Monitoring of Ambient Air Quality in Hyderabad Some Areas, Telangana

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ABSTRACT This paper presents data of the ambient air quality status of residential area of Hyderabad viz. Kukatpally, Bachupally, Nijampet, Miyapur, jeedimetla and IDA Kazipally areas in state of Telangana India. The Air quality was assessed based on National Ambient air Quality Standards stipulated as per the CPCB notification, 18th November, 2009. The ambient air quality survey was carried out during the summer for a period of 24 hrs. at six different locations with respect to, PM 10, PM2.5, SO2, NOx Ammonia, Carbon monoxide, H2S, Volatile Organic compounds & Mercaptans During summer, The Benzene was found concentration of all monitoring locations was well within the limit and the concentration ranges from 1.0 to 5.0 µg/m3 Toluene and Xylene are also presented in some of the monitoring location the concentrations are in the range of 1.0 to 5.0 µg/m3. Toulene & Xylene presents because of Vehicle & Industries emissions.Remaining all volatile organic compounds was not detected in all monitoring locations and the minimum detectable limit is 1.0 µg/m3.Pollutants concentration (S02, N0x, PM-I0,PM-2.5,NH3 and H2S) was used to calculate the air quality index .

KEYWORDS : Air pollutants, Air Quality Index, Clean Air, Hyderabad, Telangana

INTRODUCTION

The higher incidences of respiratory diseases (like lung cancer) in urban areas can be ascribed to higher levels of pollutants in the city environments. Air pollution has been aggravated by developments that typically occur as countries become industrialized: growing cities, increasing traffic, rapid economic development and industrialisation, and higher levels of energy consumption. The high influx of population to urban areas, increase in consumption patterns and unplanned urban and industrial development has led to a higher rate of increase of air pollution in urban areas. The problem is aggravated by the inadequacy of pollution control measures, lack of proper enforcement of laws and regulations, increasing desertification, and decreasing vegetation cover.

Currently, in India, air pollution is widespread in urban areas wherein vehicles are the major contributors and in a few other areas with a high concentration of industries and thermal power plants. Vehicular emissions are of particular concern since these are ground level sources and thus have the maximum impact on the general population. Also, vehicles contribute significantly to the total air pollution load in many urban areas.

Figure: No. 1: Location map of study area

Figure No.1.2   Sampling Locations
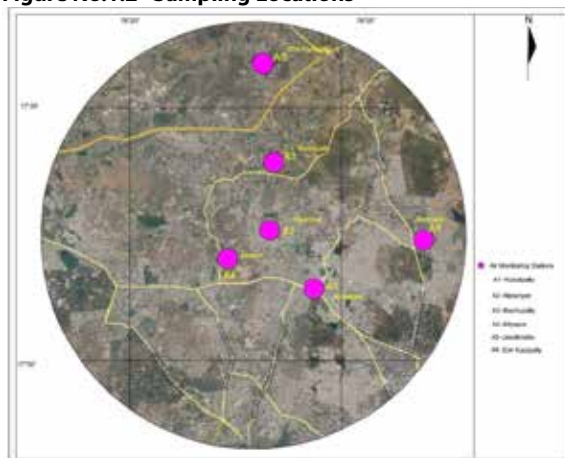
METHODOLOGY
2   AMBIENT AIR QUALITY
2.1   Respirable particulate matter (RPM) or PM10 (IS 5182 – Part 23)

Respirable dust sampler (RDS) Make-Enviro Tech Model APM 460 BL was used for RPM monitoring. The RDS first separates the coarser particles (larger than 10 microns) from the air stream before filtering it on the 0.3 µ pore size filter allowing a measurement of both the SPM and the Respirable fraction of the Suspended Particulate Matter (RPM).

Ambient air consisting of suspended particulates enters the inlet pipe of the instrument. As the air passes through the cyclone, coarse, non-respirable dust is separated from the air stream by centrifugal forces acting on the solid particles. These separated particulates fall through the cyclone's conical hopper and collect in the sampling cup placed at its bottom. The fine dust forming the respirable fraction of the Total Suspended Particulates (TSP) passes through the cyclone and is carried by the air stream to the filter paper. The respirable dust is retained by the filter and the carrier air exhausted from the system through the blower. The filter paper is removed and stored carefully in an interlocking polythene bag.

