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# "AMBIENT STATIC AIR QUALITY INDEX AT VISHWAKARMA INDUSTRIAL AREA, JAIPUR"

## (A Case Study)

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**Abstract –** *Air pollution and its consequences has vital and convoluted history. The expeditious and rapid growth of Jaipur city has a subtle impact on the air quality due to various industrial activities, enormous increase in vehicular emission, and expeditious rate in multi-story buildings construction. According to the daily monitoring, the AQI of Jaipur lies between moderate to Unhealthy. This case study aims to inspect and analyze the air quality near industrial areas involving nearby residential areas. Also, the main objective of this study intends to develop efficient monitoring of concentration of RSPM, $SO_2$ and NOx at different stations. The successive study for about two and half months at five different stations in Vishwakarma Industrial Area shows increasing rate of air pollution. The average concentration level of SPM and RSPM at all stations exceeded the permissible limits of NAAQS. Apart from that, level of $SO_2$ and NOx remains under prescribed limits of NAAQS. The study divulges that industrial site has been heavily polluted in terms of RSPM.*

***Key words: Air quality, AQI monitoring, average concentrations, Pollutants analyzed, NAAQS.***

## 1. INTRODUCTION

Air is one of the most significant constituents of man's environment. Any adjustment in common and ordinary piece of the air, that may antagonistically influence the living framework, especially the human life, constantly causes air contamination. The air contamination on Earth began when the man began utilizing kindling for cooking and warming purposes [1]. On the opposite side, because of race of globalization, numerous questionable changes in environment are getting included which in conclusion costs peril to lives of living creatures on planet.

Naik et al [2] contemplated the encompassing air quality in Madurai City of South India and found that the suspended particulate issue (SPM) fixation fluctuated from 200 to 500 µg per $m^3$, NOx from 50 to 170 µg/$m^3$ and $SO_2$ from 10 to 25 µg/$m^3$ at various locations. In reality proportions of how much air contamination can influence one's wellbeing inside long and brief term of time.

Karar et al. (2006) [3] explored the occasional and spatial varieties of particulate issue (PM10) and all out suspended particulate (TSP) in private and modern destinations in urban zone of Kolkata. Their examination uncovered huge higher particulate issue (PM10) values at mechanical region than neighborhood because of overwhelming traffic stream, outflow from close by modern zone and re-suspension of street and soil dust.

## 2. LITERATURE REVIEW

Air is must for all lives on earth. Air is a mechanical mixture of gases on which all forms of life depend. It is a mixture of oxygen, nitrogen and many other gases which surrounds the earth and forms its atmosphere. For the existence, human beings need a continuous supply of air. Air quality monitoring is needed because polluted air can make adverse effects on our health—and also on environmental health. Air Quality Index or AQI is a measure of static air quality of a desired area. The AQI shows changes in the amount of pollution in the air. It is a content definer for an Air quality report on a routine basis.

When there is mixture of different noxious and inimical particles, also the large volume pernicious gases taken place, the air is said to be polluted. Air pollution is a mixture of particles and gases that can reach unsafe and adverse concentrations both outside and indoors by discharge of unsafe and catastrophic pollutants. Air pollution is generated due to various expansions and evolution such as rapid economic development, increasing traffic, growing cities, and industrialization. Air pollution can cause health problems, damage the environment property and climate change. The major air pollutants which are responsible for air pollution are Carbon monoxide (CO), Carbon dioxide ($CO_2$), Chlorofluorocarbons (CFC), Nitrogen oxide (NOx), Sulphur dioxide ($SO_2$), Suspended particulate matter (SPM), lead and ozone.

The central Pollution Control Board (CPCB) is responsible for the better and healthier environment and sets standards and applies regulatory measures to prevent pollution in country. CPCB has been executing a nationwide programme on ambient air quality monitoring known as National Ambient Air Quality Monitoring Programme (NAMP).

In terms of Air pollution the first ambient air quality index were adopted in 1982 which was revised in 1994 and at last again revised in year 2009, which includes and notified for different parameters of air pollution. The pollutants concentrations with their limits are given below.

