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# STUDIES ON AIR QUALITY STATUS AT SELECTED POCKETS OF INDIAN CAPITAL DELHI

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**Abstract -** *Delhi Air Pollution issue addressed National importance after the emergency situation declared on November 6-10 2017, that gain noticed all over the world in leading news reports. This paper explains the analysis of the air pollution level before it and after that for a study period of one year on the chosen location R.K.Puram, Anand Vihar, Mandir Marg, Punjabi Bhag considering, seasonal, and annual AQI levels, with respect to the main studied pollutants $NO_2$, $SO_2$, $PM_{2.5}$, and $PM_{10}$. The Results revealed that the air quality at all studied locations with respect to $PM_{10}$ $PM_{2.5}$ and $NO_2$ concentrations exceeded the permissible limit. Based on the overall AQI calculated, the top most polluted areas in Delhi are: Anand Vihar (352), R.K.Puram (311), Panjabi Bhag (309), and Mandir Marg (278). Further based on the seasonal AQI calculated, it is shown 'Hazardous level' of health concern in winter and summer seasons in studied Locations.*

***Key Words*: Air Pollution, Delhi, Air Quality Index, Ambient Air Quality, Environmental Degradation, Delhi Air Quality, Air Monitoring, Air Pollutants.**

## 1. INTRODUCTION

Man is a constant source for experimenting with nature becoming center and made dominating all other creatures, making more discoveries from the stone age to the present modern technical society, which resulted deterioration of nature elements like water, air, the soil-land, fauna flora etc. all creatures are depends on good quality of air for living sustainably. There are more then 15,000 premature deaths, seen every year in Delhi due to bad air quality. According to one study published in Indian Express newspaper, nine years of extra life that people living in Delhi can gift themselves if Delhi satisfies WHO AQI standards. Delhi has alarmed to the world top 5 cities in most polluted cities list. It is currently beaten up the record brake of Beijing china. The problem of air pollution in the big metrological cities is a wide spread and is mainly due to urbanization, industrialization, poor maintenance of motor vehicle and road conditions.

### 1.1 AIR QUALITY STANDARDS

NAAQS is adopted by CPCB. It has given some guidelines as Standards. CBSC underwent many revisions, the present National Ambient Air Quality Standards (NAAQS) as in below Table 1 while Table 2 shows AQI Standards for different Zones with Pollutants Break Points.

**Table 1**: National Ambient Air Quality Standards (NAAQS) – 2009 (Units: µg/m³ Source**:** CPCB)

| Pollutants | Time weighted average | Concentration in ambient air | | Methods of measurement |
|---|---|---|---|---|
| | | Industrial, residential, rural, other areas | Ecologically sensitive area | |
| **Sulphur dioxide ($SO_2$),** | Annual<br>24 hr | 50<br>80 | 20<br>80 | Improved West and Gaeke/ Ultraviolet fluorescence |
| **Nitrogen dioxide ($NO_2$),** | Annual<br>24 hr | 40<br>80 | 30<br>80 | Modified Jacob &Hochheiser/Chemiluminescence |
| **Particulate matter** (< 10 µm) or **$PM_{10}$,** | Annual<br>24 hr | 60<br>100 | 60<br>100 | Gravimetric/TOEM/Beta attenuation |
| **Particulate matter** (< 2.5 µm) or **$PM_{2.5}$,** | Annual<br>24 hr | 40<br>60 | 40<br>60 | Gravimetric/TOEM/Beta attenuation |

**Table 2**: AQI Standard Range, Pollutants Break Points (Units: µg/m³ Source: CBSE Oct 2014)

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

### 1.2 METEOROLOGY OF DELHI

Delhi has many topographic obstructions from surrounding states, such as high hills, deserts, central hot plains etc. The desert comes at west part of the Delhi acquired by Rajasthan, it is known as Thar Desert. The north and east are covered by high hills regions. The central hot plains exist in south part of Delhi. Thus Delhi finding difficult to dilute pollution levels by necessary climates pattern.

Meteorological parameters that influence air dispersion are: Sunlight, Wind direction, Temperature, Humidity, Atmospheric stability, Mixing height, Clouds & precipitation, Visibility, Horizontal and Vertical dispersion.

