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Air Pollution in Hyderabad City, India for the years 2014 to 2016

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ABSTRACT: The major problem that the atmosphere is being subjected to is pollution. In India, about 100 million tons of pollutants are being added to the atmosphere annually. This figure is likely to go up in future. Polluted air is harmful to the human beings, animals, vegetation, environment and the biosphere on the whole, as well. This problem needs to be tackled and to be controlled urgently. Since all of us contribute to it directly or indirectly, we must study automobile vehicle air pollution in detail and discuss the means of controlling and preventing it. Attempts to redress the situation though isolated and uncoordinated are evident. Automobile air pollution is a growing problem in Hyderabad, Telangana State, India and as such it needs immediate attention before it goes out of control. The problem is most pronounced in the city centre especially during rush hours. This paper starts by citing some environmental effects of air pollution. It then analyses the problem of automobile air pollution in Hyderabad. This research is an attempt to contribute to consideration of traffic caused air pollution (Automobile Vehicle Air Pollution) in Hyderabad City, Telangana State, India. It looks at automobile air pollution in the backdrop of the traffic situation in the City of Hyderabad, then it examines the associated problems and subsequently it recommends some remedial measures.

KEYWORDS: Air pollution; Exhaust Emissions, Automobile Vehicles Air Pollution, Pollutants, Hyderabad

I. INTRODUCTION

The major problem that the atmosphere is being subjected to is pollution. In India, about 100 million tons of pollutants are being added to the atmosphere annually. This figure is likely to go up in future. Polluted air is harmful to the human beings, animals, vegetation, environment and the biosphere on the whole, as well. This problem needs to be tackled and to be controlled urgently. Since all of us contribute to it directly or indirectly, we must study automobile vehicle air pollution in detail and discuss the means of controlling and preventing it. Attempts to redress the situation though isolated and uncoordinated are evident. To that end various studies have been looked at air pollution, mainly as part of other projects and to a limited extent as studied in their own right. As a result, a few incidents of air pollution from industrial sources and an even smaller number of transport related air pollution that is automobile vehicle air pollution incidents have been reported.

Air pollution is an important public health problem in most cities of the developing world. Pollution levels in megacities such as Bangkok, Cairo, Delhi and Mexico City exceed those in any city in the industrialized countries. Epidemiological studies show that air pollution in developing countries accounts for tens of thousands of excess deaths and billions of dollars in medical costs and lost productivity every year. These losses, and the associated degradation in quality of life, impose a significant burden on people in all sectors of society, but especially the poor. Common air pollutants in urban cities in developing countries include:

- Particulate matter from smoky diesel vehicles, two-stroke motorcycles and 3-wheelers, burning of waste and firewood, entrained road dust and stationary industrial sources.
- Lead aerosol from combustion of leaded gasoline.
- Carbon monoxide from gasoline vehicles and burning of waste and firewood.

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- Photochemical smog (ozone) produced by the re-action of volatile organic compounds and nitrogen oxides in the presence of sunlight; motor vehicle emissions are a major source of nitrogen oxides and volatile organic compounds.
 - Sulphur oxides from combustion of sulphur containing fuels and industrial processes.
 - Secondary particulate matter formed in the atmosphere by reactions involving ozone, sulphur and nitrogen oxides and volatile organic compounds.
 - Known or suspected carcinogens such as benzene, 1,3 butadiene, aldehydes and polynuclear aromatic
- In most of the cities gasoline vehicles are the main source of lead aerosol and carbon monoxide, while diesel vehicles are a major source of respirable particulate matter.

II. SOURCES OF AIR POLLUTION

There are various locations, activities or factors which are responsible for releasing pollutants into the atmosphere. These sources can be classified into two major categories.

Anthropogenic (man-made) sources:

