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A CASE STUDY

Suspended particulate matter status of urban area's in Mysore

SREENIVASA AND G.V. VENKATARAMANA

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ABSTRACT : *:* The present study indicates the variation of SPM concentration of Mysore city during the year 2013 to 2015 at three sampling locations. During the study period the average values of SPM ranges from 37.0 µg/m³ to 62.25 µg/m³. In the year 2013 highest values of SPM was recorded in KSRTC bus station (58.25 µg/m³) followed by Irwin road (56.50 µg/m.³) and KSPCB (53.50 µg/m³). During 2014 the average concentration of SPM found to be in the order of KSPCB (62.25 µg/m³), KSRTC (59.0 µg/m³) and Irwin road (57.0 µg/m³). At last in 2015 the highest average concentration of SPM values were recorded in KSRTC (56.0 µg/m³) and lowest values were recorded in KSPCB (37.00 µg/m³).

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Key Words : Suspended particulate matter, Monitoring, City roads, Concentration, Environmental quality, Air pollutants

Author for correspondence **:**
SREENIVASA
Department of Environmental Science, Manasagangothri University of Mysore, MYSORE (KARNATAKA) INDIA
Email : sreenivasaseenu123@gmail.com
See end of the article for **Coopted authors'**

The Speedy economic growth, urbanization, globalization, increase in technological and industrial advancement, coupled with increases in population growth, has triggered the deterioration of environmental quality throughout the country. The growing metropolitan cities, increasing traffic growth, development and industrialization with higher levels of energy consumption has resulted an increase in pollution load in an urban environment (CPCB, 2010).

Air pollution has become one of the serious environmental problems of the century which has a severe health consequence as well as societal economic and climate impacts. The air pollutants so generated are detrimental to human health. In addition, they cause negative impacts directly or indirectly, if at elevated concentrations, on vegetation, animal life, buildings and monuments, weather and climate and on the aesthetic quality of the environment. The World Health Organization estimates that air pollution contributes to approximately 800,000 deaths and 4.6 million lost life years annually (WHO, 2010). The number of urban centers may be viewed as dense sources of enormous man induced air pollutants and pollution of air is of serious concern in recent times, particularly for developing countries such as China and India, and it may further extend from local to global scale (Mage *et al.*, 1996; Cohen, 2006; Fenger, 2009 and Fang *et al.*, 2009).

The PM_{10} refers to particulate matter comprising particles less than 10 PM in diameter. Particles > 2.5 PM in diameter are generally referred to as coarse particles and particles less than 2.5 PM and 100 nm in diameter as fine particles and ultrafine particles, respectively, the majority of these studies have assessed the health effects of particles expressed as the risk per unit mass/ m^3 of PM_{10} or $PM_{2.5}$ (Marko Vallius, 2005).

The majority of recent health studies suggest that fine particles ($PM_{2.5}$) arising mainly from man-made sources are more harmful than coarse particles (Schwartz *et al.*, 1996; Laden *et al.*, 2000; Mar *et al.*, 2000 and Hoek *et al.*, 2002) and, therefore, the measurement of PM in health effect studies has currently focused on particulate matter ($PM_{2.5-10}$). Several efforts have also been specifically aimed at studying concentrations and potential health effects of the so-called ultrafine particles in the size range below 0.1 PM (Peters *et al.*, 1997; Ruuskanen *et al.*, 2001 and de Hartog *et al*., 2003).

In the case of ambient air pollution, WHO, estimates there were 40 per cent people suffering from Ischaemic, heart disease; 40 per cent people suffering from stroke; 11 per cent people suffering from chronic obstructive pulmonary disease (COPD); 6 per cent people suffering from lung cancer; and 3 per cent people were suffering from acute lower respiratory infections in children (WHO, 2012). Therefore, a systemic study, monitoring of ambient gaseous pollutants in air in all over the world especially in Indian cities is urgently needed. The objective of this study is to identify urban SPM present in Mysore city by air quality data collected using primary and secondary techniques, especially those related to SPM pollutants.