Calculation:

(F_2-F_1)

RPM (PM10) (mg/m³) =--------- X 10^6

V_a

Where,

F_1= Initial weight of Filter Paper, gm,

F_2 = Final weight of Filter Paper, gm,

Va = Volume of Air Sampled, m³

2.2 Particulate Matter 2.5 (Instrument manual)

Envirotech APM 550 Fine Particulate Sampler was used to collect Particulate Matter size Less than 2.5 µ Air inlet to the sampler is designed in circular way so that unaffected by wind direction, rain, insects, very large particles. The inlet air leads to impactor designed to trap particles with an aerodynamic diameter larger than 10 microns. Air with particles less than 10 micron size are accelerated through the nozzle of the well shaped impactor(WINS) designed to trap particles with an aerodynamic diameter between 2.5 & 10 microns. The air stream leaving WINS impactor consists of only particles with aerodynamic diameter of less than 2.5 microns.

To avoid sampling errors due to tendency of small particles to bounce off the impaction surface a 37 mm diameter GF/A paper immersed in Silicone oil was used as an impaction surface. Pre Weighted 47mm of Special Teflon Membrane (PTFE) was used to collect PM 2.5.

Calculation:

(F_2-F_1)

PM 2.5 (mg/m³) = ---------X 10^6

V_a

Where,

F_1= Initial weight of Filter Paper, gm,

F_2 = Final weight of Filter Paper, gm,

Va = Volume of Air Sampled, m³

2.3 Sulphur Dioxide in Ambient (IS 5182-Part 2)

RDS attached gaseous kit is used to monitored Sulphur dioxide by absorbing measured volume of air through Sodium- Tetra- Chloromercurate solution. It forms a stable Dichloro-sulphito-mercurate complex. The amount of SO_2 is estimated by absorbance measured by spectrophotometer at 560 nm.

Calculation:

Concentration SO_2 in µg/m³
$$= \frac{(A-A_0) \times 10^3 \times B}{V}$$

Where:

A   -   Sample absorbance
A_0 -   Reagent black absorbance
10^3 -   Conversion liters to cubic meters
B   -   Calibration factor, µg / absorbance
V   -   Volume of air sampled in liters.

2.4 Nitrogen oxides (IS 5182 – Part 6)

Nitrogen oxides were estimated by bubbling air through 0.1 N sodium hydroxide (with sodium arsenate) solution to form a stable solution of sodium nitrite. The nitrite ion produced during sampling is determined spectrophotometerically at 540 nm by reacting the exposed absorbing reagent with phosphoric acid, sulphanilamide and NEDA.

Calculation:

Concentration of NO_x in µg/m³
$$= \frac{\mu g / NO_x \times V_s}{V_a \times 0.82 \times V_t} \times D$$

Where:

µg / NO_x - NO_2 concentration in analysed sample

V_a - Volume of air sample, m_3

0.82 - Sampling efficiency

D - Dilution factor (D = 1 for no dilution, D = 2 for 1:1 dilution)

V_s - Final volume of sampling solution

V_t - Aliquot taken for analysis

2.5 Carbon Monoxide (IS 5182- Part X)

At monitoring location grab air samples were collected in a polythene bag for CO. Sample bags have transported to the laboratory.

From the sample bags, Draw a known volume (2ml) of sample by means of a gas tight syringe and introduce into the gas chromatographic column maintained at suitable condition for CO analysis simultaneously. The sample gets carried by Nitrogen, the carrier, from the injection port to the detector base.

During its movement CO get separated simultaneously and adsorbs on the column material. It gets eluted at specific retention time, which is characteristic of the above-mentioned gases. Carbon Monoxide gets reduced with Hydrogen, catalytically, to Methane. On producing ionization current, which is read as sharp peak on the screen was plotted on the printer paper along with actual value of the area. Compare the area of peak so obtained with the area of peak obtained for a known concentration of Carbon Monoxide CO

Calculation:

mg/m³= A/(B)(C)	Where	A	=	µg/sample from curve
		B	=	liters of air sampled
		C	=	extraction efficiency

2.6 Ammonia (Indo Phenol Blue Method)

Respirable Dust sampler and Impingers were used to collect Ammonia samp[les. Ambient air is allowed to pass through absorbing medium (0.01 N H_2SO_4), NH_3 present in the air will combine with Sulphuric acid forming $NH_4 (SO_4)_2$ which is stable for 48 hrs and measured spectrophotometerically at 630 nm.

