in Alwar and poor-quality range in Bhiwadi. The exceedance factor was showing PM_{10} and $PM_{2.5}$ were major polluting factors. Study shows that the Bhiwadi is more polluted than Alwar.

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