IOSR Journal of Engineering (IOSR JEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
PP 38-42

Ambient Air Quality of Jaipur City: A Case Study

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Abstract: *Air pollution is a serious problem which causes great loss to the health of human and other living beings. The major causes of air pollution are industrialization, urbanization and increased number of vehicles. In this study, three important parameters such as NO_2, SO_2 & PM10 of ambient air at five locations of Jaipur city were collected and analyzed. The monthly average of these pollutants were calculated and compared with the CPCB standards. The analysis of data shows that SO_2 and NO_2 are within the permissible limits while PM10 is found to be above the permissible limits at all the locations.*

Keywords: *Air pollution, Ambient Air Quality, NO_2, SO_2. PM10*

I. Introduction

Rapid urbanization and industrialization has become a major environmental concern for developing countries. In India, ambient air quality has progressively deteriorated due to rapid urbanization, industrialization, exponential growth of vehicles, increased construction activities, burning of agricultural waste, domestic cooking and dust storms. Central and State authorities have taken some regulatory steps to curb emissions and reduce ambient air pollution. However lack of rational policy as well as unplanned growth across various developmental sectors (construction, transport, industry) has caused hindrance in the efforts.

AQI is a tool, introduced by Environmental Protection agency (EPA) in USA to measure the levels of pollution due to major air pollutants. In the present study the AQI was calculated using IND-AQI specified (Sharma et.al. 2000, 2003b). The index has been developed based on the dose-response relationship of various pollutants. The index is named as INDAQI (Indian Air Quality Index) and is useful as it indicate the day to day changes in air quality.

Earlier some researchers had been conducted studies to find the level of pollutants in the ambient air and their remedial measures. Sharma and Sharma (2016) carried out study in Vishwakarma Industrial (VKI) area of Jaipur city and found both particulate pollutants (PM 10and PM 2.5) above permissible limits. The results showed that high particulate concentration might be due to heavy transport activity, industrial emissions, dust from paved roads, garbage burning in open, use of conventional fuels like wood, cow dung etc for cooking and other domestic purposes. Also it was observed that concentration during winters as compared to summer and monsoon was high which might be due to slow dispersion of pollutants in air during winters.

A study was conducted by Sharma (2016) at fifteen different locations of Ajmer city. The size classification of the particulate was achieved through a cyclone installed in the sampler which separates the respirable (PM10) and non respirable fractions. The air quality parameters such as suspended particulate matter (SPM), Respirable suspended particulate matter (RSPM), SO2 and NOx were studied. The result revealed that gaseous pollutants such as SO2 and NOx are within the permissible limits and particulate matter is the predominant cause of air pollution in the study area. The AQI method involves formation of subindices for each pollutant and aggregation of sub-indices. It has been developed on the dose-response relationship of various pollutants (Prakash Mamta, 2010).

Mean levels of each air parameter were calculated using excel spreadsheet. The AQI was calculated for all the sampling areas using the daily average concentration of the measured parameters. The AQI is divided into six groups with a specific colour assigned to each in order to comprehend at first glance whether air contaminants are approaching unhealthy levels in the area (**Table 1**). (National Air Quality Index, CPCB, October 2014)

AQI	Levels of health concern	Colours
0-50	Good	Green
51-100	Moderate	Yellow
101-150	Unhealthy for sensitive groups	Orange
151-200	Unhealthy	Red
201-300	Very unhealthy	Purple
301-500	Hazardous	Maroon

Table 1: Air Quality Index (AQI) values, health concerns and color codes. *Source: https://www.airnow.gov

Ahmed and Bano (2015) studied the ambient air quality status of Firozabad city in which four pollutants such as SPM, RSPM, SO2 and NOx were measured. The authors concluded from this study that the RSPM level at all monitoring stations was found to be increased and higher than permissible limits. Dohere and Pandey (2014) conducted a study at Pondicherry, Nasik, Pune, Cuttuck, Udaipur and Kolkata. In this study monitoring of ambient air quality parameters such as Sulphur Dioxide(SO2), Nitrogen Dioxide(NO2), Particulate Matter (PM2.5 ,PM10), Ozone(O3), Lead(Pb), Carbon Monoxide(CO), and Nickel(Ni) was studied. The concentration of above mentioned parameters were found to be highest at industrial site, followed by commercial sites and lowest at residential and rural sites.