- These are mostly related to the burning of multiple types of fuel.
- Stationary sources include smoke stacks of fossil fuel power stations, manufacturing industries and waste incinerators, as well as furnaces and other types of fuel burning heating devices.
- In developing and poor countries, traditional biomass burning is the major source of air pollutants; traditional biomass includes wood, crop waste and dung.
- Mobile sources include motor vehicles, marine vessels and aircraft.
- Controlled burn practices in agriculture and forest management. Controlled or prescribed burning is a technique sometimes used in forest management, farming, prairie restoration or greenhouse gas abatement.
- Fire is a natural part of both forest and grassland ecology and controlled fire can be a tool for foresters. Controlled burning stimulates the germination of some desirable forest trees, thus renewing the forest.
- Fumes from paint, hair spray, varnish, aerosol sprays and other solvents produce air pollution and these can be substantial emissions from these sources was estimated to account for almost half of pollution from Volatile Organic Compounds.
- Waste deposition in landfills generates methane. Methane is highly flammable and may form explosive mixtures with air. Methane is also an asphyxiant and may displace oxygen in an enclosed space.
- Asphyxia or suffocation may result if the oxygen concentration is reduced to below 19.5% by displacement.
- Military resources, such as nuclear weapons, toxic gases, germ warfare and rocketry.
- Fertilized farmland may be a major source of nitrogen oxides.

Natural sources:

- Dust from natural sources, usually large areas of land with little or no vegetation.
- Methane emitted by the digestion of food by animals like cattle.
- Radon gas from radioactive decay within the Earth's crust. Radon is a colourless, odourless, naturally occurring radioactive noble gas that is formed from the decay of radium.
- It is considered to be a health hazard. Radon gas from natural sources can accumulate in buildings, especially in confined areas such as the basement and it is the second most frequent cause of lung cancer, after cigarette smoking.
- Smoke and Carbon monoxide from wild fires. During periods of active wildfires, smoke from uncontrolled biomass combustion can make up almost 75% of all air pollution by concentration.
- Vegetation, in some regions emits environmentally significant amounts of Volatile Organic Compounds (VOCs) on warmer days. These VOCs react with primary anthropogenic pollutants specifically, NO_x, SO₂, and anthropogenic organic carbon compound to produce a seasonal haze of secondary pollutants.
- Black gum, poplar, oak and willow are some examples of vegetation that can produce abundant VOCs. The VOCs production from these species result in ozone levels up to eight times higher than the low impact tree species.
- Volcanic activity, which produces Sulphur, Chloride and ash particulates.

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The air pollution is due to activities of human beings and also natural causes like the volcanoes, anaerobic decomposition of organic matter and atmospheric reactions, etc. The main sources of air pollution are burning of fossil fuels, automobiles, industries, fertilizer plants, thermal plants, textile industries and steel plants etc. Fossil fuels include petroleum and coal and burning of coal produces a lot of smoke and dust whereas burning of petrol mainly produces sulphur dioxide. In addition to these, the pollutants include carbon monoxide (CO), carbon dioxide (CO₂), nitrogen oxides (NO_x), hydrocarbons, particulate matter and traces of metals.

In automobile vehicles, combustion of petrol or diesel produces carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NO_x), aldehydes, sulphur compounds (SO_x), organic acids, ammonia and carbon particles. The fertilizer industries produce hydrocarbons (HC), nitrogen oxides (NO_x), sulphur compounds (SO_x), particulate matter and fluorine.

Major Air Pollutants:

An air pollutant is a material in the air that can have adverse effects on humans and the ecosystem. The substance can be solid particles, liquid droplets or gases. A pollutant can be of natural origin or manmade. Pollutants are classified as primary or secondary.

Primary pollutants are usually produced by processes such as ash from a volcanic eruption. Other examples include Carbon monoxide gas from motor vehicle exhausts or Sulphur dioxide released from factories. Secondary pollutants are not emitted directly. Rather, they form in the air when primary pollutants react or interact. Ground level ozone is a prominent example of secondary pollutants. Some pollutants may be both primary and secondary; they are both emitted directly and formed from other primary pollutants. Before flue gas desulphurization was installed, the emissions from this power plant in Hyderabad City contained excessive amounts of Sulphur dioxide. Schematic drawing, causes and effects of air pollution are Greenhouse effect, Particulate contamination, increased Ultra Violet Radiation, Acid rain, increased ground level Ozone concentration and increased levels of Nitrogen oxides. Thermal Oxidizers are air pollution abatement options for hazardous air pollutants (HAPs), Volatile Organic Compounds (VOCs) and odorous emissions. The main categories of air pollutants are: Hydrocarbons (HC), Carbon monoxide (CO), Carbon dioxide (CO₂), Nitrogen oxides (NO_x), Sulphur oxides (SO_x) and Particulate Matter (PM).

