Air Quality Index Analysis and Solutions for High Traffic, Industrial and Residential Regions in Delhi/NCR

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Abstract – Air Quality monitoring is important aspect these days as high pollution is causing bad health effects in the Delhi/NCR region. It is necessary to take steps for improve the air quality of the capital and also preserve natural trees for making the environment pollution free. There are a lot of traffic issues, industrial pollution and household pollution which contributes to the bad air quality index. Monitoring is generally done using devices which have sensors like ozone, PM10, PM2.5, CO, SO2, etc. here, a device with IOT is used to measure the sensor values and then convert to Air Quality Index. In this thesis, air quality index is calculated for various areas in Delhi/NCR which are namely, industrial area Patparganj, a high traffic area Wazirpur and a green area near Jawaharlal Nehru stadium. It is seen that there is high pollution in the areas of Patparganj due to industries and in Wazirpur are because of roads connecting major parts of the city and also in the area of Jawaharlal Stadium as its residential area in the surroundings and has greenery has lower pollution level. The analysis is performed for 5 days in each area. Hence, for these areas solution is provided to improve the air quality by the major use of filters and plantation is required in these areas.

Keyword: - Air Quality Index, Delhi/NCR, PM10, PM2.5, Oxygen

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INTRODUCTION

Natural contamination and related human medical problems and environmental harm zone genuine worries since they have turned into a risk to biodiversity as well as become a danger to human populace itself. [1][2] These ecological issues are of uncommon significance since they influence both widely varied vegetation including individuals. They decrease anticipated existence of individuals, hinder development of the youngsters and aggravate the whole economic advancement process. The World Health Organization (WHO) evaluated that in excess of 25 percent of all mortalities in the creating scene are because of natural elements which is very disturbing. [3] The issue turns out to be much additionally exasperated because of spontaneous development of modern groups/townships wherein huge numbers of the ventures have been spurning standards and standards. The significant test in executing any strategy of Environment Action Plans (EAP) is the recognizable proof of contaminating ventures and their area. [4] This can be accomplished by evaluating the current contamination discharges started from various industry sources and taking remedial measures in like manner. Be that as it may, it is likewise a troublesome errand for controlling organizations because of absence of dependable data on the nature and sort of contamination radiating from various modern plants and production lines.

The open air contamination is a developing worry for some urban areas in created and creating nations of the world. While the created and creating nations vary as far as their encompassing models for different contaminations (the dimension at which they believe the contamination to be destructive), the general thought behind the gauges is to know about the harm caused to the general wellbeing and the earth. The urban air toxins emerge from a wide assortment of sources, however fundamentally connected to the burning procedures. [5] The biggest sources incorporate the engine vehicles, assortment of assembling forms (businesses, for example, block furnaces, concrete, metal handling, tanning, and so forth., private fuel utilization, biomass consuming and street dust (particularly in the creating nation urban communities). [6][7] The traffic-produced toxins incorporate nitrogen oxides (NOx), carbon monoxide (CO), unstable natural mixes (VOCs) and particulates (PM). Given the blend of NOx and VOC discharges, joined with solid daylight amid the day, this prompts a development of ozone (O3) through photolysis and helper of various radicals1. Different poisons incorporate sulfur dioxide (SO2) fundamentally from the coal ignition in ventures, control plants, and neighborhoods (which likewise add to the emanations to above recorded toxins). Urban air contamination, be that as it may, is certifiably not another issue or a simple one to clarify. Every one of the toxins is related with a scope of wellbeing impacts, somewhat connected to the wellspring of the contamination.[8] For instance, PM prompting reason for the respiratory sicknesses, Ozone contamination prompting eye and lung disturbances, SO2 (with precipitation) prompting corrosive downpour, aggravation along the respiratory track and bronchitis, NOx improving the side effects for ceaseless bronchitis, and CO lessening the oxygen supply to the cerebrum (and at times lethal).[9][10]

ANALYSIS:

A device which measures the parameters of different sensors for air quality is shown in figure 1. This device was used to measure different parameters as shown in the figure in various areas mentioned. The parameters mentioned are PM2.5, PM10, NO2, NH3, SO2, CO, OZONE. All the parameters are shown in micro gram per meter cube unit. The formula mentioned in chapter 3 is used for air quality index calculation. The basic use of this device is that it has a special feature of IOT and it connects with internet and updates a hobby site or a website named a thingspeak.com. The calculated results are the downloaded from the things speak server on timings basis an analysis of all the parameters are presented on the basis of air quality index. Figure 2 shows a clear view of the LCD display.