The table 2 shows the Linear segmented relationship for sub-index values and the corresponding pollutant concentrations that are calibrated to Indian conditions.

Table - 2:
Break Points of Various Pollutants (National Air Quality Index, CPCB, October 2014)
(Units: $\mu g/m^3$)

AQI Category Range	*PM_{10} (24hr)*	*$PM_{2.5}$ (24hr)*	*SO_2 (24hr)*	*NO_2 (24hr)*
Good (0-50)	*00-50*	*0-30*	*0-40*	*0-40*
Satisfactory (51– 100)	*51-100*	*31-60*	*41-80*	*41-80*
Moderately Polluted (101–200)	*101-250*	*61-90*	*81-380*	*81-180*
Poor (201-300)	*251-350*	*91-120*	*381-800*	*181-280*
Very Poor (301-400)	*351- 430*	*121-250*	*801-1600*	*281-400*
Severe (401-500)	*>430*	*>250*	*>1600*	*>400*

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In view of the earlier studies, authors conducted the present study with the following objectives:

- To collect the data of ambient air quality of Jaipur City
- To analyze the collected data and compared with CPCB standard.
- To identify the major reasons for air pollution, and
- To suggest the remedial measures to improve the air quality

II. Methodology

In the present study, APM 460 NL respirable dust sampler manufactured by Envirotech Ins. Pvt. Ltd. was used for sampling purpose. The samplers were being installed in the breathing zone at 1.5 m. The flow rate of air is kept in the range of 1.0- 1.3 m^3/min. The size classification of the particulate was achieved through a cyclone installed in the sampler which separates the respirable (PM10) and non-respirable fractions. The particle

size less than 10 microns were collected on the filter papers; whereas SPM larger than 10 microns was collected in the separate sampling bottle, also called as dust collector. Further the air was passed through impinges, housed in separate enclosure containing absorbing solution for SO_2 and NO_2.

A constant temperature is maintained during sampling with the help of an ice box. Modified West and Geake method had been used for computing SO_2 while Jacob and Hochheiser (Modified Na – Arsenite method) was used for computing NO_x in the collected samples. The air quality parameters such as suspended particulate matter (SPM), Respirable suspended particulate matter (RSPM), SO_2 and NO_x have been studied in this investigation and the results are presented in the subsequent paragraphs, in sequel.

III. Result And Discussion

The concentration level of pollutants such as NO_2, SO_2 and PM10 at five locations of Jaipur city were collected for one year i.e. from January to December 2016. The concentration level of pollutants of five cities data is secondary data which is taken from Rajasthan Pollution Control Board (RPCB-2016) department. The analysis of data has been presented concentration of NO_2.