III. EFFECTS OF AIR POLLUTION

Global Warming: The global temperature is increasing due to increasing in pollution levels and levels of the green house gases such as water vapour, methane, chlorofluorocarbons (CFCs) and nitrous oxide, etc, called as 'Global warming'. Greenhouses are glass houses, which maintain a temperature higher than the surroundings for the plants to grow and yield better. Most of the solar radiation entering the earth's atmosphere is reflected back into the space. However, the gases like carbon dioxide absorb some of the heat. This serves to keep the earth warm much like the greenhouses. The global warming effects the climate, disturbance of plants, animals, agriculture and food production, increases sea levels by melting of snow caps causes submerging of coastal areas.

Photochemical Smog: Smog is derived from the words Smoke and fog; this is formed due to photochemical reaction of pollutants like hydrocarbons and nitrogen oxides combines in the presence of sunlight. It forms a yellowish brown haze especially during winter and hampers visibility also causes many respiratory disorders and allergies as it contains polluting gases.

Acid Rain: Sulphuric acid (H₂SO₄) and nitric acid (HNO₃) are produced when Sulphur dioxide (SO₂) and nitrogen oxides (NO_x) react with water in the atmosphere and these acids come down along with the rain; this phenomenon is called as acid rain. The pH of acid rain varies from 3 - 6. This acid rain causes respiratory and skin disorders, reduces productivity of plants by damaging the leaves, harm to the aquatics, damage to marbles and thus damage to buildings and monuments.

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Aerosol: Dispersion of solid or liquid matter in the atmosphere forms aerosol. The pollutant particulate matter like carbon particles forms pollutant aerosol. It forms a thick layer in the troposphere, which affect the weather conditions by blocking the solar radiation. Aerosols are also deposited on the leaves and affect the photosynthesis.

Ozone Depletion: The stratosphere of the atmosphere has ozone (O₃). Ozone protects us from the harmful effects of the UV rays by absorbing the ultraviolet (UV) rays present in the sun's radiation. However, the pollutants, hydrocarbons such as the chlorofluorocarbons (CFCs) destroy the ozone molecules, which deplete the ozone layer. Ozone holes have been detected in the atmosphere, which permit the UV rays to reach the earth's surface. The harmful effects of the UV rays are visible in the countries such as Australia and New Zealand where the rate of skin cancer is higher than the other regions of the world.

Effects of Exhaust Emissions:

The effects of automobile exhaust pollutants on vegetation; animals and human beings are as follows;

Oxides of Carbon: CO combines with haemoglobin thus reduces the oxygen carrying capacity of blood, which affects the respiratory activity and results in blurred vision, headache, unconsciousness and death due to asphyxiation.

Sulphur Dioxide: It causes respiratory problems, severe headache, reduced productivity of plants, yellowing and reduced storage time for paper, yellowing and damage to limestone, marbles and leather, increased rate of corrosion of iron, steel, zinc and aluminium.

Oxides of Nitrogen: It affects the photosynthetic activities of plants and causes respiratory problems in mammals.

Hydrocarbons: It causes carcinogenic/leukaemia and destroys ozone layer, which then permits harmful UV rays to enter the atmosphere, irritation of eye, throat and respiratory tract, damage to clothes, paint and rubber articles, damage to leaves and stomata tissue in plants.

Organic and inorganic Particulate matter: It causes toxic effect in man, asbestosis, and cancerous disease of the lungs silicosis, allergy and infection disease.

AUTOMOBILE VEHICLE EMISSION CONTROL STRATEGIES:

Engine efficiency has been steadily improved and reduces the toxicity of exhaust with improved engine design, more precise ignition timing and fuel metering, electronic ignition, and computerized engine management. But these alone have generally been proved insufficient to meet emissions goals. Therefore, technologies to detoxify the exhaust are an essential part of emissions control.

Air Injection: One of the first developed exhaust emission control systems is secondary air injection. Originally, this system was used to inject air into the engine's exhaust ports to provide oxygen so unburned and partially burned hydrocarbons in the exhaust would finish burning. Air injection is now used to support the Catalytic Converters oxidation reaction and to reduce emissions when an engine is started from cold. After a cold start, an engine needs an air fuel mixture richer than what it needs at operating temperature and the Catalytic Converters does not function efficiently until it has reached its own operating temperature. The air injected upstream of the converter supports combustion in the exhaust head pipe, which speeds catalyst warm up and reduces the amount of unburned hydrocarbon emitted from the tailpipe.

Exhaust Gas Recirculation (EGR): In US and Canada many engines have a system that routes a metered amount of exhaust into the intake tract under particular operating conditions. Exhaust neither burns nor supports combustion and it dilutes the air fuel charge to reduce combustion chamber temperatures and this turn to reduce the formation of NO_x.

