

Identification and Characterization of Particulate Matter Concentrations in Hyderabad City

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ABSTRACT: Ambient Monitoring is the systematic, long-term assessment of pollutant levels by measuring the quantity and types of certain pollutants in the surrounding, outdoor air. The project investigate the concentration of particular matter (PM) generated from various source like automobiles, industries over the ambient air quality of the major pollutants from 2010 to 2014 and from January,2015 to August,2015 in Hyderabad city which is located in state of Telangana, India and mentioned so of the health problems associated with increase PM Concentration. The rate of emission and concentration of PM in the ambient air is studied by Cyclonic flow technique for the measurement of PM₁₀. As per our result it is found that PM concentration was above the stipulated CPCB standard (24 hourly PM)₁₀₀. As per our study further industrial development must be restricted in Hyderabad city otherwise hazardous situation may develop.

KEYWORDS: Ambient Air, Air Pollutants, Environmental Status, particular matter, Pollution control, Quality Monitoring

I. INTRODUCTION

Air pollutants are added in the atmosphere from variety of sources that change the composition of atmosphere and affect the biotic environment. The concentration of air pollutants depend not only on the quantities that are emitted from air pollution sources but also on the ability of the atmosphere to either absorb or disperse these emissions. The air pollution concentration vary spatially and temporarily causing the air pollution pattern to change with different locations and time due to changes in meteorological and topographical condition. The sources of air pollutants include vehicles, industries, domestic sources and natural sources. Because of the presence of high amount of air pollutants in the ambient air, the health of the population and property is getting adversely affected.

II. PARTICULATE MATTER

PM is a widespread air pollutant, consisting of a mixture of solid and liquid particles suspended in the air. Commonly used indicators describing PM that are relevant to health refer to the mass concentration of particles with a diameter of less than 10 μm (PM₁₀) and of particles with a diameter of less than 2.5 μm (PM_{2.5}). PM_{2.5}, often called fine PM, also comprises ultrafine particles having a diameter of less than 0.1 μm . In most locations in Europe, PM_{2.5} constitutes 50–70% of PM₁₀. PM between 0.1 μm and 1 μm in diameter can remain in the atmosphere for days or weeks and thus be subject to long-range transboundary transport in the air.

PM is a mixture with physical and chemical characteristics varying by location. Common chemical constituents of PM include sulfates, nitrates, ammonium, other inorganic ions such as ions of sodium, potassium, calcium, magnesium and chloride, organic and elemental carbon, crustal material, particle-

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bound water, metals (including cadmium, copper, nickel, vanadium and zinc) and polycyclic aromatic hydrocarbons (PAH). In addition, biological components such as allergens and microbial compounds are found in PM.

III. SOURCES OF PM

Particles can either be directly emitted into the air (primary PM) or be formed in the atmosphere from gaseous precursors such as sulfur dioxide, oxides of nitrogen, ammonia and non-methane volatile organic compounds (secondary particles). Primary PM and the precursor gases can have both man-made (anthropogenic) and natural (non-anthropogenic) sources. Anthropogenic sources include combustion engines (both diesel and petrol), solid-fuel (coal, lignite, heavy oil and biomass) combustion for energy production in households and industry, other industrial activities (building, mining, manufacture of cement, ceramic and bricks, and smelting), and erosion of the pavement by road traffic and abrasion of brakes and tyres. Agriculture is the main source of ammonia. Secondary particles are formed in the air through chemical reactions of gaseous pollutants. They are products of atmospheric transformation of nitrogen oxides (mainly emitted by traffic and some industrial processes) and sulfur dioxide resulting from the combustion of sulfur-containing fuels. Secondary particles are mostly found in fine PM.

IV. AIR QUALITY MONITORING

Ambient air quality monitoring is required to determine the existing quality of air, evaluation of the effectiveness of control programme and to identify areas in need of restoration and their prioritization. National Air Quality Monitoring Programme is described along with details on pollutants measured and their frequency. Guidelines for monitoring are made for carrying out ambient air quality monitoring under NAM and description of the programme is essential as the monitoring is carried out to meet the objectives of NAM.

Objectives of Air Quality Monitoring

The major objectives for air quality monitoring are as below:

1. Background Data

In order to generate background data, air quality monitoring is conducted to assess existing level of contamination and to assess possible effects of air contamination occurring in future.

2. Status and Trend Evaluation

The objective is to determine air pollution status and trend information from any continuous air quality monitoring programme. The information is used to determine, whether pollution control strategies as advised by implementing authority are giving acceptable values that is lowering of pollution levels or new or additional control are required to achieve acceptable levels.

