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Ambient Air Quality Monitoring of Hyderabad City

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ABSTRACT

The Ambient Air quality Analysis of urban area was carried out at three monitoring stations namely Hyderabad, Zoo Park and IDA Pashamylaram for the month of October 2016. The study is carried out for Residential, Industrial and Eco sensitive zone. The pollutants analyzed are SO_2, NO_2 and PM $_{2.5}$ .The Average value of NO_2, SO_2 and $PM_{2.5}$ was found to be 62µg/m^3, 27.39µg/m^3 and 48.93µg/m^3. AQI for the month of October is calculated. At IDA Pashamylaram Concentration of SO_2 was found to be higher than permissible 80 (µg/m^3) and Concentration of NO_2 was also found to be higher than permissible 80 (µg/m^3). HYD station showed PM $_{2.5}$ Concentration little higher than permissible 60 (µg/m^3).Meteorological factors like Wind speed were considered. A Correlation between PM $_{2.5}$ and Wind speed was established which showed dramatic decrease in pollutants with increase in wind speed.

KEYWORDS

Air quality index, SO_2, NO_2 and PM $_{2.5}$

1. INTRODUCTION

Parameters of air quality Air pollution consists of a complex mix of various substances in different physical and chemical states and these arise from various sources. Air Quality, in general, is defined via air surrounding the unconfined part of the atmosphere, in which human and other organisms live and breathe[1].

WHO focuses on four health-related air pollutants, namely, particulate matter (PM), measured as particles with an aerodynamic diameter lesser than 10 µm (PM10) and lesser than 2.5 µm (PM2.5), nitrogen dioxide, sulfur dioxide and ozone.

Among the various air pollutants from various sources particulate matter, sulphur dioxide and oxides of nitrogen are having a significant role in effecting the air quality and thereby causing harm to human health [2].

The new information included in this latest update of the Air quality guidelines relate to four common air pollutants: particulate matter ($PM_{2.5}$), nitrogen dioxide (NO_2) and sulfur dioxide (SO_2). The scope of this review reflects the availability of new evidence on the health effects of these pollutants and their relative importance with regard to current and future health effects of air pollution. Particulate matter causes respiratory disorder, asthma, reduced atmosphere visibility and cancer [3].

2. STUDY AREA:

Telangana With the geographical area of 1,12,077 sq. kms and population of 3.5 crore, as per 2011 census, Telangana is the 12th largest State in terms of both area and population in India. The State is geographically bordered by the Maharashtra, Chhattisgarh to the North, Karnataka to the west and Andhra Pradesh to the south, east and north east. The State is strategically located in the Deccan plateau region and situated in the middle of the country. Hyderabad is the capital of the southern Indian state of Telangana having coordinates 17.3850° N, 78.4867° E and occupying 650 square kilometers along the banks of the Musi River, it has a population of about 6.7 million and a metropolitan population of about 7.75 million, making it the fourth most populous city and sixth most populous urban agglomeration in India. Annual average rainfall of 803 mm. Average monthly temperatures ranges from 26.43 °C to 15.7 °C. Average Relative Humidity 60.05 %.At an

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average altitude of 542 meters (1,778 ft), much of Hyderabad is situated on hilly terrain around artificial lakes, including Hussain Sagar.