Apart from the topographic obstruction it is the people who living in the surrounding states made to increase the pollution level higher. The Delhi is surrounded by the states like Uttar Pradesh. Haryana, Punjab. The former in this states are continuously burning the crops of stubble rice. The residue of this burned has pollutants that wind carries to Delhi air different season to different level. Thus pollutants affect Delhi severe part at winter season, since at winter season low dispersion of pollutants make high pollutants concentration. But in summer month there is better dispersion of air in compare to winter seasons.

## II. METERIAL AND METHODOLOGY

### 2. 1 STUDY AREA

Delhi is famous city in the world since it is the Capital of India. The Delhi comes in northern part of India. Delhi has 16.3 million people living their life, thus it is the 6th largest metropolis in the world having an area of 1483 $km^2$.

### 2. 2 SELECTION OF SAMPLING LOCATIONS


**Fig-1** Sampling Stations Chosen from Delhi

The sampling stations chosen are two residential area -Anand Vihar and R.K.Puram, a Commercial & residential area- Mandir Marg, and a Mixed area having Industrial, Commercial and Residential areal units - Panjabi Bhag as shown in fig 1

### 2. 3 PARAMETERS CONSIDERED AND DURATION

The pollutant parameter is considered based on the availability of data of pollutants for studied period. Thus four air quality parameters with 24 hour average concentration of studied pollutant are taken for the analysis purpose. They are $PM_{10}$.$PM_{2.5}$, $NO_2$ and $SO_2$.

### 2. 4 ANALYSIS OF SAMPLE

Delhi analysis of pollution level is based on strengthening the surface level monitoring of existing stations that are established by NAAQM and establishing the vertical monitoring on later stages. The vertical monitoring is done by using advanced instrument like Elastic Backscatter LiDAR and Raman.The Lidar it is a new type of laser technology which is already incorporated in Delhi during common wealth games 2010 for measuring meteorological phenomenon along with pollutants concentration. It uses backward scattering of laser light and the absorption of falling particulates by laser light gives the details about the pollutants. Ambient air quality was measured by using High Volume Air Sampler (HVAS). The procedure as per NAAQS has been adopted.

### 2. 5 AQI CALCULATION

It is planned to calculate Seasonal and Annual AQI of studied pollutants, after collecting the pollutants data from NAAQM. Based on the value obtained, it is also planned to tabulate results, and plot it in graph for the studied locations, along with their pollutant variations.

**Methods Used For Air Quality Index (AQI) Calculation:**

Based on IND-AQI, It can be illustrated mathematically:

$$I_p = \left(\frac{I_{HI} - I_{LO}}{BP_{HI} - BP_{LO}} \times (C_p - BR_{LO})\right) + I_{LO}$$

Where

- $I_P$ is AQI for pollutant "P" (Rounded to the nearest integer).
- $C_p$ the actual ambient concentration of pollutant "P".
- $B_{PHI}$ the upper end break point concentration that is greater than equal to $C_p$.
- $B_{PLO}$ the lower end break point concentration that is less than or equal to $C_p$
- $I_{HI}$ is the sub index value corresponding to $B_{PHI}$
- $I_{LO}$ is the sub index value corresponding to $B_{PLO}$

## III. RESULTS AND DISCUSSIONS

$PM_{10}$ found highest in winter and summer seasons. $PM_{2.5}$ found highest in winter season and in monsoon & summer seasons it's shown a similar low variation. $NO_2$ found highest in winter and monsoon seasons compare to summer season. $SO_2$ found within the NAAQS permissible limit. Pollutant concentration found high in winter and summer seasons in all the studied locations due to meteorological effects. In Anand Vihar the highest pollutant concentration is observed subsequently the R.K.Puram, and Punjabi Bhag takes second and third position, Mandir Marg found in lowest pollutant level. This is depicted in fig 2.