3. Environment Exposure Level Determination

The air quality monitoring and survey concern itself with systematic study of considerable segment of environment to define inter-relationship of source of pollution, atmospheric parameter and measurable manifestations in order to evaluate the character and magnitude of existing problem.

4. Scavenging Behaviour of Environment

To understand natural scavenging or cleansing process undergoing in the environment through pollution dilution, dispersion, wind movement, dry deposition, precipitation and chemical transformation of pollutants generated.

5. Air Quality Management

To assess the present status to judge effectiveness of air pollution control strategies

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and long term management of air quality.

V. MEASUREMENT METHOD FOR PM

NAAQS states the measurement methods for various pollutants. These methods should be used for conducting ambient air quality measurements. Selecting the method among the various options depend upon the resources available to sustain the measurement over a long time, detection limit of the methods, degree of skill required etc. Automatic analyzers are often costly and need skilled manpower to operate them. Measurement of pollutants by wet chemical methods is fairly simple. The detection limit of the method should be lower than the expected concentrations in an area.

A. Measurement Of Respirable Suspended Matter (PM10) By Cyclonic Flow Technique

1. Title: Method for measurement of Respirable Suspended Particulate Matter (PM10) in ambient air (Cyclonic Flow Technique).

2. Purpose: The purpose is to lay down an uniform and reliable method for determination of PM10 (Particulate matter less than 10µm diameter) in ambient air.

3. Principle: Air is drawn through a size-selective inlet and through a 20.3 x 25.4 cm (8 x 10 in) filter at a flow rate which is typically 1132 L/min. Particles with aerodynamic diameter less than the cutpoint of the inlet are collected by the filter. The mass of these particles is determined by the difference in filter weights prior to and after sampling. The concentration of PM10 in the designated size range is calculated by dividing the weight gain of the filter by the volume of air sampled.

4. Scope: This method is applicable for measurement of PM10 in the ambient air.

5. Calculation of PM10 in Ambient Air

$$PM_{10} = \frac{(W_f - W_i) \times 10^6}{V}$$

Where :

PM10 = Mass concentration of particulate matter less than 10 micron diameter in µg/m³

W_i = Initial weight of filter in g.

W_f = Final weight of filter in g.

V = Volume of air sampled in m³

10⁶ = Conversion of g to µg.

VI. HEALTH EFFECTS OF PM

PM10 and PM2.5 include inhalable particles that are small enough to penetrate the thoracic region of the respiratory system. The health effects of inhalable PM are well documented. They are due to exposure over both the short term (hours, days) and long term (months, years) and include:

- respiratory and cardiovascular morbidity, such as aggravation of asthma, respiratory symptoms and an increase in hospital admissions;
- mortality from cardiovascular and respiratory diseases and from lung cancer.

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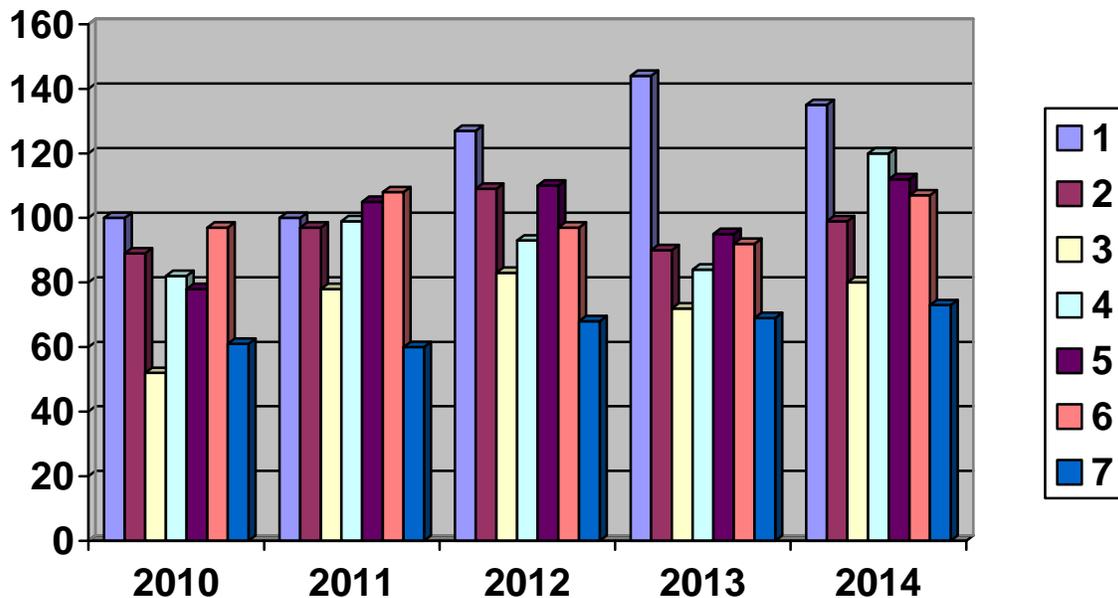
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VII. RESULTS AND ANALYSIS