**Table 1:** Permissible limits for pollutants [5]

| Sr. No | Pollutants in (µg/m3 | Concentration in Ambient Air | | |
|---|---|---|---|---|
| | | Time Weighted Average | Industrial, Urban, Rural and other Areas | Ecologically Sensitive Area |
| 1. | Sulphur Dioxide ($SO_2$) | Annual * | 50 | 20 |
| | | 24 Hrs.** | 80 | 80 |
| 2. | Nitrogen Dioxide (NOx) | Annual * | 40 | 30 |
| | | 24 Hrs.** | 80 | 80 |
| 3. | $PM_{10}$ | Annual * | 60 | 60 |
| | | 24 Hrs.** | 100 | 100 |
| **4.** | $PM_{2.5}$ | Annual * | 40 | 40 |
| | | 24 Hrs.** | 60 | 60 |
| 5. | Carbon Monoxide (CO), mg/m3 | 8 Hrs. * | 02 | 02 |
| | | 1 Hr.** | 04 | 04 |
| 6. | Ozone (O3) | 8 Hrs. * | 100 | 100 |
| | | 1 Hr.** | 180 | 180 |
| 7. | Lead (Pb) | Annual * | 0.50 | 0.50 |
| | | 24 Hrs.** | 1 | 1 |

* Annual Arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform interval.

** 24 hourly 08 hourly or 01 hourly monitored values, as applicable shall be complied with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.

The studied area Vishwakarma Industrial Area is situated in northern part of Jaipur city; Rajasthan. The actual studied area includes the various industries and adjoining residential apartments. The population of area is around 49000 having both local and migrant labors. The temperature of the area varies from $12^0$C to $32^0$C in winter and $30^0$C to $45^0$C in summer. The average rainfall in the area is nearly 72.35mm and the wind flow is towards the east direction. . It has around 454 acres of area having both Government and Private lands. The plot size varies from 350 sq. m to 4500 sq. m. It includes various types of industries in which mainly are Aluminum extraction and sections, Auto mobile accessories and parts, Barbed wire, Batteries, Box strapping, Bearing components, C.I and its casting, Cattle and poultry feed, Corrugated sheets and boxes, Dying and printing , Edible oil, Electric meter and hardware line material, Textiles and fabrics, tool room and their processing, Transformers and its accessories, Water tanks, CNC machine, Wax and its products, Paint (Varnish, thinner, distemper), Paper, Pesticides, Plastic boxes, Printing Products , Fiber glass sheet, Forging and fasteners, Fabrication engineering products and Rubber moulded goods. Most of the industries are using wood and charcoal as a fuel in their boilers. As per the regulations the gases are allowed to escape through the precipitators.

## 3. METHODOLOGY

This paper aims to summarize and describes the parameters used in location chosen, data collection and its verification, methodology used to analyze data and its implementation, and also the various chemicals and elopements used in collection of samples at the monitoring sites. These parameters and measurements are discussed in detail to understand the demeanor of the pollutants. For the ambient static air quality index at the VKI, Jaipur, we have decided to monitor the concentration of RSPM, $SO_2$, and NOx at five different stations i.e. three of them were in core industrial range and two stations were located in residential colonies.

### 3.1 Monitoring Procedure

Monitoring of ambient air quality requires current status of air quality, arrangements of equipment's, Selection of sources of emissions, background intelligence, meteorological and topographical conditions of studied area, number of sites and stations, selection of pollutants to be analyze, and criteria to determine concentrations of pollutants.

#### 3.1.1 Analysis of RSPM

The retention of Particulate issue (SPM and RSPM) was recorded by utilizing Respirable Dust Sampler Model No. APM 460. The essential and applied instrument engaged with assortment of particulate issue is taken from Stock's law which is utilized to break down the matter of size up to 0.0002µm. The normal pace of stream differs from 1.20-1.25 liter/min, from which the air mass need to go, because of the activity of divergent powers, entire measure of little non-respirable residue particles gets serrate from air mass

streams The measure of complete suspended particulate which crosses through the stream get together as fine residue is hauled by glass fiber channel.

### 3.1.1 (A) Method of measurement

The mass of RSPM is determined by calculating the weight of filter paper before and after of air stream flow induced in assembly and concentration level of RSPM is determined by division of the total gain in weight of filter paper by the total volume of air induced in the assembly during the monitoring period. Also, the mass of the NRSPM (Non respirable suspended particulate matter) is determined by calculating the difference in weight of sample bottle before and after the air stream flow induced and concentration level of NRSPM is determined by division of the total gain in weight of filter paper by the total volume of air induced in the assembly during the monitoring period.

### 3.1.2 Analysis of $SO_2$

Modified West and Gaeke Method IS 5182, section II is utilized to compute the measure of Sulfur dioxide at the observing stations in considered territories. Sulfur dioxide from the air is immersed in Potassium Tetrachloride Mercurate (TCM) arrangement. By this, an oxidation safe complex called dichlorosulphitomercurate is framed. This complex is sufficiently able to withstand against the activity of oxidants like NOx and $O_3$.The complex is thought up to blend in with Para-Rosaniline and Formaldehyde to frame the hued corrosive known as Para-Rosanilinemethylsulphonic corrosive. Finally, the ingest of the arrangement is determined with the assistance of UV-Visible Spectrophotometer at the average frequency of 560 nm.