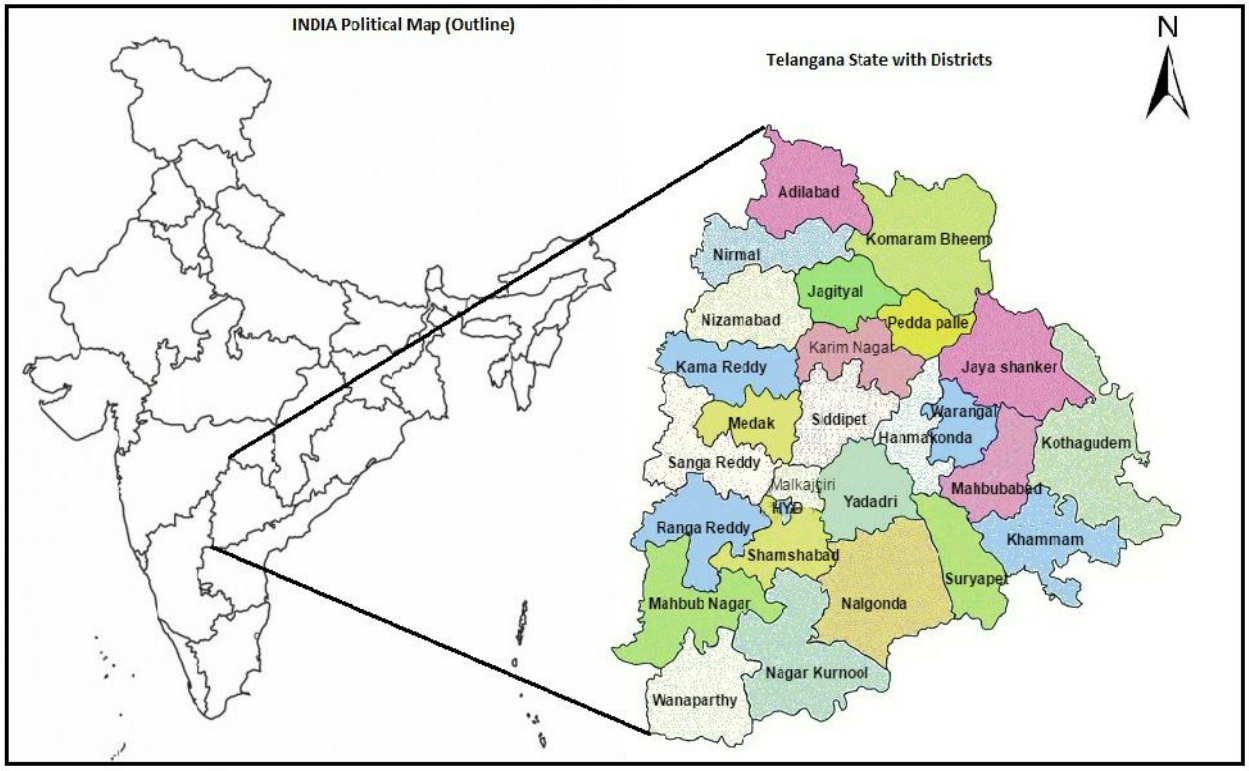

Fig 1: Map of Telangana State depicting Study area of Hyderabad District

3. MATERIALS AND METHODS:

Air quality Monitoring of $PM2_{.5}$, SO_2 and NO_2 was carried out at three monitoring sites namely residential, Eco sensitive and Industrial. Meteorology data like Temperature, Relative humidity, wind speed and wind direction was also monitored. The sampling was done at three different locations which are Sanathnagar (Location 1), Zoo Park (Location 2) and IDA pashamylaram (Location 3).

The collected samples were analyzed for various pollutants using standard methods prescribed by central pollution control board (CPCB). Particulate matter that is $PM_{2.5}$ was estimated by gravimetric method.

The concentration of NO_2 was measured with standard method of Modified Jacobs - Hochheiser method. SO2 was measured by Modified West and Geake method. Concentrations of the pollutants were measured in micrograms/cubic meter (µg/m3). SO_2, NO_2, and $PM_{2.5}$ were measured for 24hours with 4 hourly sampling for gaseous pollutants and 8 hourly sampling for particulate matter.

3.1 METHODS OF SAMPLING:

3.1.1 SULPHUR DIOXIDE (SO2):

Sampling and analysis of sulphur dioxide in ambient air is done using Improved West and Gaeke Method.Absorber is all glass midget impinger. A Spectrophotometer suitable for measurement of absorbance at 560 nm is used. Sulphur dioxide from air is absorbed in a solution of potassium tetrachloromercurate (TCM) resulting in dichlorosulphitomercurate complex. The complex is made to react with para-rosaniline and formaldehyde to form the intensely coloured pararosaniline methylsulphonic acid. The absorbance of the solution is measured by means of a suitable spectrophotometer. The detection range of the SO2 concentration is 4-1050µg/m3.

