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Original Research Paper

Assessment of Ambient Air Quality in Urban Environments of Hyderabad, India

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ABSTRACT

Environmental pollution is an ever-increasing problem in the industrialized and highly populated areas of the world. Recently the intensity and magnitude of air pollutant concentration has grown up rapidly in the troposphere. Hyderabad, capital of Andhra Pradesh, is a centre of southern part of India for both industrial and commercial activity. It is one of the most populous urban areas with approximately 6.8 million inhabitants and over 73,000 small, medium and major industrial establishments sharing the greater city. The air pollution is primarily associated with automobiles and industrial sources of which motor vehicles are of major concern. The available information on the levels of ambient gaseous pollutants in tropical areas particularly Asian countries were meagre and keeping in the view of health effects and economic burden associated with the elevated levels of air pollutants, the present study was undertaken with an objective to assess the ambient air quality of Hyderabad which is undergoing rapidly urban and industrial development. For this study, the air samples were drawn at the height of 1.5-3.0 m from the ground level in order to monitor the PM, SPM, oxides of nitrogen and sulphur concentrations to ascertain the relationship between gaseous air pollutants and meteorological parameters. The overall result reveals that the air quality of environment is deteriorating rapidly due to gaseous pollutants. This study lead us to conclude that multiple approach is needed to combat the air pollution by vehicles via public awareness campaigns, media intervention packages, effective government action plans and programmes and judicious distribution of quality oriented fuels.

INTRODUCTION

Environmental pollution is an ever-increasing problem in the industrialized and highly populated areas of the world. Recently the intensity and magnitude of air pollutant concentration has grown up rapidly in the troposphere. The man-made activities such as combustion of fossil fuels and use of nitrogen fertilizers lead to production of hydrocarbons, CO and NOx which finally enter into the environment. The increased concentration of the air pollutants adversely affects the living organisms and also the heat budget of the lower atmosphere. Studies conducted during the past have been either restricted to rural or to urban areas, mostly confined to 30°-60° latitude. A large number of studies have been carried out with regard to the quality of air in different parts of the country (Joshi & Mishra 1998, Mudri et al. 1986). The available information on the levels of ambient gaseous pollutants in tropical areas, particularly in Asian countries are meagre. Keeping in view of the health effects and economic burden associated with the elevated levels of air pollutants, an attempt was made during this study to monitor the concentration of the gaseous air pollutants in the urban environment of Hyderabad by measuring the ground level concentration of the pollutants.

MATERIALS AND METHODS

Study area: Hyderabad, a cosmopolitan capital city of Andhra Pradesh, India is one of the most populous urban area with a population of approx. 6.8 million of inhabitants, with an area of 260 km^2. The land use has 93% urban (including industrial), 1.7% agriculture and 5.3 % water spread area (GVAQI 1997). It is located between 17°10' and 17°50' N latitude and 78°10'and 78°50' E longitude on the banks of the River Moosi with an elevation of 580 m above the mean sea level. It lies within the subtropical belt and experience a mean maximum temperature of 40°C in summer (April and May) and a minimum 13°C in winter (November to January) seasons. It has a monsoon climate with an yearly average rainfall of 95.04 mm, of which 80% is received during June to September. The wind movement is from northwest to east with an average speed of 5-13 km/h. The sunshine duration was found to be maximum during the month of April and May with a monthly average value of 7.0hrs (Table 1).

It is one of the major centres of southern part of India, both for industrial and commerce activities. It is hosting nearly about 73,000 small, medium and large-scale industries and more than 12 lakhs motor vehicles. The air pollution is particularly associated with the automobiles and industrial sources. Particularly an increase in the number of automobiles from 6.9 lakhs to about 12 lakhs forms a major contributor to air pollution that leads to deterioration of the urban environments of Hyderabad. Industrial and neighbouring biomass burning, trace gases and aerosols are also the major contributors to urban air pollution.

Air sampling sites and methodology: The air pollution measurements were carried out for a period of one year starting from January 2009 to January 2010. Air samples were drawn at a height of 1.5 to 3 m from the ground level from six sampling stations namely Basheerbagh, Punjagutta, RTC X roads, Begumpet, Narayanguda and a control area, Hyderabad A. P. in order to obtain the ground level SPM, NOx and SO_2 concentrations to ascertain the relationship between gaseous air pollutants and meteorological parameters. The PM_{10} was measured by gravimetric method using HVS-filtration technique on a pre-weighed glass micro fibre filter paper (GFA/EPM 2000-Whatmann). The SPM was sampled using GF/A Whatman filter paper by gravimetric method. The collected samples were weighed according to the BSI procedure (Bureau of Indian Standard Specification: BIS-5182) and calculations were made in order to obtain the final concentrations of the SPM. Air sampling was done at 8 a.m., 4 hourly intervals at the rate of 1.5 L/min in case of SO_2 and NOx with the help of KIMOTO handy sampler (model HS-6) and the air was drawn into borosilicate glass impingers containing 1% KI solution in 0.1 M phosphate buffer (pH 7.0), 0.04 M TCM (potassium tetrachloro mercurate solution) and 0.1% NEDA (n-1-napthyl ethylenediamine dichloride) in 5% sulfanilic acid for SO_2 and NOx respectively. The gases collected in suitable absorbents, were analysed spectrophotometrically with the help of systemic UV VIS (Visible Spectrophotometer 108) in the laboratory. The modified West & Gaeke (1956) method was used to determine SO_2, and Jacob & Hoccheiser (1958) modified method for NOx content of the samples.