Table 1: Mean PM concentrations in different years from 2010 to 2014 at different sites in Hyderabad city

PM10 Parameter (In $\mu\text{g}/\text{m}^3$)/Year						
S .NO	Location	2010	2011	2012	2013	2014
1	Balanagar - CIDT office	99	99	128	144	138
2	Uppal - M/s. Modern foods	89	96	108	90	99
3	Jubilee Hills - Police Station	51	78	83	72	80
4	Paradise - Water Works Pump House	82	99	93	84	120
5	Charminar - Bus Station	78	105	110	94	110
6	Jeedimetla Jeedimetla Industrial Association building	97	106	95	91	106
7	Zoopark - Asst. Curator building	60	62	66	69	74

Graph 1: Pie chart representation of Mean PM concentrations in different years from 2010 to 2014 at different sites (from 1 to 7) in Hyderabad city



Graph 2: Line chart representation of Mean PM concentrations in different years from 2010 to 2014 at different sites (from 1 to 7) in Hyderabad city

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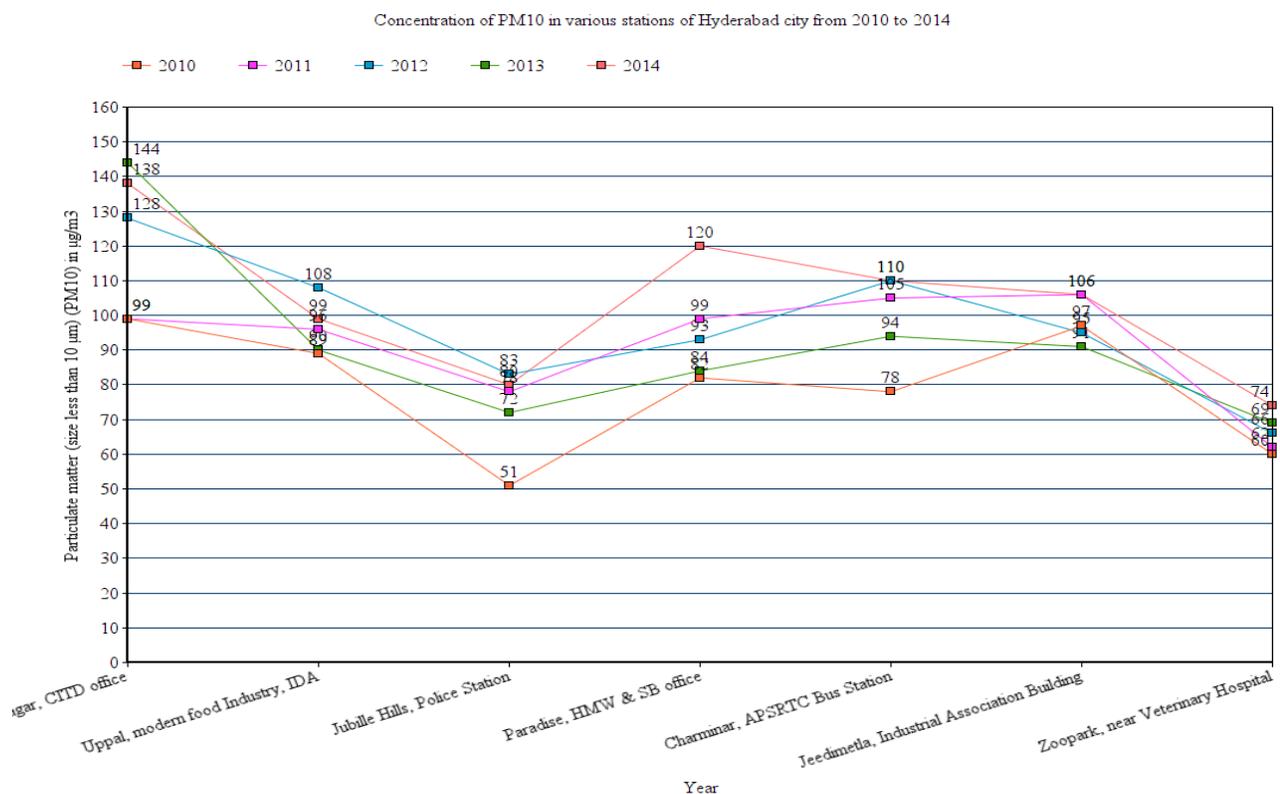