### 3.1.3 Analysis of NOx

Modified Jacobs and Hochheiser Method IS 5182, section VI is utilized to control the convergence of Oxides of Nitrogen at the observing stations in examined regions. Surrounding nitrogen oxide (NOx) is dissected by taking the arrangements of both sodium hydroxide and sodium arsenite and passing them in gurgled air masses. The delivered nitrite particles during the examining procedure were broke down and determined the arrangement of colourmeter counter when the created nitrite particles were tried against Phosphoric corrosive, Sulphanilamide and N – (1-Naphthyl)- ethylenediamine di-hydrochloride (NEDA). The absorbance estimations of test are estimated by utilizing spectrophotometer at 540 nm recurrence having high colouredazo - color as filler.

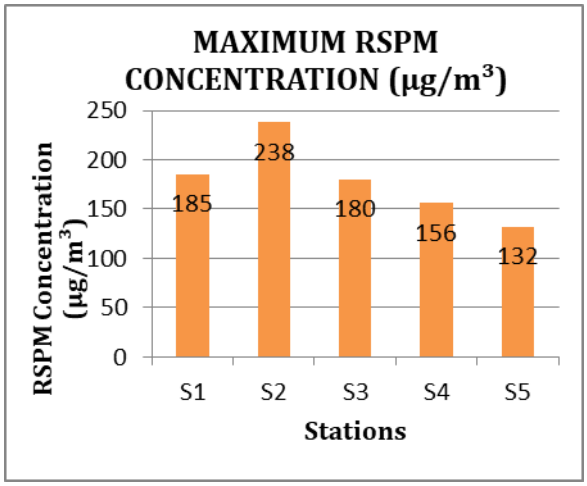
### 3.1.4 Calibration curve

In the general and applied chemistry, a calibration curve or standard curve is used to calculate and determination of quantity of unknown sample in whole concentrations of samples by comparing the set of unknown to a set of known concentration standard samples. In actual it is the curve showing how an instrument responses and records the changes towards the substance which concentration has to be measured.

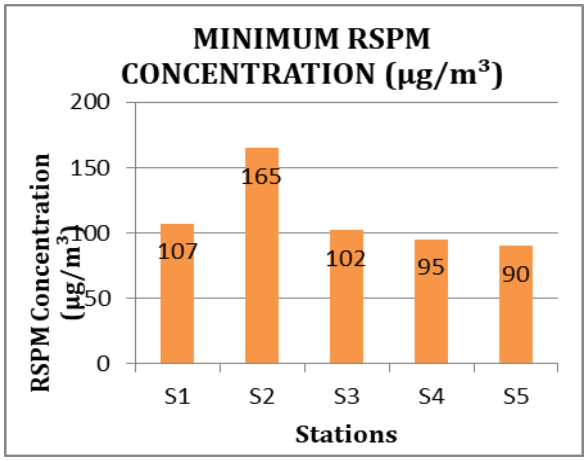
## 4. RESULT AND DISCUSSION

The samples for ambient air quality at the vishwakarma industrial area, Jaipur have been collected at the five different stations $S_1$, $S_2$, $S_3$, $S_4$, and $S_5$ for a 24 hours duration in different time slots and days schedules as discussed earlier. The observations are taken for around two months from 15 January 2020 to 18 March 2020. Also, the collected samples have quantitatively analyzed for different parameters RPSM, $SO_2$ and NOx. The extents of each pollutant were plotted against each monitoring sites at the studied area, such that effective comparisons can be made.