RESULTS AND DISCUSSION

The summarized data of average concentration of suspended particulate matter, SO_2 and Nox for the study period are depicted in the Table 2, and the NAAQS standards in Table 3. The overall results clearly reveal that the concentrations of NOx and SO_2 peaked between 8.00 a.m and 11.00 a.m and in the evening (5.00-8.00 p.m). From the data, it was observed that the highest levels of SPM were present at Punjagutta sampling station (a high density of the vehicles during the peak hours). This is due to bad and unrepaired roads, vehicular density and the type of vehicles plying on the roads irrespective of the seasons. It has been reported that the emissions from diesel vehicles contain more suspended particulate matter than petrol vehicles. The increase in SPM can be clearly correlated to the traffic particularly with the diesel vehicles such as lorries, trucks and buses, which are highest on roads (Dayal & Nandini 2000).

The average concentrations of NOx are well within 80 $\mu g/m^3$ (CPCB), but it has crossed 60 $\mu g/m^3$ of WHO limits. Of all the seasons, concentrations of NOx were found to be low in summer season in all the areas. The concentration of NOx is more in rainy season, because of higher traffic density involving four stroke ignition engines (Agarwal et al. 1996).

The average concentrations of SO_2 were also found to be within 80 $\mu g/m^3$ and 60 $\mu g/m^3$ (WHO limits) in all the areas. Average concentrations of SO_2 in winter season were more as compared to rainy and summer seasons. It is because of high traffic density and inversion preventing the dispersion of pollutants. It is evident from the observations that the density of two wheelers is more in all the sampling stations, which can be considered as the prime causative factor in injecting the pollutants into the ambient atmosphere.

Table 1: Meteorological conditions at Hyderabad during 2009-20010.

Month	Mean Monthly Values						
	Maximum temperature (0°C)	Minimum temperature (0°C)	Total Rainfall (mm)	Relative Humidity 08:30 hrs	Relative Humidity 17:30 hrs	Average Wind speed (km/h)	Sunshine duration (hrs)
August	30.1	21.9	121	85	71	12	4.1
September	30.2	21.7	124	84	59	11	4.8
October	31.1	20.3	032	76	40	08	7.5
November	30.9	16.6	000	60	39	07	8.9
December	29.0	14.2	000	67	34	05	9.1
January	30.4	15.6	000	70	47	05	9.3
February	31.4	19.2	080	79	23	07	7.9
March	34.7	22.1	000	50	31	06	5.6
April	40.8	25.2	012	52	45	07	9.4
May	38.6	26.7	064	65	70	10	9.3
June	31.6	22.9	215	84	68	12	4.2
July	30.0	22.3	129	83	76	13	4.7

Table 2: Concentration of pollutants at respective sampling stations.

Sampling station	PM_{10} in μg/m^3			SPM in μg/m^3			NOx in μg/m^3			SO_2 in μg/m^3		
	Rainy	Winter	Summer	Rainy	Winter	Summer	Rainy	Winter	Summer	Rainy	Winter	Summer
Punjagutta	120	141	134	560	793	928	60	43	13	18	52	16
R.T.C X roads	126	122	114	867	379	304	98	69	43	19	55	37
Basheerbagh	113	124	130	485	523	582	55	39	24	27	57	36
Begumpet	110	125	120	228	567	433	68	41	30	25	55	39
Narayanaguda	106	121	125	158	304	476	64	57	17	27	57	36
Control area	104	120	98	42	40	43	18	18	9	17	25	28

Table 3: Air quality standards of CPCB (Central Pollution Control Board) for prevention and control of pollution (NAAQS).

Pollutants	Concentration in Ambient air		
	Industrial area	Residential area	Sensitive area
PM_{10}	150	100	75
SPM (μg/m^3)	500	200	100
NOx (μg/m^3)	120	80	30
SO_2 (μg/m^3)	120	80	30
Remarks	Inferior	Moderate	Good

Increase in NOx concentrations is observed when the temperature of combustion of fuel is very high. The SO_2 emission is directly proportional to the content of sulphur in the fuel. The content of the sulphur in diesel is 3% which is higher than petrol (1%). Emissions of SO_2 are also higher from the diesel vehicles. Low average speed of vehicles also causes higher emission of CO (Gopinathan & Muthusubramanian 1998). The findings of Hemavathi & Jagganath (2004), Jonathan & Ojha (2004) and Gupta & Shukla (2004) on ambient air quality further support the present findings.

CONCLUSION

Due to rapid industrialization, increased urbanization and heavy rail and road transportation, the urban environments are deteriorating by the pollutants. The polluted ambient air may create immobility, eye and respiratory irritation, interferences with the visibility and obstruction of sunlight.

The major causative factors for the gaseous pollutants are the two wheelers, causing air pollution in the city. Most of the auto rickshaws run on adulterated fuel, which are also responsible to the air pollution. Apart from this, lack of awareness among the drivers, controlling mechanism, public awareness on air pollution, idling of vehicles at traffic intersections, etc. are also the reasons for rising pollution load. Multiple approach is needed to combat the air pollution by vehicles via public awareness campaigns, media intervention packages, Government action plans and programmes, judicious distribution of quality oriented fuel by the sellers.

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