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Catalytic Converter: The catalytic converter is a device placed in the exhaust pipe, which converts hydrocarbons, carbon monoxide, and NO_x into less harmful gases by using a combination of platinum, palladium and rhodium as Catalysts.

Evaporative Emissions Control: Evaporative emissions are the result of gasoline vapours escaping from the vehicle fuel system.

III. RESULTS AND DISCUSSION

The pollutant levels in ‘µg/m³’ of CO, O₃, NO₂, SO₂, PM₁₀, Benzene and Toluene at four important places namely Sanathnagar, Hyderabad Central University (HCU), Zoo Park and Panjagutta of Hyderabad City for the year 2014 to 2016 is shown in Table 1.

Table 1. Pollutant Levels at Four important Places of Hyderabad City for the years 2014 to 2016

Year	Area	Pollutant (µg/m ³)						
		CO	O ₃	NO ₂	SO ₂	PM ₁₀	Ben- zene	Tol- uene
2014	Sanath Nagar	60	49	32	9	99	4.8	23.5
	HCU	50	33.3	52.1	8.4	83.4	0.9	5.2
	Zoo Park	90	47.5	22.5	10.7	111.8	1.4	8.4
	Panja Gutta	220	12.3	46.1	9.4	121.4	2.5	24.8
2015	Sanath Nagar	60	57	37	11	101	2.8	25.2
	HCU	90	31.9	48.6	6.4	76.3	1.0	2.8
	Zoo Park	80	45.6	47.0	10.3	107.7	1.7	7.8
	Panja Gutta	200	16.9	54.8	9.9	114.7	5.5	32.4
2016	Sanath Nagar	70	56	46	10	99.4	0.9	9.3
	HCU	90.0	26.8	39.5	9.8	80.3	0.4	2.2
	Zoo Park	90.0	32.7	40.4	8.8	117.0	1.5	10.0
	Panja Gutta	170.0	6.0	27.3	8.7	111.5	2.9	29.8

The pollutant levels in ‘µg/m³’ of CO, O₃, NO₂, SO₂, PM₁₀, Benzene and Toluene at four important places like Sanathnagar, Hyderabad Central University, Zoo Park and Panjagutta of Hyderabad City for the year 2014 is shown in fig. 1.

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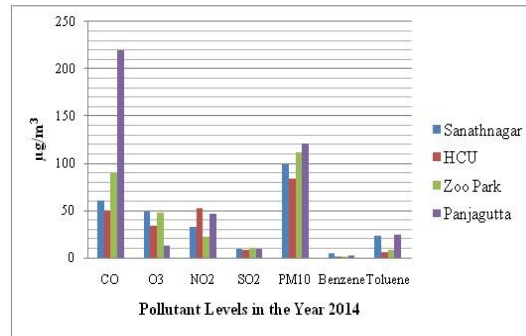


Fig. 1 Pollutant Levels in the Year 2014 at different places of Hyderabad City

From the CAAQMS and experimental data, it is observed that the ‘CO’ pollutant levels are high ($220 \mu\text{g}/\text{m}^3$) at Panjagutta centre due to heavy traffic density particularly during rush hours. As per Air Quality Index (AQI), the Panjagutta area is moderately polluted by ‘CO’. Hence preventive steps/measure has to be taken to control the ‘CO’ pollutant by reducing automobile exhaust emissions by reducing the vehicle traffic density. Also observed that the ‘PM₁₀’ pollutant levels are high ($120 \mu\text{g}/\text{m}^3$) at Panjagutta due to heavy traffic, at Zoo Park due to traffic side area and at Sanathnagar due to traffic and industrial area. Further, it is observed that the pollutant levels are ‘satisfactory’ as per AQI at HCU.

The pollutant levels in ‘ $\mu\text{g}/\text{m}^3$ ’ of CO, O₃, NO₂, SO₂, PM₁₀, Benzene and Toluene at four important places namely, Sanathnagar, Hyderabad Central University, Zoo Park and Panjagutta of Hyderabad City for the year 2015 is, shown in fig. 2.