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3.1.2 NITROGEN DIOXIDE (NO_2):

sampling and analysis of Nitrogen dioxide in ambient air is done using modified Jacob and Hochheiser Method. Absorber is a midget impinger. A Spectrophotometer suitable for measurement of absorbance at 540 nm is used. Ambient nitrogen dioxide (NO) is collected by bubbling air through a solution of 2 sodium hydroxide and sodium arsenite. The concentration of nitrite ion (NO) 2 produced during sampling is determined colorimetrically by reacting the nitrite ion with phosphoric acid, sulfanilamide, and N-(1-naphthyl)-ethylenediamine dihydrochloride (NEDA) and measuring the absorbance of the highly coloured azo-dye at 540 n m.The detection range of the NOx concentration is 9-750 µg/m3.

3.1.3 PARTICULATE MATTER ($PM_{2.5}$):

PM $_{2.5}$ in ambient air is determined by Gravimetric Method.The ambient air monitoring was carried out at 24 hours in a day in each station. The particulate matter (PM2.5) were determined by gravimetric method i.e air is drawn through a pre weighed glass fibre filter paper on 8 hourly basis for 24 hours.

4. RESULT & CONCLUSION

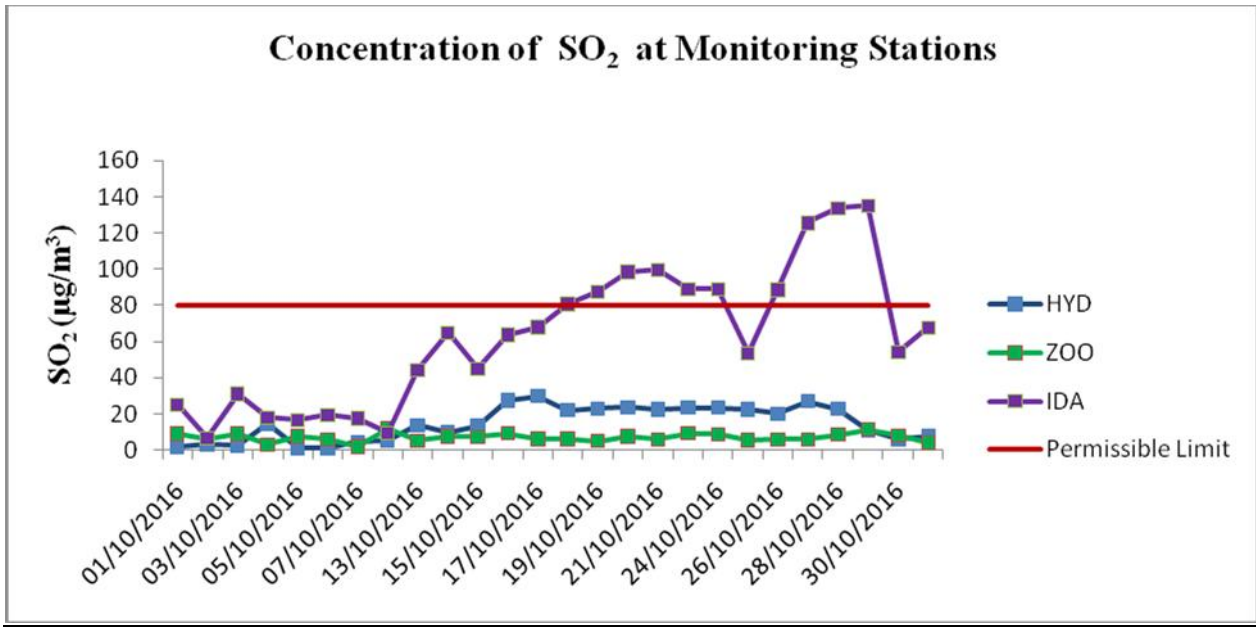

Fig: 2 Depicting Concentration of SO_2 higher than permissible 80 (µg/m^3) at IDA station.