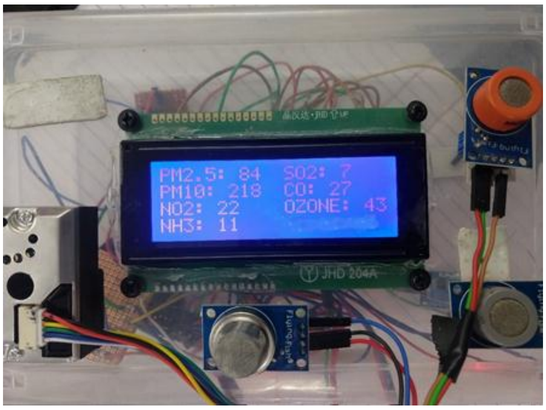

Figure 1: IOT based Device for Parameters

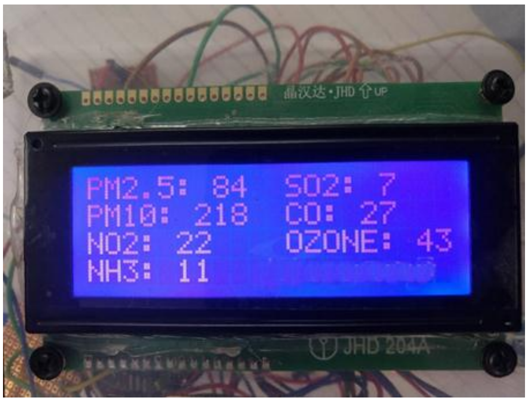

Figure 2: Clear Display VIEW of the Device

So, in the section we are getting brief about the IOT device. The results retrieved from the IOT device are shown in figure 3 to figure 17. All of these graphs are specific for each sensor value. Different dates and timings are used for the measurement to create an analysis in the next section.

Observations:

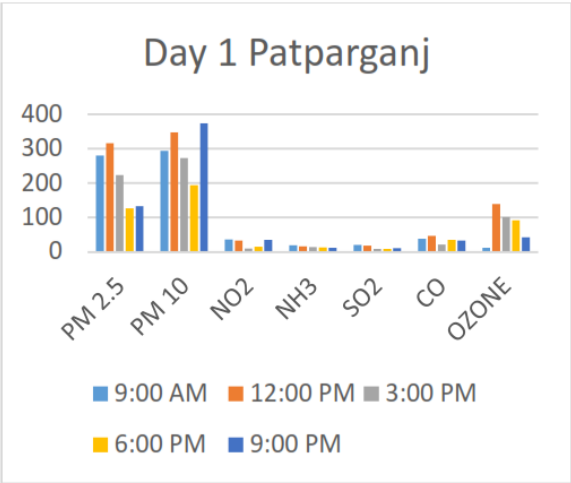

Figure 3: Graph diagram of Air quality testing: Patparganj, Delhi (day1)

The figure 3 shows the Graph diagram of Air quality testing: Patparganj, Delhi(day1) the PM2.5 is high in 12pm and low in 6.00pm, the PM10 is high in 9.00am and low in 6.00pm, the NO2 is high in 9.00pm and low in 6.00pm, the NH3 is high in 9.00am and low in 9.00pm, the SO2 is high in 9.00am and low in 3.00pm, the CO is high in 12.00pm and 3.00pm and ozone is high in 12.00 pm and low in 9.00 pm