EXPERIMENTAL METHODOLOGY

Study area :

Mysore city is one of the largest district in the state of Karnataka is a well known important tourist and heritage centre. Mysore city is the second biggest city of the state. It is located at 135km south of Bangalore metropolitan city and lies at 12° 18' 25" N latitude and 76° 38' 58" E longitude. Mean sea level or altitude of Mysore city is765m. The city is well connected to the neibering states of Kerala, Tamil Nadu through road transport and rail net work. The city is also connected to other parts of the state by road as well as rail. The district is one of the southern most districts of the state and is bordered by Kodagu district in the west, Cannanore district of Kerala state in the south west, Chamarajanagar district in the south and south east, Mandya district in the north and Hassan district in the North West. According to the results of the 2011 national population census of India, the population of Mysore is 9, 18,225. The Mysore has a warm and cool and salubrious climate throughout the year (Ground water information booklet Mysore district, Karnataka, 2012). The weather in winter is cool and the summers are endurable. The minimum temperature in winter is around 15 degree Celsius and in summer the maximum temperature is around 35 degree Celsius. Mysore gets most of its rain during the monsoon between June and September with an annual average of 782mm (central ground water board 2009). Study area of Mysore city has divided in to Commercial and industrial areas as shown in the Table 1. Based on this three sampling locations were selected with different man induced activities such has commercial and industrial areas were identified in Mysore city during the year 2014.

Commercial and industrial area :

Sub urban Bus stands (KSRTC), Irwin road, are the most traffic junctions in Mysore and were located in the core area of the Mysore city and these have been selected as a commercial areas in the present study. As KSPCB circle is located in the industrial area near the ring road at the outskirts of Mysore city, hence ring road itself will be selected site for air monitoring for industrial area of Mysore city.

Instrumental analysis:

High volume air sampler and Vacuum pump air sampler was used for the collection of samples. The mass concentration of SPM in the ambient air was calculated by taking difference between the final and initial weight of the filter paper and dividing by the volume of air sampled. The ambient SPM parameters were assessed as per the guidelines of National Ambient Air Quality Standards 2009. The air samples were collected monitored and analyzed with the help of State Pollution Control board Mysore. The study of meteorological parameters such as temperature was also integrated with the monitoring of SPM quality. The monitoring of pollutants is carried out for 24 hours (8-hourly sampling for particulate matter) with a frequency of five days per week (AAQS, 2009).

EXPERIMENTAL FINDINGS AND DISCUSSION

The present study indicates the variation of SPM concentration in of Mysore city at three sampling locations. The result shows that in Table 1 the average concentration of suspended particulate matter (SPM) in the study area varied between 53.50µg/m³ to 58.25µg/

m^3. The presence of suspended particulate matter is 58.25 µg/m^3 against standard 200 µg/m^3 at KSRTC (sub urban bus station), at Irwin road Circle 56.50µg/m^3 against standard 200 µg/m^3 and at KSPCB (Hebbel industrial area) 53.50 µg/m^3 against standard 200 µg/m^3.The particulate matter concentration in the KSRTC is more when compared to other two locations due to commercial activities, vehicular emission and particles from tire and brake wear, dust from paved roads and dust from construction sites.

A Result shows that in Table 2 the average concentration of suspended particulate matter (SPM) in the study area varied between 57.0µg/m^3 to 62.25µg/m^3. The presence of suspended particulate matter is 62.25 µg/m^3 against standard 200 µg/m^3 at KSPCB, at KSRTC 59.0 µg/m^3 against standard 200µg/m^3 and at Irwin road circle 57.0 µg/m^3 against standard 200µg/m^3.The particulate matter concentration in the KSPCB Circle is more when compared to other two locations due to industrial activities, vehicular emission and particles from tire and brake wear, dust from paved roads and dust from construction sites. Udayashankara *et al.* (2015) has also reported that average concentration of SPM of Mysore city varied from 57.0µg/m^3 to 62.25µg/m^3.