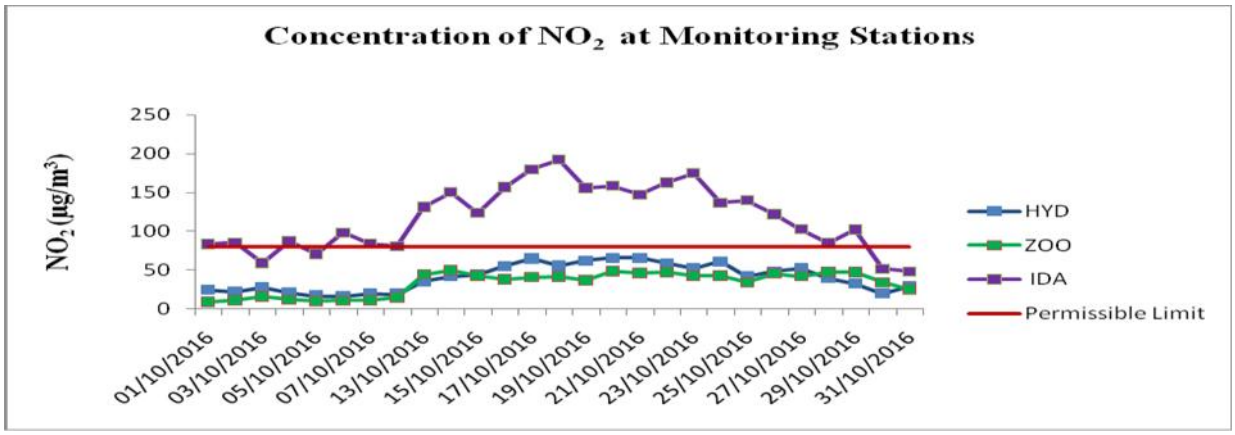

Fig: 3 Depicting Concentration of NO_2 higher than permissible 80 (µg/m^3) at IDA station.

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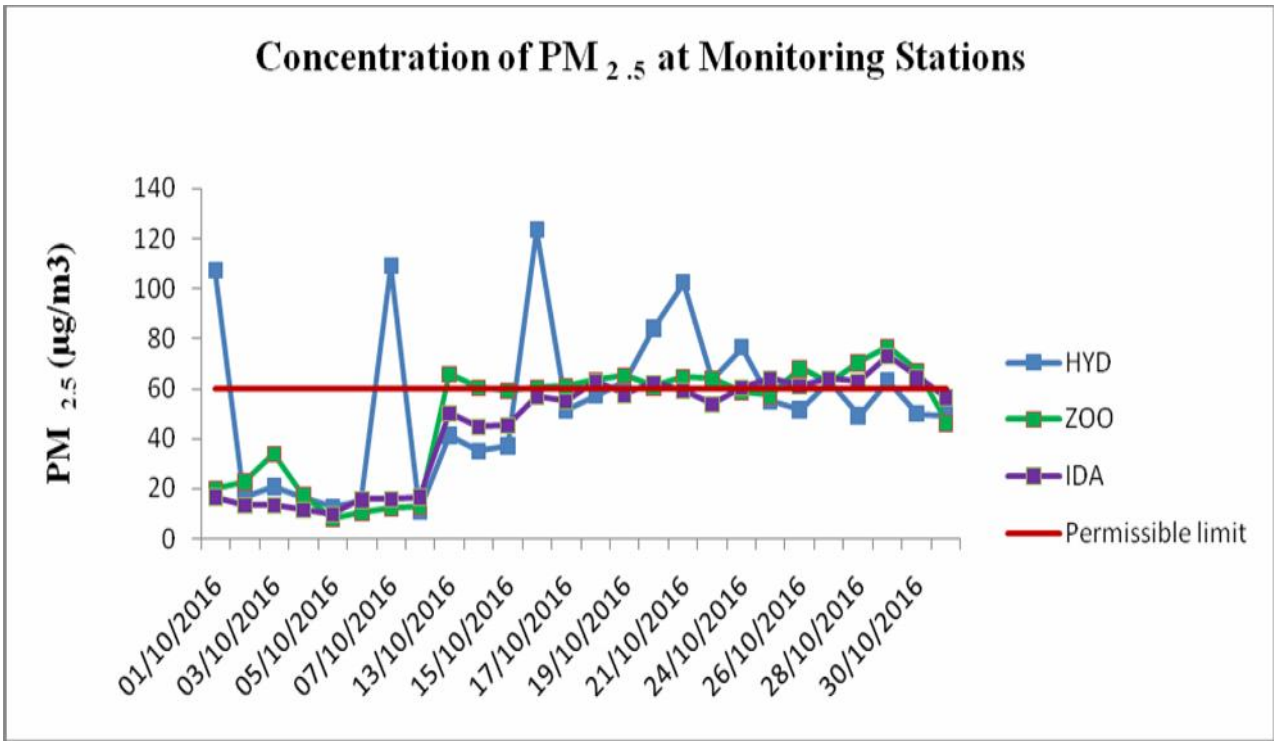