Table 2: Mean PM concentrations in different months of the year 2015 at different sites in Hyderabad city

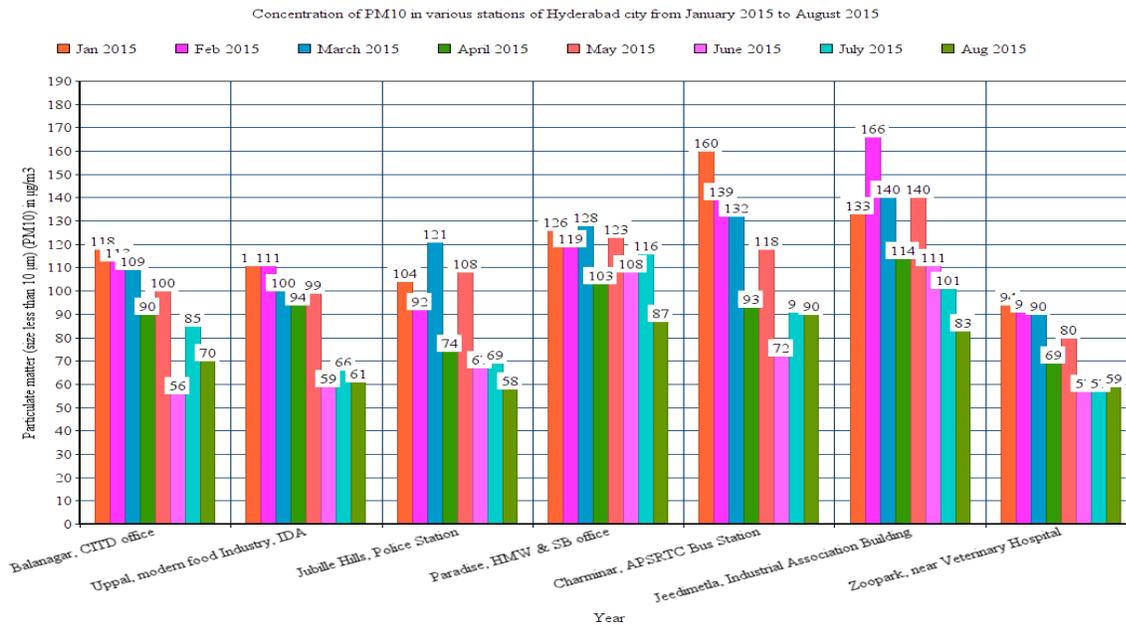
Particulate matter (size less than 10 µm) (PM10) in µg/m ³									
S. No.	NAMP Station Name	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15	Jul-15	Ag-15
1	Balanagar, CITD office	118	113	109	90	100	56	85	70
2	Uppal, modern food Industry, IDA	111	111	100	94	99	59	66	61
3	Jubille Hills, Police Station	104	92	121	74	110	67	69	56
4	Paradise, HMW & SB office	126	120	126	102	123	108	116	86
5	Charminar, APSRTC Bus Station	160	139	132	93	118	72	91	88
6	Jeedimetla, Industrial Association Building	133	166	140	114	140	121	101	84
7	Zoopark, near Veterinary Hospital	94	91	90	69	80	57	56	61