In Annual Variation, the pollutant $PM_{10}$ concentration found high in all the studied locations followed by $NO_2$ $PM_{2.5}$. The $SO_2$ concentration found to be within the permissible limit of NAAQS. The $PM_{10}$ pollutants concentration found exceeding 3.92 times higher then acceptable limit in Anand Vihar. In station wise the pollutant $PM_{10}$ in Anand Vihar is found to be highly pollutant with 392 µg/m³ followed by Punjabi Bhag (253 µg/m³), R.K Puram (253 µg/m³) and Mandir Marg 205 µg/m³. The second highest pollutant is $NO_2$ and it is highest in Anand Vihar (3.83 times the limit) 307 µg/m³ followed by R.K.Puram (190 µg/m³), Punjabi Bhag (167 µg/m³) and Mandir Marg which has least value of 93 µg/m³. The third highest pollutant is $PM_{2.5}$ concentration, found highest in Anand Vihar (2.58 times the limits) 155 µg/m³ followed by R.K.Puram (134 µg/m³), Punjabi Bhag (132 µg/m³) and Mandir Marg which has the least value 113 µg/m³. This is depicted in fig 3.

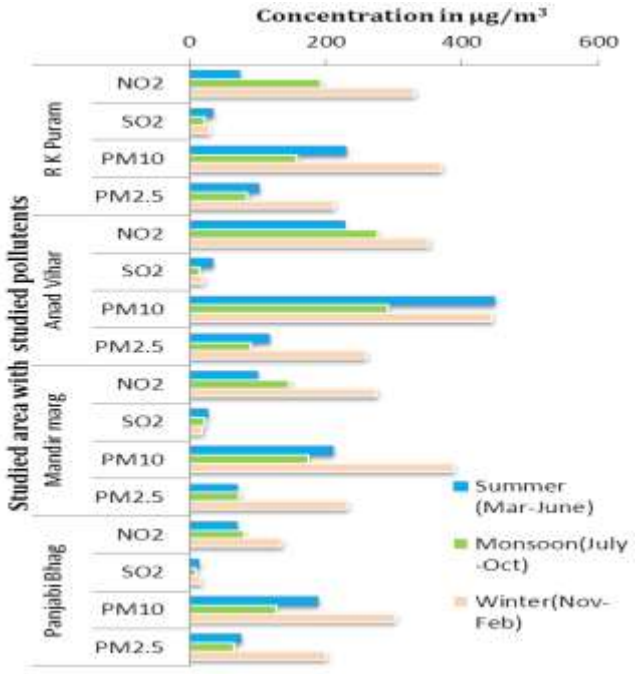


**Fig -2** Seasonal Variations of Pollutants at Studied Locations

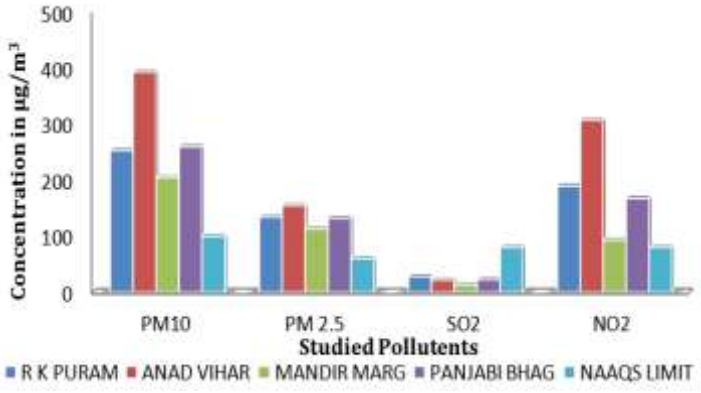


**Fig -3** Annual Variations of Pollutants at Studied Locations

AQI found to be higher *in winter season* in all studied locations and it is found highest in Anand Vihar in 'severe range' (AQI>401) and other three study locations found in 'Very poor' range (301-400), *In summer season* the AQI found 'severe' (AQI>400) in Anand Vihar, Poor (AQI,201-300) in R.K.puram, Moderately polluted (AQI,101-200) in both Punjabi Bhag and Mandir Marg *In Monsoon season* Anand Vihar and R.K.Puram both found in 'Poor Range'(AQI,201-300), the other two stations Punjabi Bhag and Mandir Marg Found in Moderately polluted range(AQI,101-200).