Fig: 4 Depicting Concentration of PM $_{2.5}$ higher than permissible 60 (µg/m^3) at HYD station.

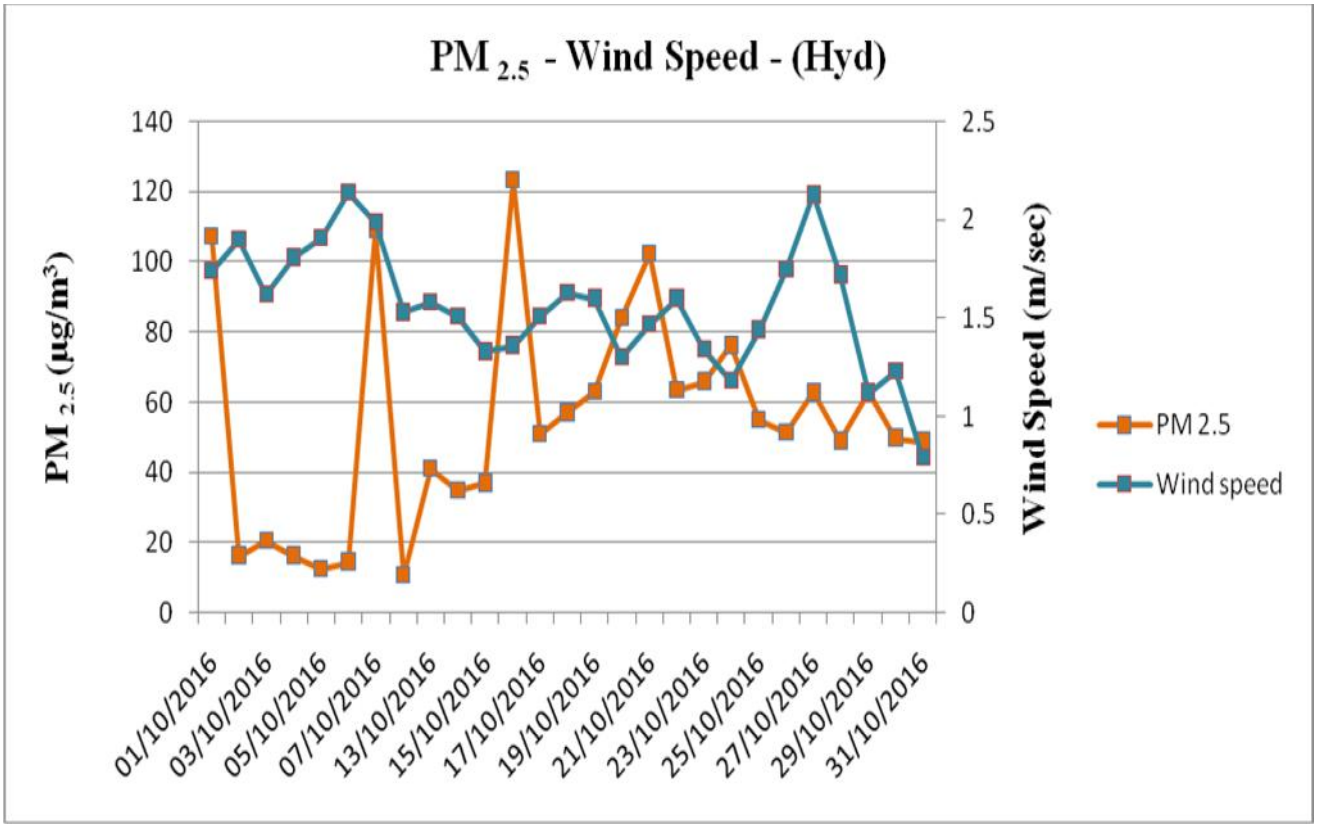

