



AIR QUALITY INDEX DETERMINATION OF RESIDENTIAL AREAS OF JODHPUR CITY: A CASE STUDY

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ABSTRACT

This paper presents a case study of Jodhpur City in which residential areas have been analysed for their ambient air quality analysis. Whole experimental and calculative procedure was based on the guidelines of Central Pollution Control Board of India. 24 hourly average concentrations of five criteria pollutants i.e., PM₁₀, PM_{2.5}, SO₂, NO₂ and CO were selected for the study for the year 2016 at five different locations of residential areas in Jodhpur city. Observations were taken twice in a week for three months. Results revealed that SO₂ and NO₂ concentrations were within prescribed limit of standard norms. CO concentration was also within permissible limit except few areas. Only particulate matters were crossing the standard limit and specially PM₁₀. Overall AQI was falling under the category of Good to moderate category. Thus, it can be concluded from the study that major pollution in the residential areas of Jodhpur was due to particulate matters.

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INTRODUCTION

Today pollution in urban areas especially in residential areas has become an important issue to all the government. Because of increasing commercial activities, industrial activities and transportation load air quality is continuously deteriorating. The acute health effect of suspended particulate matter (SPM), even at short term low levels exposure; include increased daily mortality and hospital admission rates for exacerbation of respiratory disease⁶. Long term exposure to PM_{2.5} increases the risk of the non accidental mortality. Living close to busy traffic appears to be associated with elevated risk¹. The available human clinical results do not establish a mechanistic pathway leading to adverse health impacts for short term NO₂ exposure at present day ambient environment². In all the analytical studies total mortality was directly associated with long term exposure to particulate matter⁵. Each day our lungs are directly exposed to more than 7000 liters of air, which contain varying amount of inorganic, organic particles and various types of gases³. Air Quality Index is a medium to communicate the quality of ambient air to common people so it is easy to understand. It transforms the complex data of various air pollutants into a single number which is called index value along with nomenclature and colour. Jodhpur is the second largest city of Rajasthan and is a well-known tourist

place. There are more than 3 lakh registered vehicles in Jodhpur city and also this city has desert like climatic and soil structure which in overall contribute more to air pollution. Varieties of pollutants are emitted in ambient air of Jodhpur city but particulate matters primarily dominate. Jodhpur is Rajasthan's most polluted city as per May 2016 report of World Health Organisation⁷. Therefore an attempt was made to present overall air quality in residential areas of Jodhpur city in terms of Air Quality Index & AQI has been calculated as per the guidelines of Central Pollution Control Board of India⁴.

MATERIAL AND METHOD

Monitoring has been carried out at five different locations in residential areas of Jodhpur city i.e., Chaupasani Housing Board Sector-10, Shastri Nagar, Sector-G, Saraswati Nagar, Golf Course and Nehru Park. Five ambient air pollutants (i.e. PM₁₀, PM_{2.5}, SO₂, NO₂ and CO) were determined using Respirable Dust Sampler, Fine Particulate Sampler, gaseous sampling attachment (EPA modified-West and Gaeke method for SO₂ and Modified Jacobs Hochheiser method for NO₂) and CO meter respectively. Readings were taken for twice in a week during the months of March to May as per the norms established by Central Pollution Control Board. Particulate matters measured by Cyclonic Flow Technique and Gravimetric method using GF/A filter papers on 8 hourly basis for 24 hours. Size of filter paper for PM₁₀ was 20.3 cm × 25.4

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cm with a flow rate of 1000 L/min and 47 mm at the rate of 16.7 L/min for PM_{2.5}. Gaseous pollutants which were SO₂ and NO₂ were measured using gaseous sampling attachment attached with Rapid Dust Sampler. Carbon Mono-oxide was measured using CO meter at the desired locations instantly.

Sub-Index calculation

Air Quality index (AQI) is so deigned that any three of the parameters from PM₁₀, PM_{2.5}, SO₂, NO₂, CO, O₃, Pb, &NH₃, are sufficient to calculate the AQI. Sub-indices of eachselected pollutants were calculated and then highest value from among all the values of sub index was considered as AQI for that area.