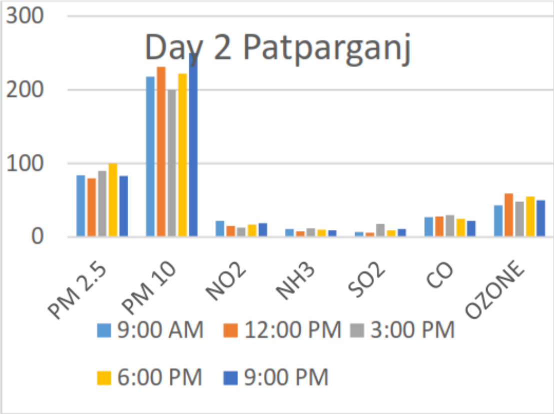

Figure 4: Graph diagram of Air quality testing: Patparganj, Delhi (day 2)

The figure 4 shows the Graph diagram of Air quality testing: Patparganj, Delhi(day2) the PM2.5 is high in 6.00pm and low in 12.00pm, the PM10 is high in 9.00am and low in 3.00pm, the NO2 is high in 9.00pm and low in 3.00pm, the NH3 is high in 3.00am and low in 12.00pm, the SO2 is high in 3.00pm and low in 12.00pm, the CO is high in 3.00pm and 9.00pm and ozone is high in 12.00 pm and low in 9.00 am

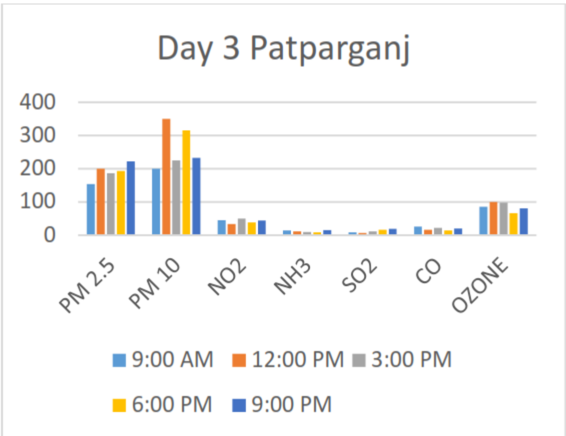

Figure 5: graph diagram of Air quality testing: Patparganj, Delhi (day 3)

The figure 5 shows the Graph diagram of Air quality testing: Patparganj, Delhi (day3) the PM2.5 is high in 9.00am and low in 9.00pm, the PM10 is high in 12.00pm and low in 3.00pm, the NO2 is high in 3.00pm and low in 6.00pm, the NH3 is high in 9.00am and low in 3.00pm, the SO2 is high in 9.00pm and low in 12.00pm, the CO is high in 9.00am and 6.00pm and ozone is high in 12.00 pm and low in 3.00 pm

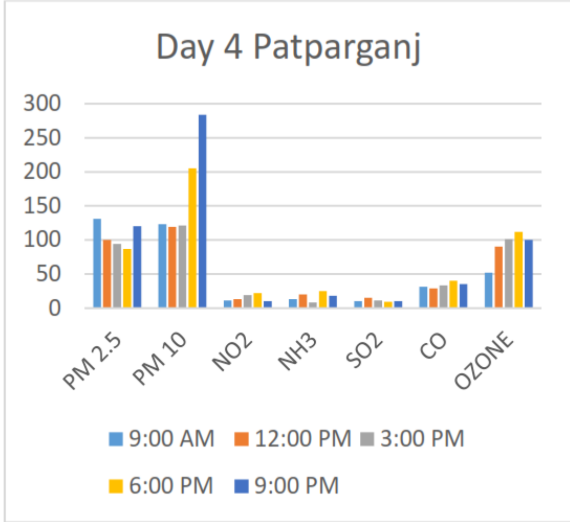

Figure 6: graph diagram of Air quality testing: Patparganj, Delhi (day 4)

The figure 6 shows the Graph diagram of Air quality testing: Patparganj, Delhi(day4) the PM2.5 is high in 9.00pm and low in 6.00pm ,the PM10 is high in 9.00pm and low in 12.00pm ,the NO2 is high in 6.00pm and low in 9.00pm ,the NH3 is high in 6.00am and low in 3.00pm ,the SO2 is high in 12.00pm and low in 6.00pm ,the CO is high in 12.00pm and low in 12.00pm and ozone is high in 12.00 pm and low in 9.00 am