Calculation:

Concentration Ammonia in µg /m³ $= \dfrac{\text{Concentration in µg X 1000}}{\text{Flow Rate X Total Time}}$

2.7   Hydrogen sulphide (IS 5182-part No. 7)

Hydrogen Sulphide was collected by aspirating measured volume of air through alkaline suspension of cadmium hydroxide. The Sulphide is precipitated as cadmium Sulphide to prevent oxidation of Sulphide ion.

The collected Sulphide is determined spectrophotometerically by measurement of methylene blue that was produced by the reaction of the Sulphide with strongly acidic solution of N, N-dimethyl, P-phenylene diamine and ferric chloride. 20 ml of absorbing solution is taken in impinge, Air is allowed to pass through it by using suction pump, Start time is noted, Flow rate of air is fixed near 500ml/min with the help of manifold, Actual flow rate of air is measured with the help of rotameter, Flow rate of air is noted after every hour throughout the sampling period, Closing time is noted. Total Samples are brought to the laboratory, One impinger is filled with 20 ml of absorbing media as blank, 0.6 ml of N. N-Dimethyl-P-Phenylene-Diamine Sulphate and 1 drop of ferric Sulphate solution is added. The volume has to be made upto 30 ml with distilled water. The samples are kept for 30 min for colour development. Optical Density is measured at 670 nm.

Calculation:

The final volume of H_2S in ambient air is worked out using the formula,

$$H_2S \text{ in } \mu g / m^3 = \frac{\mu g \text{ of } H_2S \times 10^3}{\text{Volume of air in liter}}$$

2.8 Mercaptans (OSHA chemical sampling method. No. 26)

Samples were collected on glass fiber filters impregnated with mercuric acetate. Methyl mercaptan is regenerated from the mercuric mercaptide, formed during sampling, by treatment with hydrochloric acid. The methyl mercaptan is extracted into methylene chloride and analyzed by gas chromatography with a flame photometric detector.

Sampling Procedure
Apparatus
1. Personal sampling pump: Calibrated personal sampling pump, the flow rate of which can be determined within 5% at the recommended flow rate.
2. Glass fiber filters impregnated with mercuric acetate: The filters are prepared by soaking 37-mm Gelman type A glass fiber filters (or equivalent) in a 5% (w/v) aqueous solution of mercuric acetate. The filters are allowed to dry, and then assembled in two-piece filter cassettes without backup pads. The filters may be yellowish in color, which does not seem to affect their collection efficiency

Sampling technique:

Immediately before sampling, the plugs removed from the filter cassette. The cassette connected to the sampling pump with flexible tubing. Air being sampled should not pass through any hose or tubing before entering filter cassette.

The sampling done at the flow rate of 0.2 lit/min and maximum of 12 liters air volume was collected. The plugs were replaced in the filter cassette immediately after sampling. With each batch of samples, one blank filter submitted for analysis. This filter should be subjected to exactly the same handling as the samples except no air is drawn through it. Samples were transported to the laboratory.

Sample preparation and analysis

Twenty milliliters of 25% hydrochloric acid and 5 mL of methylene chloride were added to a 30-mL separatory funnel. The sample filter was folded and inserted into the neck of the separation funnel, but not allowed to contact the liquid. The filter is then pushed into the funnel with the stopper, which is seated in the same motion. The funnel was shaken for 2 min without venting.

After the phases have separated, the methylene chloride was drained into a vial. The vial is then sealed with a Teflon-lined cap. Then the samples were injected in and analysed by the gas chromatography

Calculations The methyl mercaptan concentration (μg/sample) is obtained from the calibration curve from Section

The air concentration for samples is calculated using the following formulae.

$mg/m^3 = A/(B)(C)$	where	A	=	μg/sample from curve
		B	=	liters of air sampled
		C	=	extraction efficiency

2.9 Volatile Organic compounds

The monitoring procedure involves pulling a volume of air through a sorbent packing to collect VOCs followed by a thermal desorption-capillary GC/MS analytical procedure.