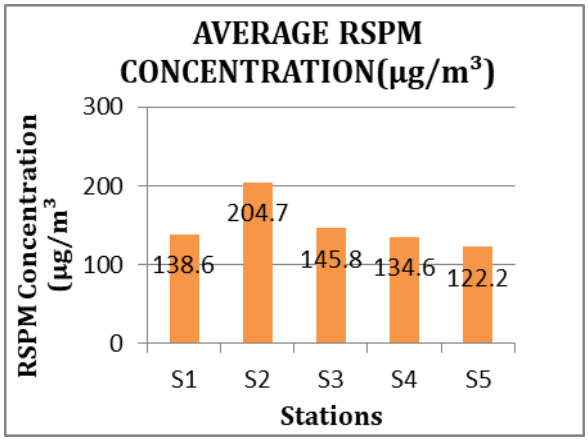
### 4.1 Concentration of RSPM



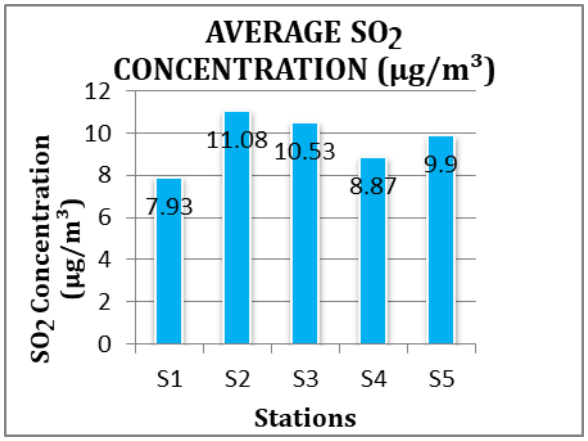

**Graph 1: Maximum RSPM Concentration in µg/m³ at different stations**




**Graph 2: Minimum RSPM Concentration in µg/m³ at different stations**

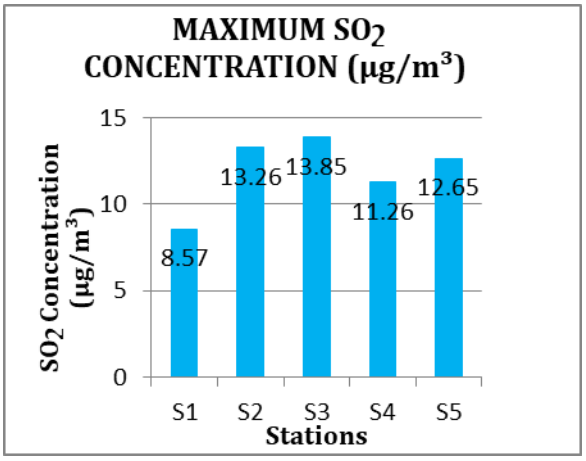



**Graph 3: Average RSPM Concentration in µg/m³ at different stations**

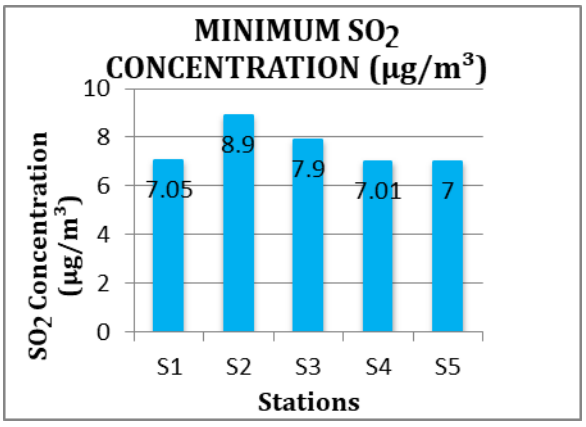



**Graph 6: Average $SO_2$ Concentration in µg/m³ at different stations**

### 4.2 Concentration of $SO_2$

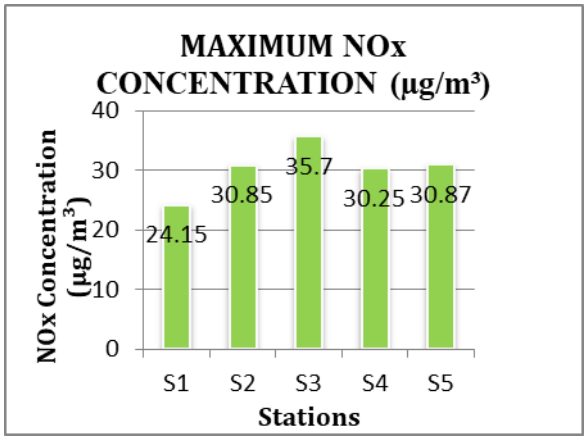



**Graph 4: Maximum $SO_2$ Concentration in µg/m³ at different stations**

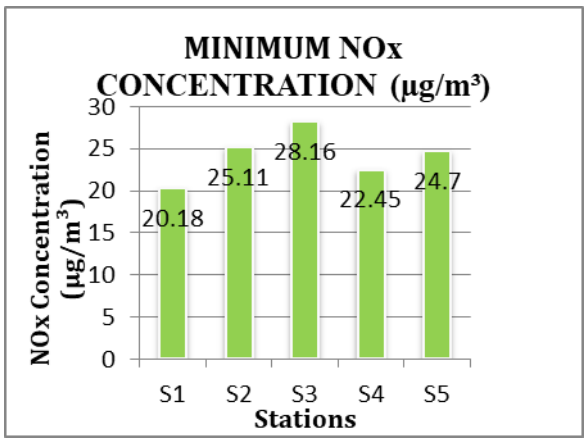



**Graph 5: Minimum $SO_2$ Concentration in µg/m³ at different stations**

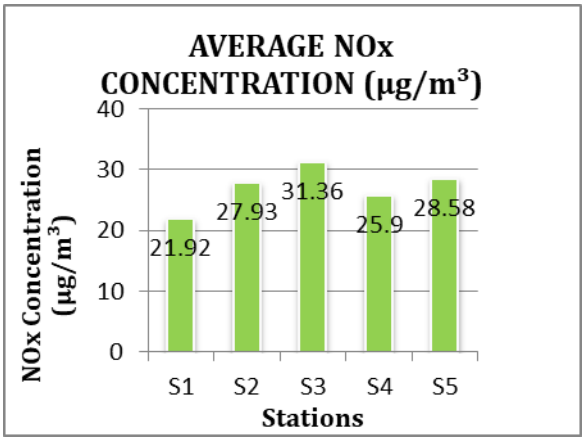
### 4.3 Concentration of NOx




**Graph 7: Maximum NOx Concentration in µg/m³ at different stations**



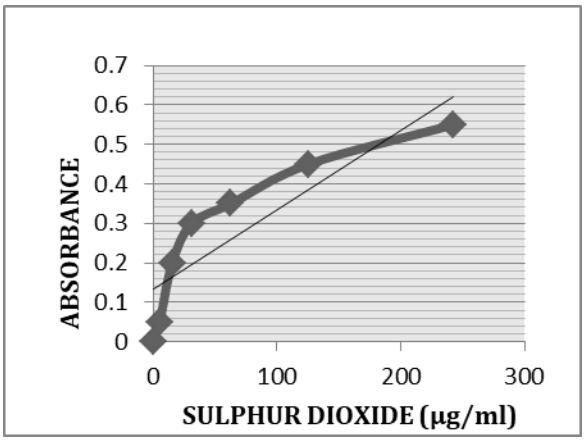

**Graph 8: Minimum NOx Concentration in µg/m3 at different stations**



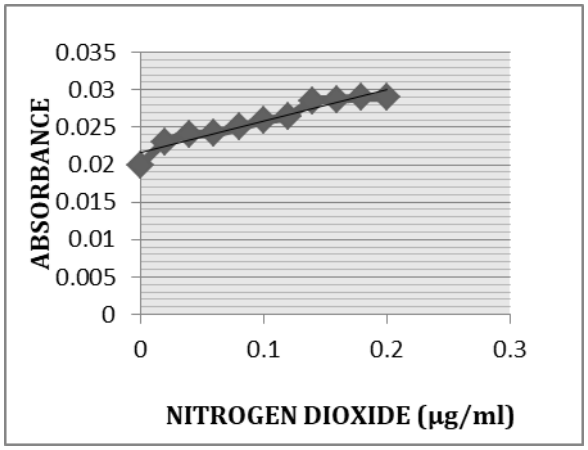

**Graph 9: Average NOx Concentration in µg/m³ at different stations**

### 4.4 Calibration curve for $SO_2$ and NOx

In the general and applied chemistry, a calibration curve or standard curve is used to calculate and determination of quantity of unknown sample in whole concentrations of samples by comparing the set of unknown to a set of known concentration standard samples. In actual it is the curve showing how an instrument responses and records the changes towards the substance which concentration has to be measured.




**Graph 10: Calibration curve of $SO_2$**




**Graph 11: Calibration curve of NOx**

## 5. CONCLUSION

Computed and analyzed data of collected samples revealed that Respirable Suspended Particulate Matter (RSPM) were the major pollutant at all five monitoring sites also exceeds the permissible limits of NAAQS. It has been observed that emission of particulate matter was due high movement of heavy vehicles and boiler industries. However, the concentrations of gaseous pollutants ($SO_2$ and NOx) were well within their permissible limit at all the five monitoring sites as per the permissible limits of NAAQS. Futherly, the monitoring of other pollutants such as Carbon Monoxide (CO), Ammonia (NH3), Benzene ($C_6H_6$), Banazo, Ozone ($O_3$), and heavy metals Lead (Pb), Nickel (Ni), Arsenic (As) should be made regularly to find out the quantity of pollutant level in ambient air at vishwakarma industrial area so that the health problems of people residing in and around industrial area shall be minimized by taking measures to reduce the quantity of above pollutant.

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