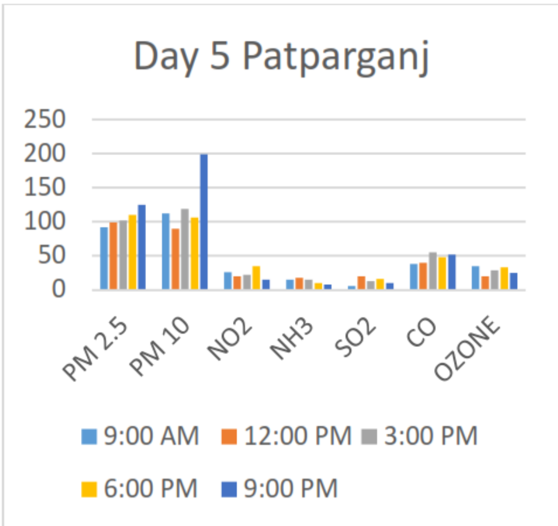

Figure 7: graph diagram of Air quality testing: Patparganj, Delhi (day 5)

The figure 7 shows the Graph diagram of Air quality testing: Patparganj, Delhi (day2) the PM2.5 is high in 9.00pm and low in 9.00am ,the PM10 is high in 9.00am and low in 12.00pm ,the NO2 is high in 6.00pm and low in 9.00pm ,the NH3 is high in 12.00pm and low in 9.00pm ,the SO2 is high in 12.00pm and low in 9.00am ,the CO is high in 3.00pm and low in 9.00am and ozone is high in 9.00 am and low in 12.00 pm

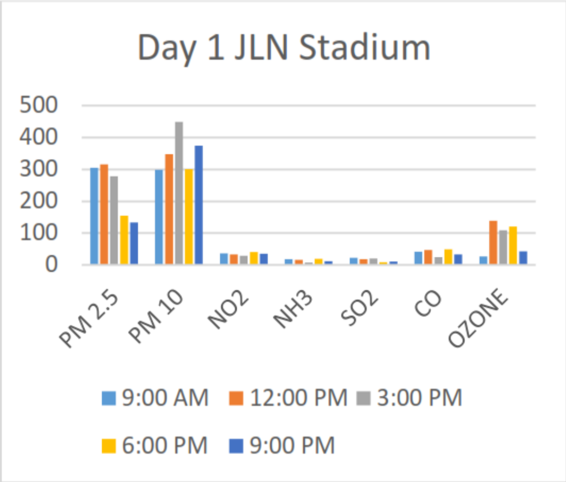

Figure 8: graph diagram of Jawaharlal Nehru stadium (day 1)

The figure 8 shows the graph diagram of Jawaharlal Nehru stadium (day 1) the PM2.5 is high in 12.00pm and low in 9.00pm ,the PM10 is high in 3.00am and low in 6.00pm ,the NO2 is high in 6.00pm and low in 3.00pm ,the NH3 is high in 9.00am and low in 3.00pm ,the SO2 is high in 3.00pm and low in 6.00pm ,the CO is high in 6.00pm and 3.00pm and ozone is high in 12.00 pm and low in 9.00 am.

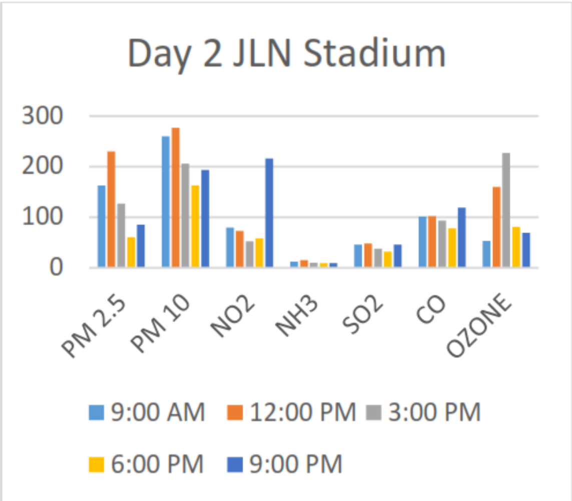

Figure 9: Graph diagram of Jawaharlal Nehru stadium (day 2)

The figure 9 shows the graph diagram of Jawaharlal Nehru stadium (day 2) the PM2.5 is high in 12.00pm and low in 6.00pm, the PM10 is high in 12.00am and low in 6.00pm, the NO2 is high in 9.00pm and low in 3.00pm ,the NH3 is high in 12.00am and low in 6.00pm ,the SO2 is high in 12.00pm and low in 6.00pm ,the CO is high in 9.00pm and 6.00pm and ozone is high in 3.00 pm and low in 9.00 am.