Table 1: Average concentration of SPM (µg/m^3) during the sampling period at three sampling locations during the year- 2013

Sampling site	Concentration of SPM (µg/m^3)				Average
	Feb.	April	May	June	
KSPCB	49	63	53	49	53.50
KSRTC	49	64	71	49	58.25
Irwin road	49	63	65	49	56.50

Table 2: Average concentration of SPM (µg/m^3) during the sampling period at three sampling locations during the year 2014

Sampling site	Concentration of SPM (µg/m^3)				Average
	Feb	April	May	June	
KSPCB	49	86	69	57	62.25
KSRTC	49	65	69	53	59.00
Irwin road	49	65	61	53	57.00

Table 3: Average concentration of SPM (µg/m^3) during the sampling period at three sampling locations during the year- 2015

Sampling site	Concentration of SPM (µg/m^3)				Average
	Feb.	April	May	June	
KSPCB	36	43	38	31	37.00
KSRTC	36	62	65	61	56.00
Irwin road	36	61	64	60	55.25

Table 4 : Vehicles registered in RTO Mysore

Vehicle category	Year			
	2010	2011	2012	2013 (up to march)
Two-wheelers	17,994	21268	24176	6892
Light motor vehicles(LMV)	4319	4136	4381	1364
Heavy motor vehicles (HMV)	1826	2120	2510	639
Total	24139	27524	31067	8895

Table 5 : Climate data for Mysore 1901-2000 (Source: Mysore city, from Wikipedia, the free encyclopedia)

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Yearly average
Record high °C	36.3	37.8	38.2	38.0	38.5	38.4	37.9	37.5	38.1	37.5	37.2	35.8	37.6
Average high °C	28.6	31.1	33.6	34.3	32.9	29.2	27.7	28.0	28.9	28.8	27.9	27.5	29.87
Average low °C	16.2	17.9	20.1	21.2	21.0	20.1	19.6	19.5	19.3	19.5	18.2	16.5	19.09
Record low °C	7.7	10.2	13.8	17.5	21.1	17.5	16.8	16.3	15.4	14.2	10.7	8.3	7.7
Average rainfall mm (inches)	4.8	5.1	11.6	62.4	145.7	67.3	74.3	78.6	117.6	158.7	63.8	14.3	804.2

The result shows that in Table 3, the average concentration of suspended particulate matter (SPM) in the study area varied between 37.0µg/m³ to 56.0µg/m³.The presence of suspended particulate matter is 56.0 µg/m³ against standard 200 µg/m³ at KSRTC, at Irwin road circle 55.25 µg/m³ against standard 200µg/m³ and at KSPCB circle 37.0 µg/m³ against standard 200µg/m³.The particulate matter concentration in the KSRTC Circle is more when compared to other two locations due to commercial activities, vehicular emission and particles from tire and brake wear, dust from paved roads and dust from construction sites.

It is evident from the Table 4 that almost all types of vehicles have been growing constantly. It may be observed that 2-wheeler vehicles have been growing at relatively faster rate. At this growth rate there will be a further increase in the vehicular density in the upcoming years and will have an effect on the traffic conditions of the city roads. It is evident from the Table 5 and Fig. 5 that the highest temperature recorded in summer in Mysore was 39.4 °C on 4th April 1914, and the lowest was 7.7 °C on 16th January 2012.The city's average annual rainfall is 804.2 mm.

Conclusion :

Ambient Suspended particulate matter (SPM) emitted in KSRTC, KSPCB and Irwin road of Mysore

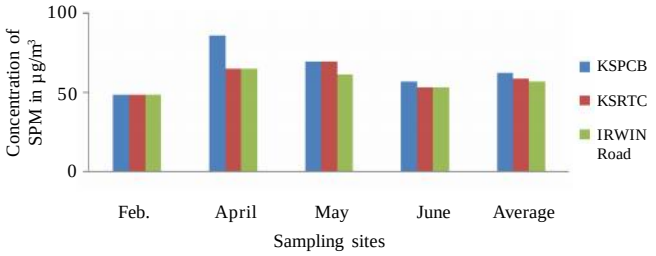

Fig. 1 : Average concentration of SPM (µg/m³) during the sampling period at three sampling locations during the year- 2013

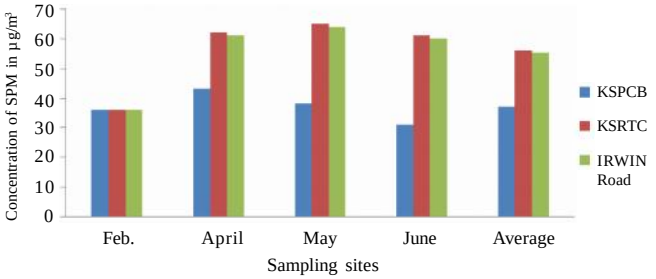

Fig. 2 : Average concentration of SPM (µg/m³) during the sampling period at three sampling locations during the year- 2014