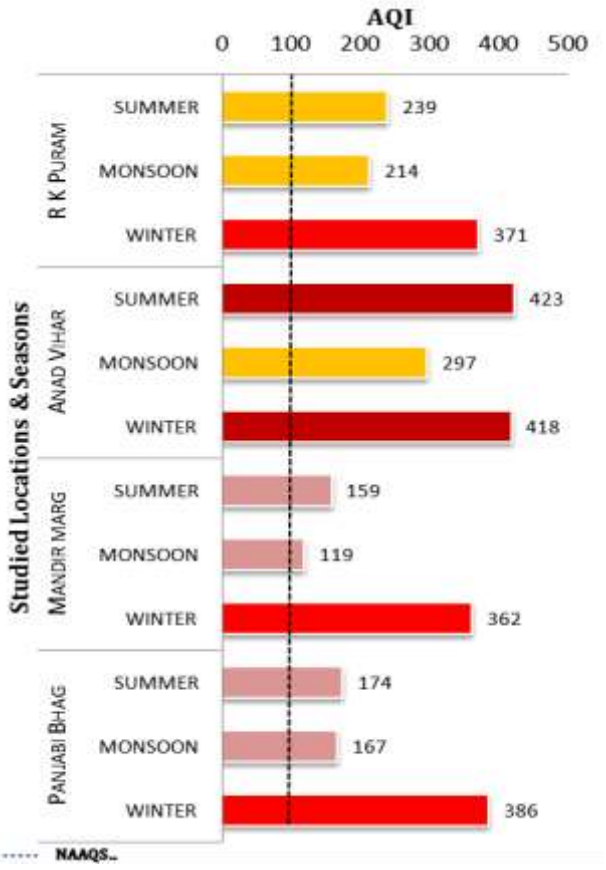


**Fig- 4** Seasonal AQI at Studied Locations

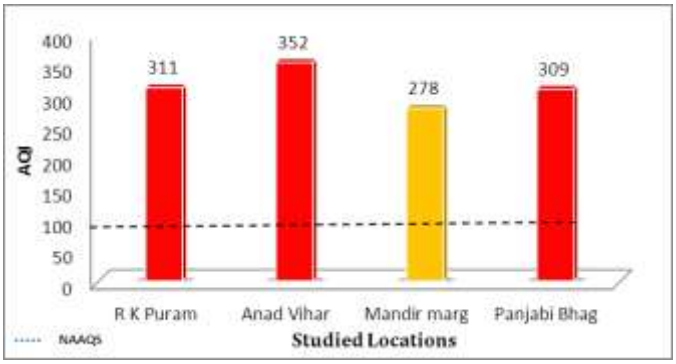


**Fig-5** Annual AQI at Studied Locations

In Annual comarision of AQI, the three stations R.K.Puram, Anad Vihar and Punjabi Bhag have crossed and found in 'Very Poor range' (AQI,301-400). But Mandir Marg found in 'Poor range' (AQI,201-300). The seasonal and Annual comparison are depicted in fig 4 and fig 5.

## IV. SUMMARY AND CONCLUSIONS

The studies made on status of air quality at selected pockets of Indian capital Delhi 2017-18, analysis was done the results are shown in graphs. Based on the analysis following conclusions are made.

## CONCLUSIONS

- The concentration of $NO_2$, $PM_{2.5}$ pollutants crossed the prescribed standards and found highest in Anad Vihar, followed by R.K.Puram, Punjabi Bhag and Mandir Marg.
- The concentration of $PM_{10}$ crossed the prescribed standards found highest in Anad Vihar, followed by Punjabi Bhag, R.K.Puram and Mandir Marg.
- The pollutant concentration found higher in winter and summer seasons. Overall, $PM_{10}$ concentration found higher in all the studied locations followed by $PM_{2.5}$, $NO_2$.
- The pollutant $SO_2$ concentration found within the limit of NAAQS in all the studied locations.
- The Results revealed that, the air quality at all studied locations with respect to $PM_{10}$, $PM_{2.5}$ and $NO_2$ concentrations exceeded the permissible limit. Based on the overall AQI calculated, the top most polluted areas in Delhi are: Anand Vihar (352), R.K.Puram (311), Panjabi Bhag (309), and Mandir Marg (278). Further based on the seasonal AQI calculated, it is shown 'Hazardous level' of health concern in winter and summer seasons in all the studied areas. The AQI values warns there is a urgent need to take steps to mitigate the deterioration of air quality.

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