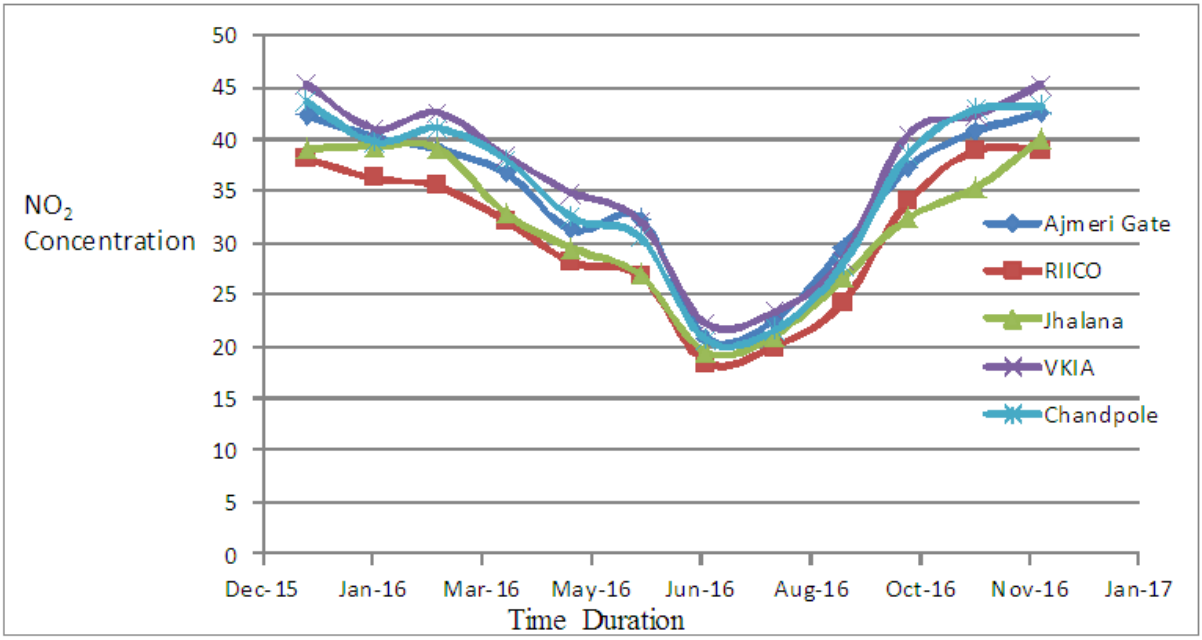

Figure: 1 monthly average of NO_2

The monthly average of NO_2 at all five locations of Jaipur is being presented in Figure 1.

It can be conclude by analysing the Figure 1 that Vishwa Karma Industrial Area (VKIA) is the location where maximum amount of NO_2 concentration is found in ambient air throughout the year which might be due to presence of various types of industrial units in that area. It has been also observed that the concentration of NO_2 was in the range of 18.48µg/m^3 (minimum) to 45.54µg/m^3 (maximum), which is well below the permissible limits 80µg/m^3 prescribed by CPCB. It can be seen that concentration of NO_2 was found to be the highest during winter and lowest during summer season. The higher concentration during winter might be due to less dispersion of gases due to low temperature and NO_2 remained in lower atmosphere.

Concentration of SO_2

The monthly average of SO_2 concentration at all the five locations has been presented in Figure 2.