Key steps of this method are listed below.

- Selection of a sorbent or sorbent mix tailored for a target compound list, data quality objectives and sampling environment.
- Screening the sampling location for VOCs by taking single tube

samples to allow estimates of the nature and amount of sample gases.
- Initial sampling sequences with two tubes at nominally 1 and 4 liter total sample volumes (or appropriate proportional scaling of these volumes to fit the target list and monitoring objectives).
- Analysis of the samples and comparison to performance criteria.

Key steps in sample analysis are listed below.

- Dry purge of the sorbent tube with dry, inert gas before analysis to remove water vapor and air. The sorbent tube can be held at temperatures above ambient for the dry purge.
- Thermal desorption of the sorbent tube (primary desorption).
- Analyte refocusing on a secondary trap.
- Rapid desorption of the trap and injection/transfer of target analytes into the gas chromatograph (secondary desorption).
- Separation of compounds by high resolution capillary gas chromatography (GC).

Measurement by mass spectrometry (MS) or conventional GC detectors

Once the GC run has been initiated by desorption of the focusing trap, the chromatographic procedure continue.. Separation of compounds by high resolution capillary gas chromatography (GC) and concentration is measured by mass spectrometry (MS). The precision of the analytical system should be tested using six standard tubes all loaded with a mid-concentration-range standard

Calculation:

$$\text{Concentration of targeted VOC in } \mu g/m^3 = \frac{\text{Concentration in ppm}}{\text{Volume of air sampled in } m^3}$$

3. Meteorological study

Micrometeorology and microclimatic parameters were recorded by installing automatic weather station near to sampling locations. The wind velocity, wind direction, ambient temperature, relative humidity and rainfall were recorded at hourly intervals during study period.

RESULTS
3 .1 Meteorological study

Meteorological parameters are important factors in the study of air pollution. The transport and diffusion of the pollutants in the atmosphere are governed by meteorological parameters. Wind velocity, wind Direction and atmospheric stability are known as primary/basic meteorological parameters since the dispersion and diffusion of pollutants depend mainly on three Factors. Ambient temperatures, humidity, rainfall, atmospheric pressure, etc. are known as secondary meteorological parameters as these factors control the dispersion of the pollutants indirectly by affecting the primary factors. Thus, to assess the air pollution impact, it is essential to collect the above meteorological parameters in the project area.
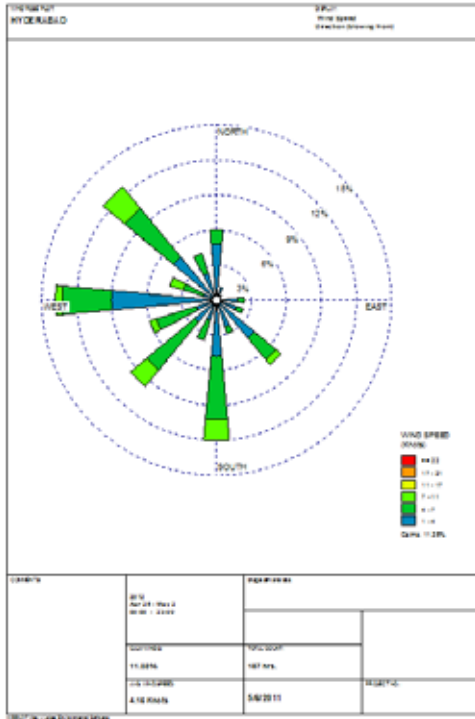
Data presentation

Meteorological data was recorded at intervals of every one hour, during the study period of 29.04.2012 to 06.05.2012

Recorded Average Values for 29.04.2012 to 06.05.2012

Table No.1.0

S.No.	Parameters	March –2011	
		Min	Max
1	Relative humidity (%)	6.0	79.0
2	Temperature (ºC)	26.0	41.6
3	Total Rainfall (mm)	Nil	
4	Predominant wind direction	West	
5	Wind Speed (m/sec)	0	4.2

Wind Rose Diagram 00-23 hours (For 29.04.2012-06.05.2012).

Ambient Air Quality Results:
Table No.1.2, Kukatpally.