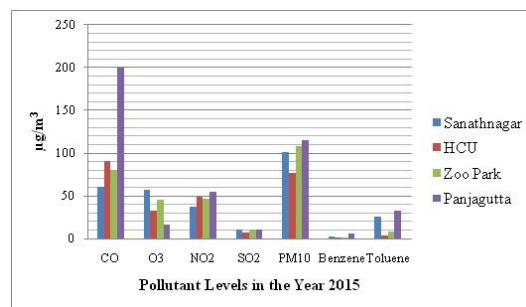


Fig. 2 Pollutant Levels in the Year 2015 at different places of Hyderabad City

From the CAAQMS and experimental data, it is observed that the ‘CO’ pollutant levels are high ($200 \mu\text{g}/\text{m}^3$) at Panjagutta centre due to heavy traffic density particularly during rush hours. As per Air Quality Index (AQI), the Panjagutta area is moderately polluted by ‘CO’. Hence preventive steps/measure has to be taken to control the ‘CO’ pollutant by reducing automobile exhaust emissions by reducing the vehicle traffic density. It is also observed that the ‘PM₁₀’ pollutant levels are high ($115 \mu\text{g}/\text{m}^3$) at Panjagutta due to heavy traffic. Further, it is observed that the pollutant levels are ‘satisfactory’ as per AQI at HCU and Sanathnagar.

The pollutant levels in ‘ $\mu\text{g}/\text{m}^3$ ’ of CO, O₃, NO₂, SO₂, PM₁₀, Benzene and Toluene at four important places namely, Sanathnagar, Hyderabad Central University, Zoo Park and Panjagutta of Hyderabad City for the year 2016 is, shown in fig. 3.

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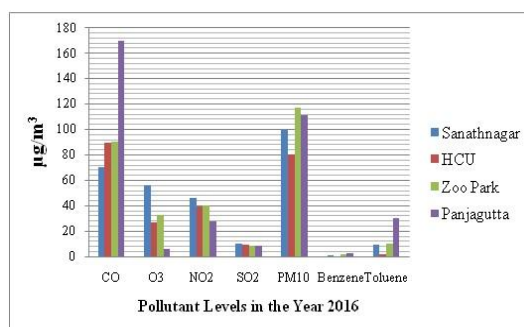


Fig. 3 Pollutant Levels in the Year 2016 at different places of Hyderabad City

From the CAAQMS and experimental data, it is observed that the ‘CO’ pollutant levels are high ($170 \mu\text{g}/\text{m}^3$) at Panjagutta centre due to heavy traffic density particularly during rush hours. As per Air Quality Index (AQI), the panjagutta area is moderately polluted by ‘CO’. Hence preventive steps/measure has to be taken to control the ‘CO’ pollutant by reducing automobile exhaust emissions by reducing the vehicle traffic density. It is also observed that the ‘PM₁₀’ pollutant levels are high ($116 \mu\text{g}/\text{m}^3$) at Zoo Park, Panjagutta and Sanathnagar due to metro works, heavy traffic, industrial area and construction works ‘MMTS works’. Further, it is observed that the pollutant levels are ‘satisfactory’ as per AQI at HCU.

Table 2 PM₁₀, SO₂ & NO_x Pollutant Levels at Different Places of Hyderabad City from 2014 to 2016

Station Name/ Year	PM ₁₀ ($\mu\text{g}/\text{m}^3$)			SO ₂ ($\mu\text{g}/\text{m}^3$)			NO _x ($\mu\text{g}/\text{m}^3$)		
	2014	15	16	14	15	16	14	15	16
Balanagar	135	105	131	5.1	5.4	4.7	32.0	34.3	31.1
Uppal	99	88	96	5.0	5.3	4.8	26.5	28.8	28.5
Jubilee Hills	80	85	108	4.5	4.9	4.7	19.6	24.2	28.1
Charminar	112	114	108	5.0	5.4	4.7	27.7	32.1	30.4
Jeedimetla	107	123	115	5.1	5.4	5.0	29.5	29.7	28.0
MGBS	69	67	76	4.8	4.9	4.6	22.1	25.2	20.9
Kukatpally	114	123	89	5.0	5.2	4.8	26.9	28.5	26.5
Abids	104	92	107	5.0	5.1	4.6	27.8	30.0	24.2

The pollutant levels in ‘ $\mu\text{g}/\text{m}^3$ ’ of ‘PM₁₀’ at Balanagar, Uppal, Jubilee Hills, Charminar, Jeedimetla, MGBS, Kukatpally and Abids of Hyderabad City for the year 2014 to 2016 are, as shown in fig. 4.