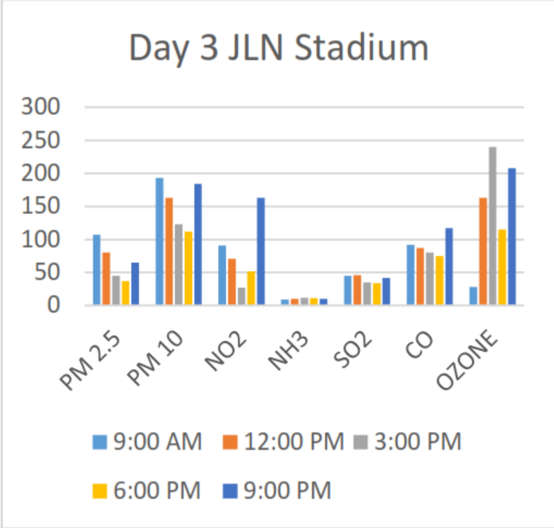

Figure 10: graph diagram of Jawaharlal Nehru stadium (day 3)

The figure 10 shows the graph diagram of Jawaharlal Nehru stadium (day 3) the PM2.5 is high in 9.00am and low in 9.00pm ,the PM10 is high in 9.00am and low in 6.00pm ,the NO2 is high in 9.00pm and low in 3.00pm ,the NH3 is high in 9.00am and low in 3.00pm ,the SO2 is high in 3.00pm and low in 6.00pm ,the CO is high in 6.00pm and 3.00pm and ozone is high in 12.00 pm and low in 9.00 am.

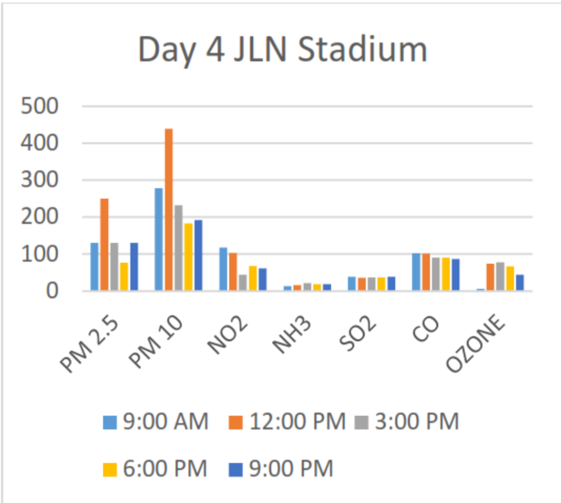

Figure 11: Graph diagram of Jawaharlal Nehru stadium (day 4)

The figure 11 shows the graph diagram of Jawaharlal Nehru stadium (day 1) the PM2.5 is high in 12.00pm and low in 9.00pm ,the PM10 is high in 3.00am and low in 6.00pm ,the NO2 is high in 6.00pm and low in 3.00pm ,the NH3 is high in 3.00pm and low in 3.00pm ,the SO2 is high in 9.00am and low in 3.00pm ,the CO is high in 6.00pm and 3.00pm and ozone is high in 3.00 pm and low in 9.00 am.