S. No	Parameters	Unit	06 – 14 hours	14 – 22 hours	22 – 06 hours	24 hrs. Avg
1	Particulate Matter size less than10µm or PM_{10}	µg/m³	48.2	51.2	46.3	48.6
2	Particulate Matter size less than2.5µm or PM2.5	µg/m³	10.6	13.1	9.6	11.1
3	Sulphur Dioxide (SO_2)	µg/m³	7.5	9.4	7.3	8.1
4	Oxides of Nitrogen (NO_x)	µg/m³	16.5	17.2	11.2	15.0
5	Carbon Monoxide (CO)	mg/m³	0.8	0.9	0.6	0.8
6	Ammonia (NH_3)	µg/m³	8.2	9.5	6.8	8.2
7	Hydrogen sulphide (H_2S)	µg/m³	BDL	BDL	BDL	BDL
8	Mercaptans	µg/m³	BDL	BDL	BDL	BDL

Table No.1.3, Nizampet

S. No	Parameters	Unit	06 – 14 hours	14 – 22 hours	22 – 06 hours	24 hrs. Avg
1	Particulate Matter size less than10µm or PM_{10}	µg/m³	40.2	43.6	41.2	41.4
2	Particulate Matter size less than2.5µm or PM2.5	µg/m³	8.8	9.6	8.9	7.9
3	Sulphur Dioxide (SO_2)	µg/m³	7.5	8.2	6.9	8.5

4	Oxides of Nitrogen (NO_x)	µg/m³	12.2	13.1	9.8	11.0
5	Carbon Monoxide (CO)	mg/m³	0.6	0.7	0.5	0.7
6	Ammonia (NH_3)	µg/m³	6.8	7.5	6.4	6.6
7	Hydrogen sulphide (H_2S)	µg/m³	BDL	BDL	BDL	BDL
8	Mercaptans	µg/m³	BDL	BDL	BDL	BDL

Table No.1.4,Bhachupally.

S. No	Parameters	Unit	06 – 14 hours	14 – 22 hours	22 – 06 hours	24 hrs. Avg
1	Particulate Matter size less than10µm or PM_{10}	µg/m³	40.2	44.3	39.8	41.4
2	Particulate Matter size less than2.5µm or PM2.5	µg/m³	8.6	9.5	8.7	8.9
3	Sulphur Dioxide (SO_2)	µg/m³	7.6	8.6	6.8	7.7
4	Oxides of Nitrogen (NO_x)	µg/m³	11.5	13.5	10.5	11.8
5	Carbon Monoxide (CO)	mg/m³	0.8	0.7	1.1	0.9
6	Ammonia (NH_3)	µg/m³	6.9	8.2	6.7	7.3
7	Hydrogen sulphide (H_2S)	µg/m³	BDL	BDL	BDL	BDL
8	Mercaptans	µg/m³	BDL	BDL	BDL	BDL

Table No.1.5,Miyapur

S. No	Parameters	Unit	06 – 14 hours	14 – 22 hours	22 – 06 hours	24 hrs. Avg
1	Particulate Matter size less than10µm or PM_{10}	µg/m³	58.2	62.1	52.8	57.7
2	Particulate Matter size less than2.5µm or PM2.5	µg/m³	11.2	13.8	10.6	11.9
3	Sulphur Dioxide (SO_2)	µg/m³	11.2	12.8	10.6	11.5
4	Oxides of Nitrogen (NO_x)	µg/m³	13.2	17.6	14.6	15.1
5	Carbon Monoxide (CO)	mg/m³	1.2	1.3	1.0	1.2
6	Ammonia (NH_3)	µg/m³	9.8	10.2	8.7	9.6
7	Hydrogen sulphide (H_2S)	µg/m³	BDL	BDL	BDL	BDL
8	Mercaptans	µg/m³	BDL	BDL	BDL	BDL

Table No.1.6, Jeedimetla.