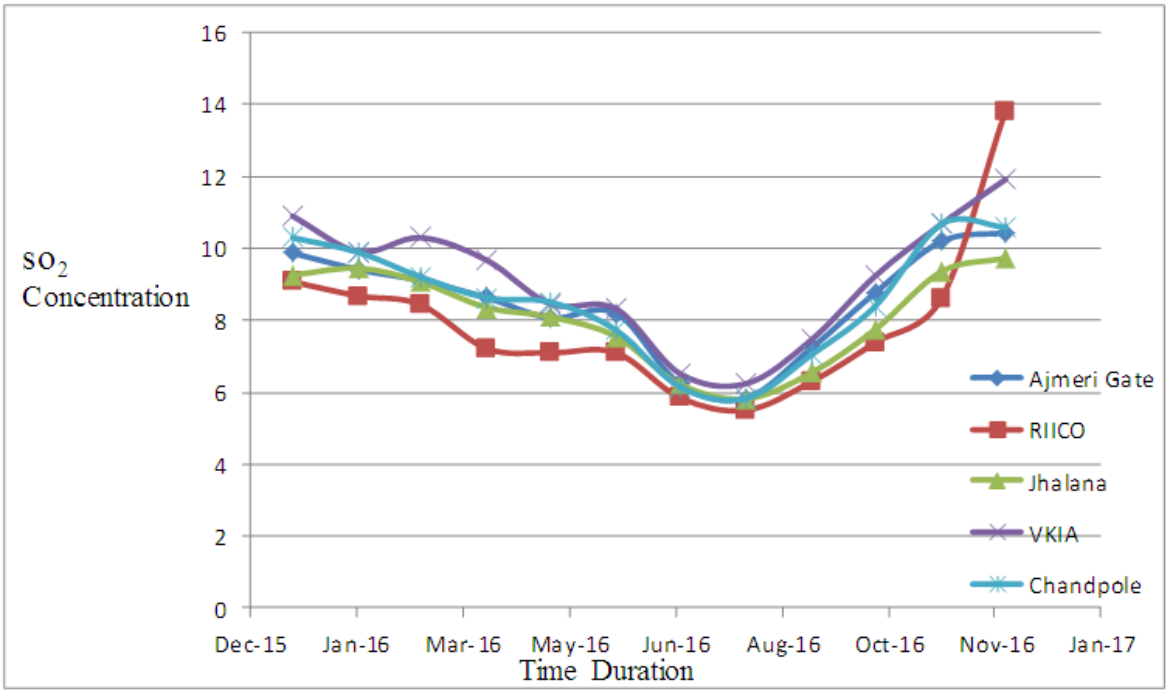

Figure 2: variation in the concentration of SO_2 at various locations

Figure 2 shows that Vishwa Karma Industrial Area (VKIA) is the location where maximum amount of SO_2 concentration is found in ambient air throughout the year which might be due to presence of industries generating pollution in the area. It can be seen that the concentration of SO_2 is in the range of 5.5µg/m^3 (minimum) to 13.83µg/ m^3 (maximum), which is found to be well below the permissible limits of 80µg/m^3 as prescribed by CPCB.

It can also seen that concentration of SO_2 is found to be highest during winter and lowest during summer season. The higher concentration during winter might be due to less dispersion of SO_2 due to which it remains in lower atmosphere.

Concentration of PM10

The monthly average of PM10 concentration at all the five locations has been presented in Figure 3.

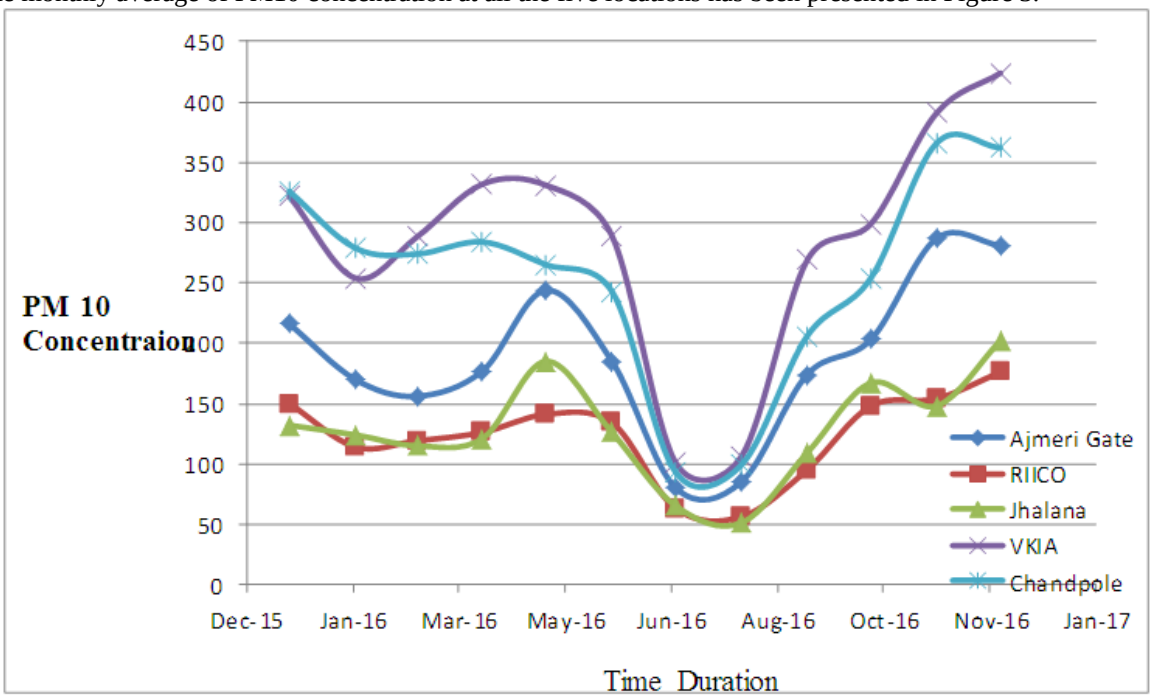

Figure 3: variation in the concentration of PM10at various locations

It can be concluded by analysis that variation in the concentration of PM 10 is irregular (zig-zag) at all the locations. The concentration of PM 10 mainly depends upon the movement of traffic in the area. Vishwa Karma Industrial Area (VKIA) is the location where maximum amount of PM10concentration is found in ambient air throughout the year as compared to others, which might be due to movement of heavy traffic coming in the industrial area for loading and unloading of finished goods and raw materials respectively. It has been also observed that the concentration of PM10 during the year 2016 was in the range of 51 ug/m3 (minimum) to 424 ug/M3 (maximum), which is above the permissible limits of 100µg/m^3 as prescribed by CPCB.