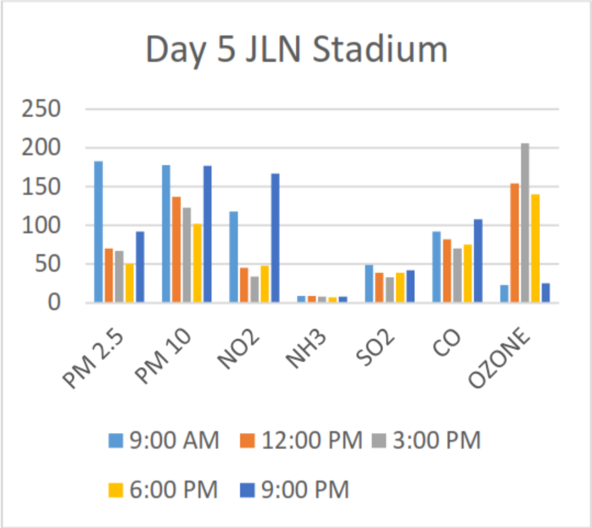

Figure 12: Graph diagram of Jawaharlal Nehru stadium (day 5)

The figure 12 shows the graph diagram of Jawaharlal Nehru stadium (day 5) the PM2.5 is high in 9.00am and low in 6.00pm, the PM10 is high in 9.00am and low in 6.00pm, the NO2 is high in 9.00pm and low in 3.00pm ,the NH3 is high in 3.00am and low in 6.00pm ,the SO2 is high in 9.00am and low in 3.00pm ,the CO is high in 9.00pm and 3.00pm and ozone is high in 3.00 pm and low in 9.00 am.

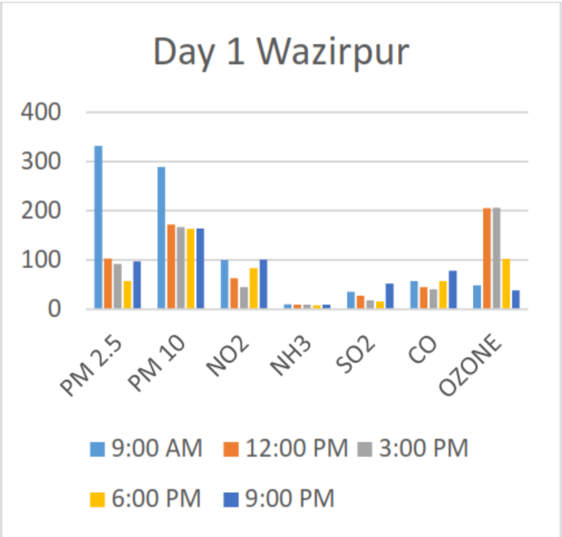

Figure 13: Graph diagram of Wazirpur (day 1)

The figure 13 shows the graph diagram of Wazirpur (day 1) the PM2.5 is high in 9.00am and low in 6.00pm, the PM10 is high in 9.00am and low in 6.00pm, the NO2 is high in 9.00pm and low in 3.00pm, the NH3 is high in 3.00am and low in 6.00pm ,the SO2 is high in 9.00am and low in 3.00pm ,the CO is high in 9.00pm and 3.00pm and ozone is high in 3.00 pm and low in 9.00 am.

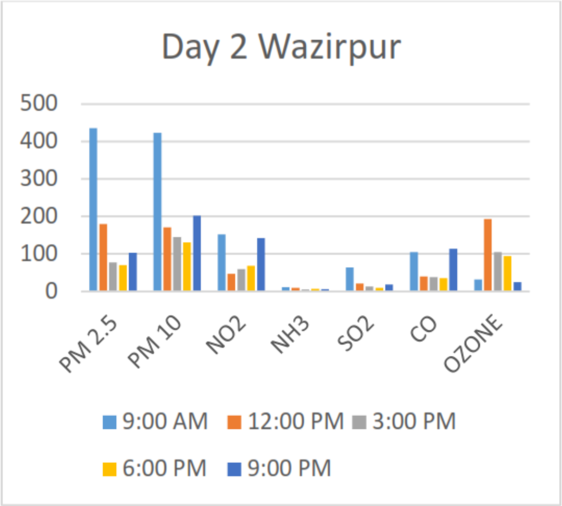

Figure 14: graph diagram of Wazirpur (day 2)

The figure 14 shows the graph diagram of Wazirpur (day 2) the PM2.5 is high in 9.00am and low in 6.00pm, the PM10 is high in 9.00am and low in 6.00pm, the NO2 is high in 9.00pm and low in 3.00pm, the NH3 is high in 3.00am and low in 6.00pm, the SO2 is high in 9.00am and low in 3.00pm, the CO is high in 9.00pm and 3.00pm and ozone is high in 3.00 pm and low in 9.00 am.