Fig: 5 Comparison of PM $_{2.5}$ - Wind speed at Hyderabad monitoring station

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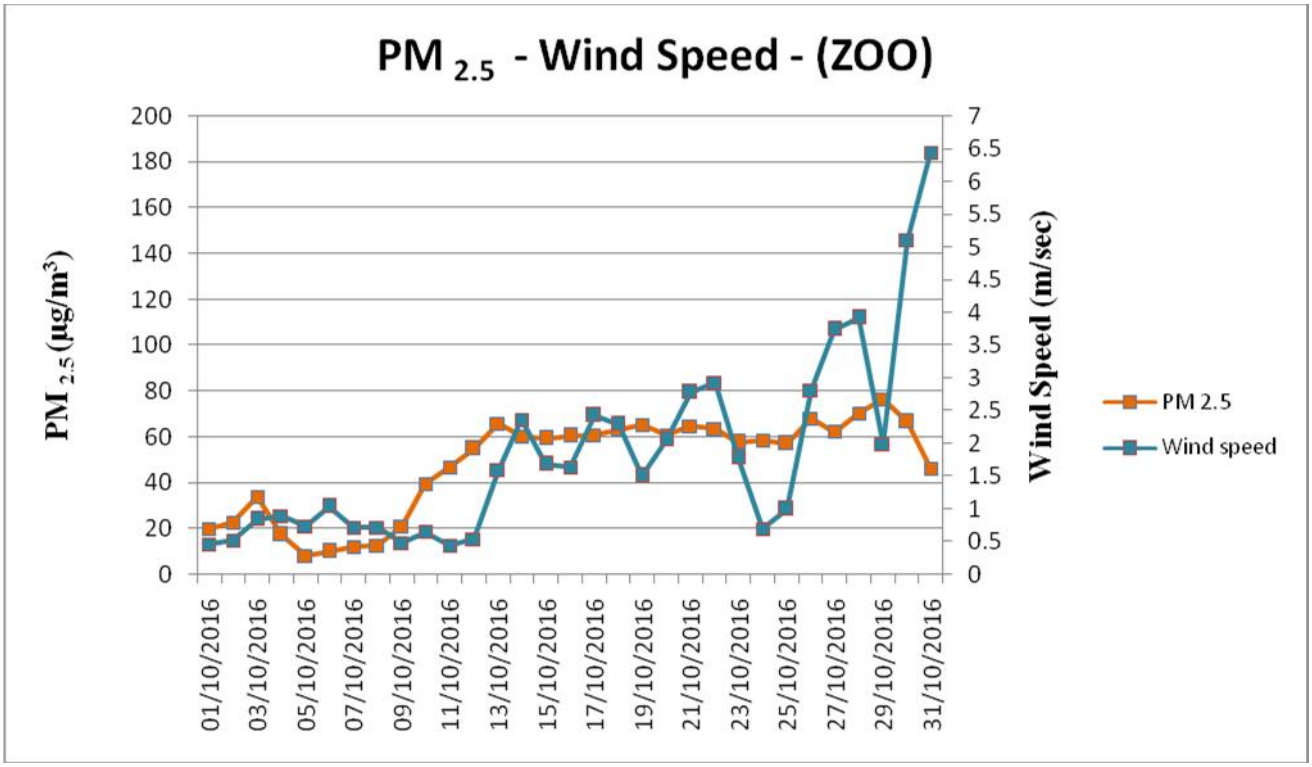