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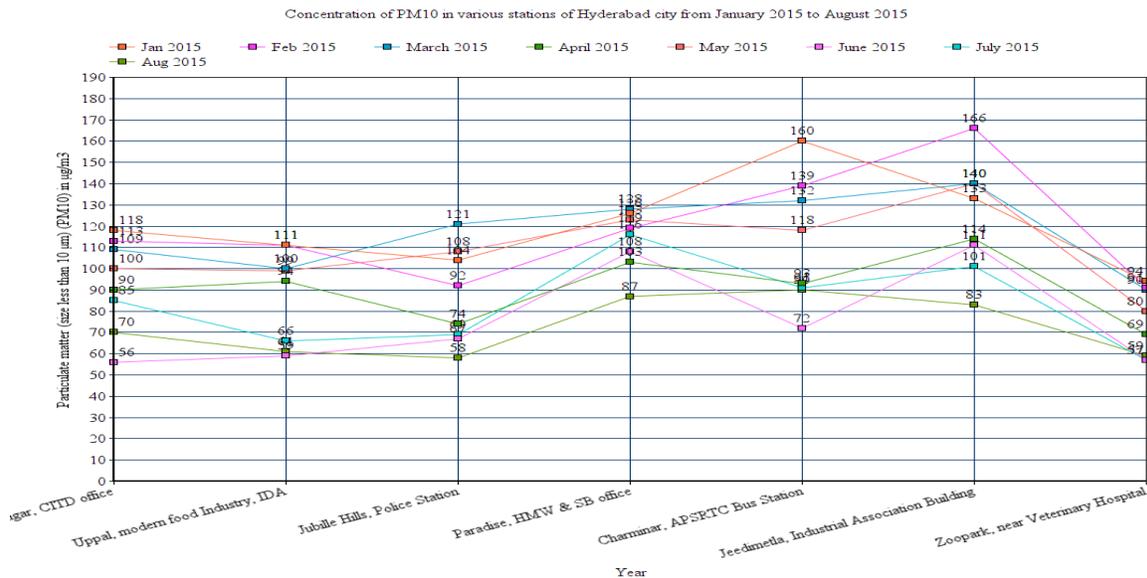
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Graph 3: Pie chart representation of Mean PM concentrations in different months of the year 2015 at different sites in Hyderabad city



Graph 4: Line chart representation of Mean PM concentrations in different months of the year 2015 at different sites in Hyderabad city



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While outdoor concentrations have generally fallen in recent decades in the cities of Asia and North America, there have been increases in urban air pollution concentrations in many cities like Hyderabad of Asia, Africa. In many cities of developing countries, the levels of air pollutants often exceed toxic limits and adversely affect human health, vegetation and built cultural heritage. Air pollution has become one of the most visible environmental problems in some city of India. Air pollutant sources of Iran classifies into three categories: (1) motor vehicles; (2) factories, workshops and power plants are the major source of air pollution in most parts of Hyderabad. Another important source of air pollutants in India is combustion of fuels for heating of buildings. Thus, it seems that air pollutants in the heating and non heating seasons are different.

Yearly and Monthly mean PM₁₀ concentrations at air quality monitoring station during 2010 to 2014 and Jan to Aug 2015 are shown in Table 1, 2 respectively. The concentrations of PM quality parameters were different in 2010 to 2014.

Air monitoring conducted in Hyderabad has shown that the minimum and maximum concentration of PM₁₀ ranged from 60 to 99 $\mu\text{g}/\text{m}^3$ (in 2010) and in 2011 it was ranged from 62-106 $\mu\text{g}/\text{m}^3$, and in 2012 it was ranged from 66-128 $\mu\text{g}/\text{m}^3$, and in 2013 it was ranged from 69-144 $\mu\text{g}/\text{m}^3$, in 2014 it was ranged from 74-138 $\mu\text{g}/\text{m}^3$ in various stations of Hyderabad.

It is observed that, PM₁₀ concentrations at air quality monitoring station during January 2015 to August 2015 were gradually increased. Air monitoring conducted in Hyderabad has shown that the minimum and maximum concentration of PM₁₀ ranged from 94 to 160 $\mu\text{g}/\text{m}^3$ in January 2015 and in Feb 2015 it was ranged from 91-166 $\mu\text{g}/\text{m}^3$, and in March 2015 it was ranged from 90 -140 $\mu\text{g}/\text{m}^3$, and in April 2015 it was ranged from 69 -114 $\mu\text{g}/\text{m}^3$, in May 2015 it was ranged from 80-140 $\mu\text{g}/\text{m}^3$, in June 2015 it was ranged from 57-121 $\mu\text{g}/\text{m}^3$, in July 2015 it was ranged from 56-116 $\mu\text{g}/\text{m}^3$, in August 2015 it was ranged from 56-88 $\mu\text{g}/\text{m}^3$ in various stations of Hyderabad.

VIII. CONCLUSION

The results of this study clearly showed that from 2010 until 2014 the Concentration of PM₁₀ concentration Increased and from January 2015 to August 2015 it was increased drastically. As per our study further industrial development must be restricted in Hyderabad city otherwise hazardous situation may develop and causes many health problems as explained above.

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