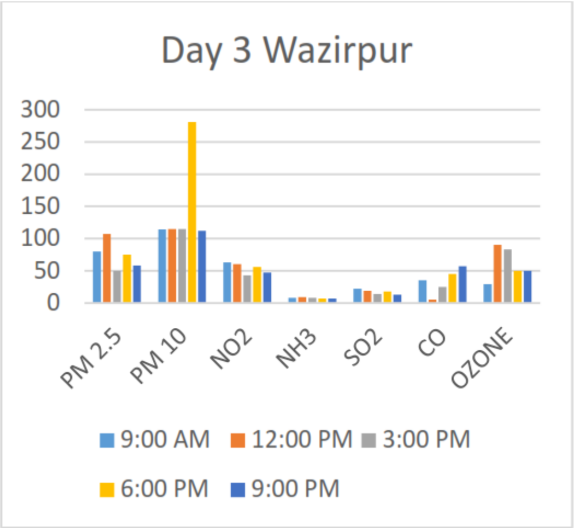

Figure 15: graph diagram of Wazirpur (day 3)

The figure 15 shows the graph diagram of Wazirpur (day 3) the PM2.5 is high in 9.00am and low in 6.00pm, the PM10 is high in 9.00am and low in 6.00pm, the NO2 is high in 9.00pm and low in 3.00pm, the NH3 is high in 3.00am and low in 6.00pm ,the SO2 is high in 9.00am and low in 3.00pm ,the CO is high in 9.00pm and 3.00pm and ozone is high in 3.00 pm and low in 9.00 am.

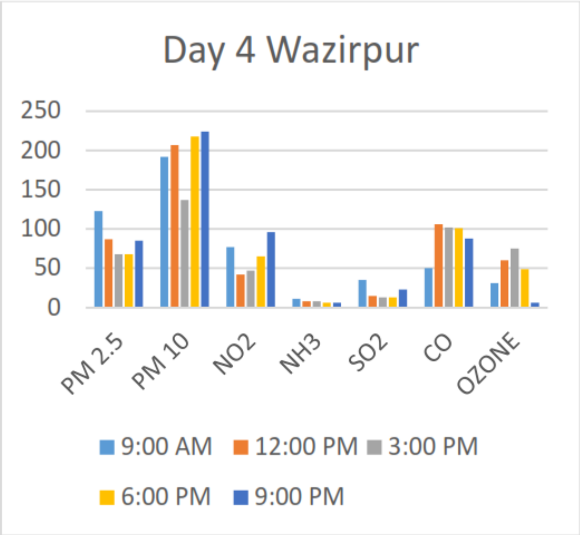

Figure 16: graph diagram of Wazirpur (day 4)

The figure 16 shows the graph diagram of Wazirpur (day 2) the PM2.5 is high in 9.00am and low in 6.00pm, the PM10 is high in 9.00am and low in 6.00pm, the NO2 is high in 9.00pm and low in 3.00pm, the NH3 is high in 3.00am and low in 6.00pm, the SO2 is high in 9.00am and low in 3.00pm, the CO is high in 9.00pm and 3.00pm and ozone is high in 3.00 pm and low in 9.00 am.

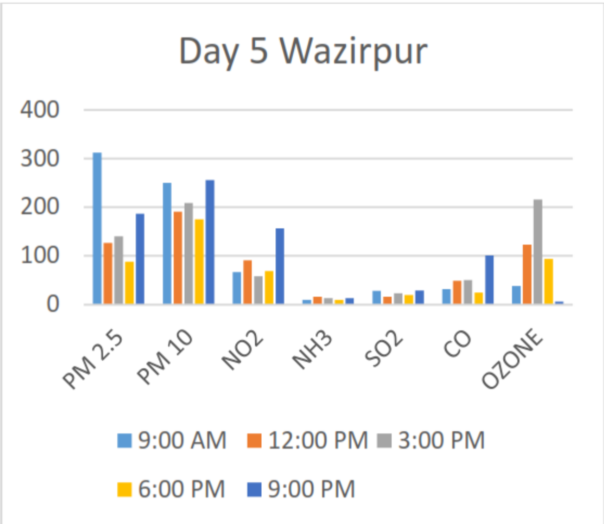

Figure 17: graph diagram of Wazirpur (day 5)