Fig: 6 Comparison of PM $_{2.5}$ - Wind speed at Zoo monitoring station

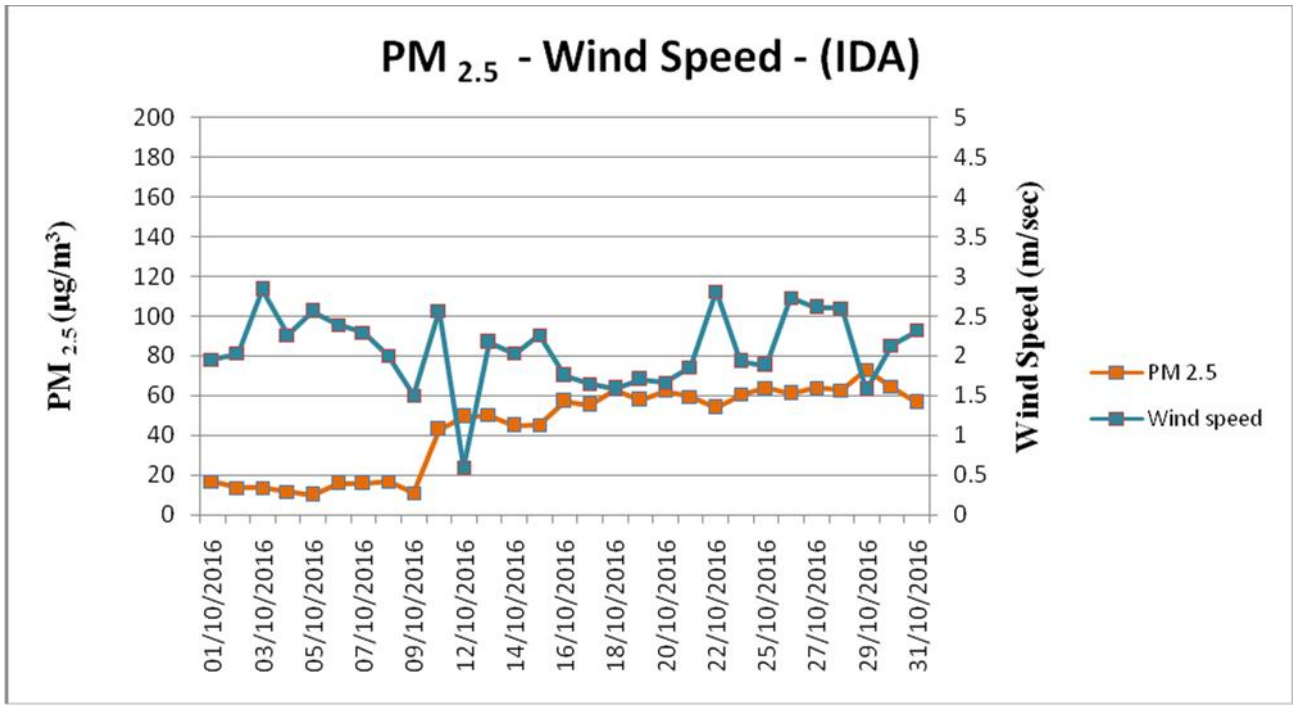

Fig: 7 Comparison of PM $_{2.5}$ - Wind speed at IDA Monitoring station

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MONITORING STATION	NO_2	$PM_{2.5}$	SO_2
Hyderabad	40.54 µg/m^3	55.09 µg/m^3	15.22 µg/m^3
ZOO	31.45 µg/m^3	47.90 µg/m^3	6.68 µg/m^3
IDA	114.03 µg/m^3	43.81 µg/m^3	60.28 µg/m^3

The Average value of Nitrogen dioxide (NO_2) is 62.00 µg/m^3.

The Average value of Sulfur Dioxide (SO_2) is 27.39 µg/m^3.

The Average value of Particulate matter 2.5 ($PM_{2.5}$) is 48.93 µg/m^3.

The Average value for pollutants namely NO2, SO_2 and PM $_{2.5}$ was found to be 62 µg/m3, 27.39 µg/m3 and 48.93 µg/m3.

The monitoring results are important to identify short and long term air quality monitoring objectives to determine the current air quality, and to evaluate the effectiveness of different air quality abatement programmes [4].