S. No	Parameters	Unit	06 – 14 hours	14 – 22 hours	22 – 06 hours	24 hrs. Avg
1	Particulate Matter size less than10µm or PM_{10}	µg/m³	63.5	67.5	58.2	63.1
2	Particulate Matter size less than2.5µm or PM2.5	µg/m³	14.3	14.9	12.9	14.0
3	Sulphur Dioxide (SO_2)	µg/m³	10.2	12.6	10.1	11.0
4	Oxides of Nitrogen (NO_x)	µg/m³	11.2	14.5	10.3	12.0
5	Carbon Monoxide (CO)	mg/m³	1.1	1.3	1.0	1.1
6	Ammonia (NH_3)	µg/m³	12.6	14.5	11.2	12.8

| 7 | Hydrogen sulphide (H_2S) | $\mu g/m^3$ | BDL | BDL | BDL | BDL |
| 8 | Mercaptans | $\mu g/m^3$ | BDL | BDL | BDL | BDL |

Table No.1.7, Summary of Ambient air quality

S No.	Particulate	Unit	Min	Max
1	Particulate Matter size less than10µm or PM_{10}	$\mu g/m^3$	41.1	63.1
2	Particulate Matter size less than2.5µm or PM2.5	$\mu g/m^3$	7.9	14.0
3	Sulphur Dioxide (SO_2)	$\mu g/m^3$	7.5	13.2
4	Oxides of Nitrogen (NO_x)	$\mu g/m^3$	9.9	16.0
5	Carbon Monoxide (CO)	mg/m^3	0.6	1.3
6	Ammonia (NH_3)	$\mu g/m^3$	6.6	15.3
7	Hydrogen sulphide (H_2S)	$\mu g/m^3$	BDL	BDL
8	Mercaptans	$\mu g/m^3$	BDL	BDL

Figure:1.3 National Ambient Air Quality Standards.

Results:

- PM 10 – The maximum value, 63.1 µg/m³ was observed at Jeedimetla   and the minimum values, 41.1 µg/m³ was observed at Bachupally
- PM 2.5 – The maximum value, 14.0 µg/m³ was observed at Jeedimetla   and the minimum values, 7.9 µg/m³ was observed at Nizampet
- Sulphur dioxide – The maximum value, 13.1 was observed at IDA Kazipally and minimum value, 7.5µg/m³ was observed at Nizampet
- Oxides of Nitrogen – The maximum value, 16.0 was observed at IDA Kazipally and minimum value, 9.9 µg/m³ was observed at Nizampet
- Ammonia – The maximum value, 15.3µg/m³ was observed at IDA Kazipally monitoring and minimum value, 6.6 µg/m³ was observed at land fill area.
- Carbon monoxide –The maximum was observed at 1.3 mg/m³ minimum was observed at 0.6 mg/m³ at Nizampet
- Hydrogen sulphide and Mercaptans values were below detectable limit, the minimum detectable limit is 1 µg/m³.
- Volatile Organic compounds like Toluene, Xylene and are present in ambient air of selected locations, especially which were near to Industrial area.
- The observed concentrations of Toluene and Xylene ,
- Toluene – 1-6 µg/m³ and Xylene – 1-6 µg/m³
- Benzene are presented in all locations in the concentration are in the range 1-5 µg/m³
- Remaining all volatile Organic compounds was not detected in all locations and the minimum detectable limit is 1 µg/m³.

CONCLUSION

The following observations/conclusions can be made:

4   Ambient Air Quality

The all obtained results of Ambient Air quality is compared with National Ambient Air Quality standards stipulated as per the CPCB notification, 18th November, 2009.

Based on the ambient air quality results, it can be concluded that the ambient air quality of the study area is well within the permissible limits.

The Mercaptans and hydrogen sulphide were below dateable limit in all monitoring locations. The minimum detachable limit is 1.0 µg/m³.

4.1 Volatile Organic compounds.

The monitoring of volatile organic compounds were carried in all selected locations for two successive days and analysed.

The Benzene concentration of all monitoring locations was well within the limit and the concentration ranges from 1.0 to 5.0 µg/m³. Benzene presents because of vehicular & Industries emissions.

Apart from Benzene, Toluene and Xylene are also presented in some of the monitoring location the concentrations are in the range of 1.0 to 5.0 µg/m³. Toulene & Xylene presents because of Vehicle & Industries emissions.

Remaining all volatile organic compounds was not detected in all monitoring locations and the minimum detectable limit is 1.0 µg/m³.

Reference:

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