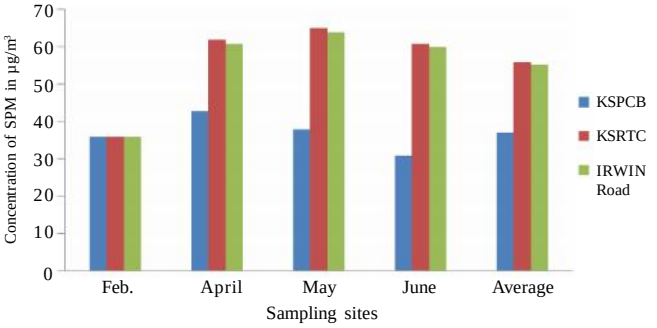

Fig. 3 : Average concentration of SPM (µg/m³) during the sampling period at three sampling locations during the year- 2015

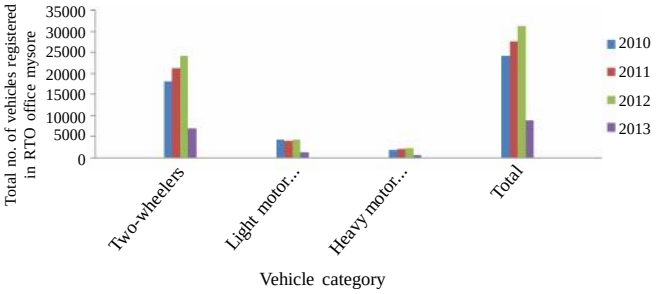

Fig. 4 : Vehicles registered in RTO office Mysore (up to march 2013

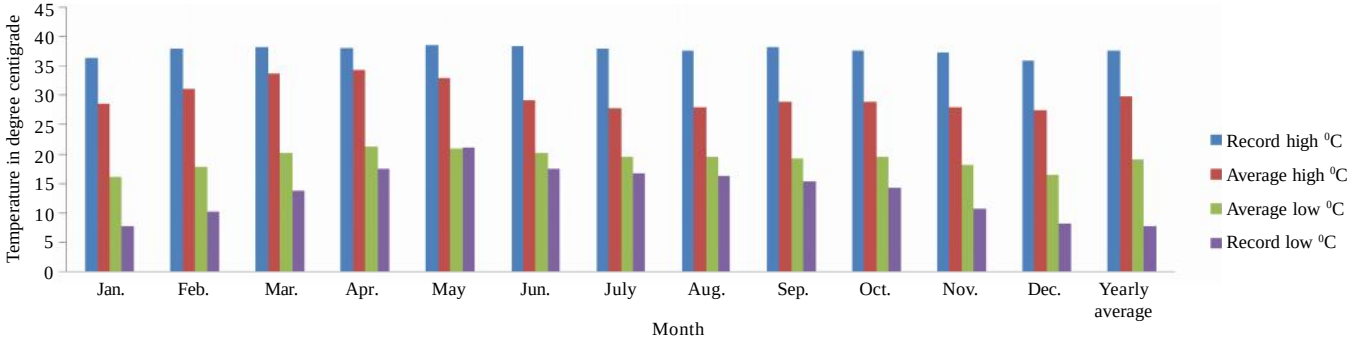

Fig. 5 : Climate data for Mysore 1901-2000 (Source: Mysore city From Wikipedia, the free encyclopedia)

city is mainly due to rapid growing numbers of petrol and diesel motor vehicles and poor traffic control, particles from tire and brake wear, dust from paved roads and dust from construction sites and congested roads. Analysis of SPM in each site revealed that with KSRTC bus station had the maximum average concentration of SPM. Selected three sampling locations are below the National Ambient Air quality standards. The city is under going rapid urbanization, rapid trend in population growth leading to increase in the vehicular crowd and reduction of green cover affecting the air quality, there are chances of increase in SPM pollution in future. So Mysore city is a firm case for continuous monitoring of ambient air quality.

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Coopted Authors' :

G.V. VENKATARAMANA, Department of Studies in Environmental Science, University of Mysore, Manasagangothri, MYSORE (KARNATAKA) INDIA

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