The sub-index (I_p) for a given pollutant concentration (C_p) was calculated as⁴,

$$I_p = \left[\left\{ \frac{I_{HI} - I_{LO}}{B_{HI} - B_{LO}} \right\} \times (C_p - B_{LO}) \right] + I_{LO}$$

Where,

B_{HI}= Breakpoint concentration greater than or equal to given concentration

B_{LO}= Breakpoint concentration smaller than or equal to given concentration

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

I_{LO}= AQI value corresponding to B_{LO}, subtract one from I_{LO} if I_{LO} is greater than 50

C_p= Pollutant concentration

Finally, AQI = Max (I_p) (where, p = 1, 2, 3 ...denotes n pollutants)

Observations & Analysis

Observed values, standard values and calculated values ofvarious parameters are given in table no 1 to 3.

Table 1 Location of monitoring stations

S.N.	Station Name	Location	
		Latitude	Longitude
1.	Chaupasani Housing Board, Sector-10	26°15'58'' N	72°58'30'' E
2.	Shastri Nagar, Sector-G	26°15'51'' N	72°59'55'' E
3.	Saraswati Nagar, Sector-8, Basani	26°13'48'' N	73°01'03'' E
4.	Air Force Area, Golf Course	26°15'28'' N	73°02'01'' E
5.	Nehru Park, Sardarpura	26°16'27'' N	73°00'45'' E

Table 2 Breakpoints for AQI Scale 0-500 (Units: µg/m³ unless mentioned otherwise)⁴

AQI Category	PM ₁₀	PM _{2.5}	NO ₂	CO	SO ₂
(Range)	24-hr	24-hr	24-hr	8-hr (mg/m ³)	24-hr
Good (0-50)	0-50	0-30	0-40	0-1.0	0-40
Satisfactory(51-200)	51-100	31-60	41-80	1.1-2.0	41-80
Moderately polluted(101-200)	101-250	61-90	81-180	2.1-10	81-380
Poor(201-300)	251-350	91-120	181-280	10-17	381-800
Very poor(301-400)	351-430	121-250	281-400	17-34	801-1600
Severe(401-500)	430+	250+	400+	34+	1600+

Table 3 Pollutant concentrations at different monitoring stations

Station Name: Chaupasani Housing Board, Sector-10						
Sub Index	Pollutants					AQI
	SO ₂	NO ₂	PM ₁₀	PM _{2.5}	CO	
Maximum	8	42	127	78	16	127
Minimum	6	29	105	57	10	105
Average	7	36	117	68	12	117
Station Name: Shastri Nagar, Sector-G						
Sub Index	Pollutants					AQI
	SO ₂	NO ₂	PM ₁₀	PM _{2.5}	CO	
Maximum	10	47	128	97	24	128
Minimum	7	36	110	73	16	110
Average	8	42	122	85	20	122
Station Name: Saraswati Nagar						
Sub Index	Pollutants					AQI
	SO ₂	NO ₂	PM ₁₀	PM _{2.5}	CO	
Maximum	9	52	147	110	24	147
Minimum	8	38	132	83	15	132
Average	9	45	138	95	20	138
Station Name: Air Force Area, Golf Course						
Sub Index	Pollutants					AQI
	SO ₂	NO ₂	PM ₁₀	PM _{2.5}	CO	
Maximum	9	49	146	127	20	146
Minimum	7	27	132	85	12	132
Average	8	36	139	98	16	139
Station Name: Nehru Park, Sardarpura						
Sub Index	Pollutants					AQI
	SO ₂	NO ₂	PM ₁₀	PM _{2.5}	CO	
Maximum	9	47	160	207	25	207
Minimum	7	27	137	133	17	137
Average	8	36	149	172	21	172

CONCLUSION

Results of these areas reveal that SO₂ and NO₂ concentrations were within prescribed limit as per NAAQS (National Ambient Air Quality Standard) norms. Reason for low concentration of above two pollutants may be because of absence of their major source of production like burning of fuels and lack of industrial activities near these residential areas and also various measures taken by the government to reduce their concentration like reduction of sulphur in fuel, reduction in old vehicles, better traffic management etc. Carbon mono-oxide (CO) concentration was almost within the prescribed limit set by NAAQS but it was observed little high in some areas. . Pollutants like PM₁₀, PM_{2.5} were exceeding the prescribed limit, especially PM₁₀. Large amount of these particulate matters in ambient air may be because of high traffic density consisting majority of heavy vehicular movement, natural dust etc. AQI in these areas varies between 105 and 207 and these values indicates that air quality lies between satisfactory to moderate polluted. As in Jodhpur most of the time atmospheric condition remains unstable with moderate wind velocity even than in some areas AQI is more than 200 which indicates that in future if proper measures are not taken now to control the pollution level situation may become worse. Hence now administration must take proper action so that in future, fresh air is available to the residents of city.

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