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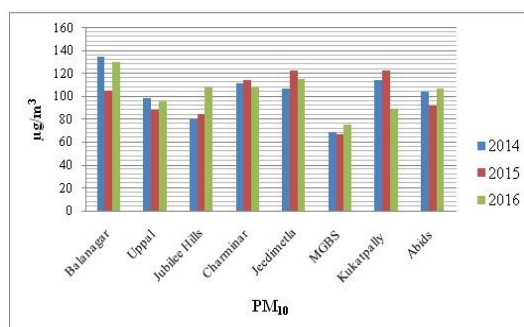


Fig. 4 PM₁₀ Pollutant Levels for the Year 2014 to 2016 at different places of Hyderabad City

From the CAAQMS and experimental data, it is observed that the ‘PM₁₀’ pollutant levels are high (130 µg/m³) at Balanagar and Jeedimetla due to industrial area and Jubilee Hills and Kukatpally due to heavy traffic density particularly during rush hours. As per Air Quality Index (AQI), the Balanagar and Jeedimetla areas are moderately polluted by ‘PM₁₀’. Hence preventive steps/measure has to be taken to control the ‘PM₁₀’ pollutant by collecting the dust particles through dust collectors. It is also observed that the ‘PM₁₀’ pollutant levels are high in the year 2014 and 2016 and moderate in the year 2015. Further, it is observed that the pollutant levels are ‘satisfactory’ as per AQI at remaining areas.

The pollutant levels in ‘µg/m³’ of ‘SO₂’ at Balanagar, Uppal, Jubilee Hills, Charminar, Jeedimetla, MGBS, Kukatpally and Abids of Hyderabad City for the year 2014 to 2016 are, as shown in fig. 5.

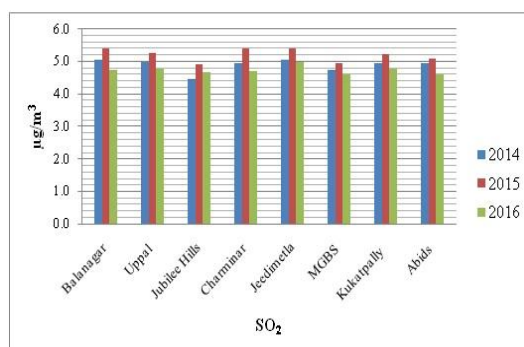


Fig. 5 SO₂ Pollutant Levels for the Year 2014 to 2016 at different places of Hyderabad City

From the CAAQMS and experimental data, it is observed that the ‘SO₂’ pollutant levels are within the satisfactory limit (40 - 80 µg/m³) at Balanagar, Uppal, Jubilee Hills, Charminar, Jeedimetla, MGBS, Kukatpally and Abids areas for the years from 2014 to 2016 and slightly higher in the year 2015.

The pollutant levels in ‘µg/m³’ of ‘NO_x’ at Balanagar, Uppal, Jubilee Hills, Charminar, Jeedimetla, MGBS, Kukatpally and Abids of Hyderabad City for the year from 2014 to 2016 are, as shown in fig. 6.

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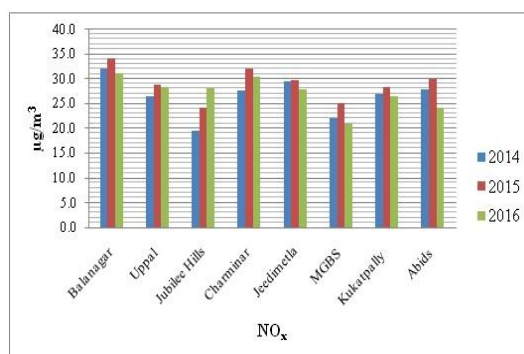


Fig. 6 NO_x Pollutant Levels for the Year 2014 to 2016 at different places of Hyderabad City

From the CAAQMS and experimental data, it is observed that the 'NO_x' pollutant levels are within the Good limit (0 - 40 µg/m³) at Balanagar, Uppal, Jubilee Hills, Charminar, Jeedimetla, MGBS, Kukatpally and Abids areas for the years from 2014 to 2016 and slightly higher in the year 2015.