Figure 3 also shows that concentration of PM10 is found to be higher during winter and lowest during summer season. The higher concentration during winter might be due to less dispersion of gases and due to low temperature, the PM10 remains in lower atmosphere. High PM10 concentration might be due to heavy transport activity in study area apart from industrial emission dust from paved roads, garbage burning in open, use of conventional fuels like wood, cow dung, etc., for cooking and other domestic purpose.

IV. Conclusion

In this study, three parameters (NO_2, SO_2, PM10) of ambient air at five locations such as Ajmeri Gate, Malviya Industrial Area (MIA), RPCB Jhalana Office, Vishvakarma Industrial Area (VKIA) and Chandpole has been collected and analyzed. The data were compared with the standards prescribed by CPCB and conclusions are drawn.

1. This study revealed that gaseous pollutant SO_2 and NO_2 is under permissible limits at all the study locations.
2. The concentration of PM10 is found to be in the range of 50 ug/m3 to 450 ug/m3 at various locations, which is above the permissible limits of 100 ug/m3 prescribed by CPCB. High concentration of PM10 might be due to heavy transport activity in study area, industrial emissions in industrial areas, dust from paved roads, garbage burning in open, use of conventional fuels like wood, cow dung etc for cooking in nearby rural areas.
3. The concentration of all pollutants was observed to be highest during winters as compared to summer and monsoon, which might be due to slow dispersion of pollutants in air during winter.
4. Traffic diversions, provision of alternate routes, restricting heavy vehicles movement through residential area, arranging for periodic vehicle maintenance and encouraging public transport instead of private vehicles are important considerations to control air pollution due to transportation.
5. Regular monitoring on the emissions from industries may reduce the concentration of pollutants in air.
6. Public awareness for environment protection should be given due attention and plantation along highways should be encouraged.

It may, thus be concluded that strict implementation of environmental regulations and adoption of adequate pollution control measure is need of the hour.

References

[1]. Ahmed AteequeandBanoNikhat (2015), "Ambient air quality status of Firozabad city-A spatio-temporal analysis", Journal of Global Biosciences ISSN 2320-1355,Vol-4.

[2]. CPCB,National Air Quality Index, 2014, (http://cpcb.nic.in/AQI-FINAL-BOOK.pdf)

[3]. Doharedevendra and pandeyvijayant (2014), "Monitoring of ambient air Quality in India", International journal of engineering and research technology. ISSN 2277-9655.

[4]. Environmental Engineering and Air pollution - by S K GARG (Khanna Publishers)

[5]. Kumar Ashwin and AnandSubhash(2009) "Status Of Vehicular In NCT Of Delhi". International Journal of Advanced Research InManagrment and Social Science, ISSN: 2278-6236.

[6]. Prakash Mamta, Bassin, J.K, 2010, Analysis Of Ambient Air Quality Using Air Quality Index – A Case Study, International Journal of Advanced Engineering Technology, Vol 1,106-114.

[7]. Sharma Sanjeev Kumar and Sharma Kriti (2016). "Ambient Air Quality Status of Jaipur city ,Rajasthan". International research journal of environment sciences. ISSN 2319-1414, Vol.5(1), 43-48,January (2016).

[8]. Sharma Rashmi (2016). " Study of Air Quality Status In Some Cities Of Rajasthan". IOSR Journal of pharmacy and Biological Services (IOSR-JPBS). e-ISSN : 2278-3008, p-ISSN:2319-7676. Vol. 11, issue 1 ver. (Jan.- Feb 2016), pp 36-39.

[9]. Sharma, Pandey, R., Maheswari, M., Sengupta, B., Shukla, B. P.,Mishra, A., 2003 b.Air quality Index and its interpretation for the city of Delhi. Clean Air. International Journal on Energy for a Clean Environment 4, 83-98.

[10]. www.environment.rajasthan.gov.in/rajasthan-state-control-board.

[11]. Yadav Rajesh, Sharma Smita, SainiYashoda, and KallaShuda, (2016). "Environmental Assessment of Air Quality near SuratgarhSuperThermal Power Plant" in Sriganganagar District, Rajasthan (August 2016).