The figure 17 shows the graph diagram of Wazirpur (day 4) the PM2.5 is high in 9.00am and low in 6.00pm, the PM10 is high in 9.00am and low in 6.00pm, the NO2 is high in 9.00pm and low in 3.00pm, the NH3 is high in 3.00am and low in 6.00pm, the SO2 is high in 9.00am and low in 3.00pm, the CO is high in 9.00pm and 3.00pm and ozone is high in 3.00 pm and low in 9.00 am.

RESULT OBTAINED:

Table 1. Average Result for Wazirpur Area

WAZIRPUR			
Pollutants	**Average Observed Concentration**	**24-Hour Average Standard Concentration (NAAQ Standards)**	**Difference (in %)**
PM 2.5	128	60	53.1
PM 10	193	100	48.1
NO2	76	80	-
NH3	9	400	-
SO2	23	80	-
CO	59	6	89.8
Ozone	82	300	-

Table 2. Average Result for Patparganj Area

PATPARGANJ			
Pollutants	**Average Observed Concentration**	**24-Hour Average Standard Concentration (NAAQ Standards)**	**Difference (in %)**
PM 2.5	141	60	57.4
PM 10	216	100	53.7
NO2	25	80	-
NH3	13	400	-
SO2	12	80	-
CO	32	6	81.2
Ozone	67	300	-

Table 3. Average Result for JLN Stadium Area

JLN STADIUM			
Pollutants	**Average Observed Concentration**	**24-Hour Average Standard Concentration (NAAQ Standards)**	**Difference (in %)**
PM 2.5	135	60	**55.5**
PM 10	227	100	**55.9**
NO2	75	80	**-**
NH3	12	400	**-**
SO2	35	80	**-**
CO	82	6	**92.6**
Ozone	104	300	**-**

SOLUTIONS:

Here we are comparing the air quality analysis of residential industrial and high traffic area. Air filters are used to shield the equipments from dust and debris in air and improve airflow. More soltuions can be planting trees and changing work timings and limits for industries. In table 4, we can see plantation cost.

Solutions are given as:

1) For Residential Areas- Portable Air Filters

2) For Industrial- Heavy Duty Air Filters

3) For traffic area- Road Side Plantation

4) Government Initiatives- Awareness, Exhaust Systems, Rapid Transport Systems

Table 4: Types of trees and its implementation cost

Types of Trees	Plantation Cost per Km (INR)
Neem	7000
Jamun	17000
Shisham	34000
Gulmohar	30000
Peepal	13000
Mango	13000

CONCLUSION: -

Hence, we have completed the analysis of the air quality parameters of three regions- residential area Jawaharlal Nehru Stadium, High Traffic Area Wazirpur and Industrial Area Patparganj in Delhi region. The main pollutant is PM10 and ozone is mainly rising in afternoon time. We can also make use of battery operated electric vehicles to improve the air quality. The conclusions can be given in the following below points:

- In Industrial Area Patparganj, 57.4% increase in PM2.5 and 53.7% increase in PM10 and CO values are increased by 81.2%, which indicates unhealthy level of pollution but due to lower values and no activity in night time the values on daily basis are nearly balanced in other sensors.

- In High Traffic Area Wazirpur, there is 53.1% and 48.1% increase in PM2.5 and PM10 respectively indicates high levels. A significant increase in CO values by 89.8% is seen which indicates that high traffic is causing pollution levels to increase.

- In Residential Area Jawaharlal Nehru Stadium, 55.5 %, 55.9 % and 92.6% increase in PM2.5, PM10 and CO values respectively. This shows that in resident's high amount of pollution is generated by the use of generators and other factors effecting the nature.

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