IV. CONCLUSIONS AND RECOMMENDATIONS

From the CAAQMS data and experimental data, the following observations were made:

- The 'CO' pollutant levels are high (200 - 220 µg/m³) at Panjagutta centre due to heavy traffic density particularly during rush hours. As per Air Quality Index (AQI), the panjagutta area is moderately polluted by 'CO'. Hence preventive steps/measure has to be taken to control the 'CO' pollutant by reducing automobile exhaust emissions by reducing the vehicle traffic density. Also observed that the 'PM₁₀' pollutant levels are high (115 - 120 µg/m³) at Panjagutta due to heavy traffic, at Zoo Park due to traffic side area and at Sanathnagar due to traffic and industrial area. Further, it is observed that the pollutant levels are 'satisfactory' as per AQI at HCU.
- It is also observed that the 'PM₁₀' pollutant levels are too high (140 µg/m³) at Zoo Park and and HCU due to dust from construction works in the year 2019. Further, it is observed that the pollutant levels are 'satisfactory' as per AQI at Sanathnagar.
- The 'PM₁₀' pollutant levels are high (130 µg/m³) at Balanagar and Jeedimetla due to industrial area and Jubilee Hills and Kukatpally due to heavy traffic density particularly during rush hours. As per Air Quality Index (AQI), the Balanagar and Jeedimetla areas are moderately polluted by 'PM₁₀'. Hence preventive steps/measure has to be taken to control the 'PM₁₀' pollutant by collecting the dust particles through dust collectors. It is also observed that the 'PM₁₀' pollutant levels are high in the year 2014 and 2016 and moderate in the year 2015. Further, it is observed that the pollutant levels are 'satisfactory' as per AQI at remaining areas.
- It is observed that the 'SO₂' pollutant levels are within the satisfactory limit (40 - 80 µg/m³) at Balanagar, Uppal, Jubilee Hills, Charminar, Jeedimetla, MGBS, Kukatpally and Abids areas for the years from 2014 to 2016 and slightly higher in the year 2015.
- It is observed that the 'NO_x' pollutant levels are within the Good limit (0 - 40 µg/m³) at Balanagar, Uppal, Jubilee Hills, Charminar, Jeedimetla, MGBS, Kukatpally and Abids areas for the year 2014 to 2016 & slightly higher in the year 2015.

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- It is observed that the 'PM₁₀' pollutant levels are high (100 µg/m³) from the years 2014 to 2019 limits at Sanathnagar area due to metro construction works and heavy traffic density particularly during rush hours. As per Air Quality Index (AQI), the Sanathnagar area is satisfactorily polluted by 'PM₁₀'. Hence preventive steps/measure has to be taken to collect the dust particles. Also observed that the remaining all pollutants with in the 'Good' limits at Sanathnagar area, as per AQI.
- It is observed that the 'PM₁₀' pollutant levels are high (120 µg/m³) from the years 2014 to 2019 at Hyderabad Central University (HCU) area due to construction works, traffic side area and metro works. Particularly, PM₁₀ pollutant is high in the year 2019. As per Air Quality Index (AQI), the Hyderabad Central University (HCU) area is satisfactorily polluted by 'PM₁₀'. Hence preventive steps/measure has to be taken to collect the dust particles. Also observed that the remaining all pollutants with in the 'Good' limits at Hyderabad Central University (HCU) area, as per AQI.
- It is observed that the 'PM₁₀' pollutant levels are high (140 µg/m³) from the years 2014 to 2019 at Zoo Park area due to construction works, traffic side area and metro works. Particularly, PM₁₀ pollutant is high in the year 2019.
- As per Air Quality Index (AQI), the Zoo Park area is satisfactorily polluted by 'PM₁₀'. Hence preventive steps/measure has to be taken to collect the dust particles. It is observed that the pollutant level of 'CO' is high (120 µg/m³) particularly in the year 2017 due to heavy traffic density. Further, it is observed that the remaining all pollutants with in the 'Good' limits at Zoo Park area, as per AQI.
- It is observed that the 'CO' pollutant levels are too high (220 µg/m³) for the year from 2014 to 2019 at Panjagutta area due to heavy traffic density and vehicle exhaust gas emissions, particularly during rush hours. 'PM₁₀' pollutant is also high for the year from 2014 to 2019 due to construction works and MMTS works. As per Air Quality Index (AQI), the Panjagutta area is satisfactorily polluted by 'PM₁₀'. Hence preventive steps/measure has to be taken to collect the dust particles. It is also observed that the pollutant level of 'CO' is too high (220 µg/m³) particularly in the year 2014 due to heavy traffic density. Further, it is observed that the remaining all pollutants with in the 'Good' limits at Panjagutta area, as per AQI.

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