Meteorology plays a major role in study of air pollution. The wind speed and direction play a major role in dispersion of air pollutants. Wind direction has an important role in distributing and dispersing pollutants from stationary and mobile sources in horizontally long downwind areas. Wind speed determines the travel time from a source to a given receptor while on the other causes dilution of pollutants in downwind direction. The stronger the wind, the greater will be the dissipation and dilution of pollutants emitted.

The prevailing calm conditions during winter facilitate more stability to atmosphere and consequently slow dispersion of pollutants generated and thus leading to build up of pollutants in vicinity of the pollutant sources. Lower average mixing height in winter season results in less volume of troposphere available for mixing and hence higher $PM_{2.5}$ concentrations.

While older vehicles have been phased out due to the Supreme Court of India norms, thereby reducing vehicular emissions, it has been balanced out by increased flow of vehicular traffic in the city over the years [3].

Air Quality Index:

The AQI method involves formation of sub indices for each pollutant and aggregation of sub-indices. It has been developed on the dose-response relationship of various pollutants [5].

In the present study the AQI was calculated using IND-AQi.

The calculated AQI value of pollutants for all areas is compared with prescribed standards given by Central Pollution Control Board, New Delhi, India. The overall AQI was found to fall under the category ‘moderate’ and owing to PM $_{2.5}$, respectively. Thus it is observed that PM $_{2.5}$ is critical pollutant at these three sites in Hyderabad. The introduction of alternative fuels as compressed natural gas (CNG) which does not contain lead or sulfur, and total suspended particulate, and is lower in NOx, SO2 and CO than conventional fuel [6].

The overall AQI can give a clear view about ambient air and the critical pollutant The AQIs were calculated to assess the ambient air quality at three different sites namely the industrial, Eco sensitive and residential area during the month of October, 2016.

The Indian Air Quality Index (IND-AQI) is useful in indicating the day to day changes in air quality [7].

However, as the winter months have comparatively calm weather conditions, facilitating more stability to atmosphere and thus, slow dispersion of pollutants resulting in higher concentrations of pollutants in the ambient air.

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Table 1: Air quality Index of Hyderabad

Date	Air Quality	Index Value	Prominent pollutant
01/10/2016	Satisfactory	62	PM2.5, NO2
02/10/2016	Good	36	O3, NO2
03/10/2016	Good	41	PM2.5, PM10
04/10/2016	Good	47	PM2.5, NO2
05/10/2016	Good	31	O3, NO2
06/10/2016	Good	34	PM2.5, O3
07/10/2016	Good	42	PM2.5, PM10
08/10/2016	Good	48	PM2.5, O3
09/10/2016	Good	31	O3
10/10/2016	Satisfactory	52	PM2.5
11/10/2016	Satisfactory	87	PM10
12/10/2016	Satisfactory	99	PM10
13/10/2016	Moderate	117	PM2.5, PM10
14/10/2016	Satisfactory	92	PM2.5, PM10
15/10/2016	Satisfactory	89	O3, PM10
16/10/2016	Moderate	136	PM2.5, PM10
17/10/2016	Moderate	112	PM2.5, NO2
18/10/2016	Moderate	114	PM2.5
19/10/2016	Moderate	119	PM2.5
20/10/2016	Moderate	128	PM2.5
21/10/2016	Moderate	143	PM2.5
22/10/2016	Moderate	122	PM2.5, PM10
23/10/2016	Moderate	119	PM2.5, NO2
24/10/2016	Moderate	120	PM2.5, PM10
25/10/2016	Moderate	119	PM2.5
26/10/2016	Moderate	112	PM2.5
27/10/2016	Moderate	119	PM2.5
28/10/2016	Moderate	110	PM2.5
29/10/2016	Moderate	134	PM2.5
30/10/2016	Moderate	120	PM2.5
31/10/2016	Satisfactory	89	PM2.5

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Table 2: Possible Health Impacts:

Good	Minimal impact
Satisfactory	Minor breathing discomfort to sensitive people
Moderate	Breathing discomfort to the people with lungs, asthma and heart diseases
Poor	Breathing discomfort to most people on prolonged exposure
Very Poor	Respiratory illness on prolonged exposure
Severe	Affects healthy people and seriously impacts those with existing diseases

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