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Exposure Assessment of Respirable Suspended Particulate Matter in Urban Ambient Air: A Case Study of Bikaner City

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ABSTRACT
Clean air is the prime need for human health as well as other living being. Urban ambient air quality is a matter of concern because of exposure of pollutants in large amount is detrimental to human health and the environment of the planet. The current study was carried out to evaluate the Respirable Suspended Particulate Matter (RSPM) exposure in the ambient air at residential, industrial, traffic and sensitive locations in Bikaner city for pre-Monsoon season during March, 2018 to June, 2018. The highest concentration of RSPM was recorded at Kotegate (297.5µg/m3) and lowest was at MGSU Campus (27.5µg/m3). The average concentration of RSPM was recorded much higher than the maximum permissible limits prescribed by the National Ambient Air Quality Standards (NAAQ, 2009) and long -term exposure of particulate matter may cause for harmful effect on human health such as arrhythmias, reduced lung function, cardiovascular and respiratory diseases with increased risk of mortality and morbidity.
Key words: *Major Pollutants, RSPM, NAAQS, Air quality Index, Health Risk*

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INTRODUCTION

Air pollution is an atmospheric condition in which substance are present at a concentration high enough above their normal ambient air level to produce measurable effects on man, animal, vegetable etc. It has been globally recognized issue and becomes a basic problem in today's world. Developing countries such as India and China are presently facing serious problems of poor air quality due to rapid urbanization and industrialization. The rapid population growth, development in industry sector, increase vehicular numbers and indecorous execution of stringent emission standards make the problem of air pollution still worse [13]. The report of WHO indicated that Gwalior, Allahabad, Patna and Raipur ranked second, third, sixth and seventh respectively in term of $PM_{2.5}$ concentration among top 10 cities having poor air quality of the world. It is also reported that New Delhi ranked 11th among 3000 cities in 103 countries in term of $PM_{2.5}$ concentration [14]. In India it is noticed that after globalization, the environmental pollution has been rapidly increased at national level during last two decades [3]. The ambient air quality of Bikaner city is also being deteriorated as well as Jaipur, Jodhpur, Alwar and western Rajasthan since this decade. The air pollution, particularly with reference to suspended particulate matter has attracting concerns in scientific community. Particulate matter is the aggregation of all solid and liquid particles suspended in air including smoke, soot, salts, acids and metals etc., are associated in air due to dust from construction, landfill and agriculture, dust blow from open lands, smoke from wildfires and waste burning, chemical reactions from industry and motor vehicles etc. Most of SPM are hazardous for human health although the particles with average diameters higher than 10µm are stopped in the upper areas of the respiratory tract. Particles of median diameters less than 10µm (PM_{10}) can migrate to the lungs and those with diameters less than 2.5µm can reach bronchial alveolus and may be retained for a long period. Higher concentrations of pollutants cause breathing difficulties, chronic cough, sore throat, nasal congestion, cancer, asthma, respiratory diseases and premature death. Exposure of suspended air particulates in exceeding limit can lead to respiratory problems as asthma respiratory allergies [4, 5] and other health hazards depending on their physicochemical properties. According to estimation of world health organization during 2016-2018, 91% of the world's population lives in places where air quality exceeds WHO guideline limits and 9 out of 10 people worldwide do not breathe fresh air [1, 2]. Nearly 15,000 people died prematurely in Delhi due to deteriorated ambient air quality by fine particulate matter (PM_{10} and $PM_{2.5}$) and other major air pollutants in 2016 and national capital was third in a list of cities reporting most deaths due to air pollution, Shanghai stood first in most premature deaths at 17,600 and

Beijing second with 16,200 deaths due to $PM_{2.5}$. In Indian megacities, the premature death were 14,800 in Delhi, 10,500 in Mumbai, 7,300 in Kolkata and 4,800 in Chennai in that order [7, 8]. The present investigation deals with the effects of anthropogenic emissions, urbanization, industrialization, and vehicular emission on ambient air quality. Objectives of the study is to determine status and trends in ambient air quality with reference to respirable dust and effects of air pollution in urban environment of Bikaner city and to aware local administration and industries for implementation of proper management system in this region to mitigate the air pollution.

METARIAL AND METHEDS

STUDY AREA: Bikaner district is located in the north-western part of Rajasthan and encompassed between north latitudes 27□11' to 29□03' and east longitudes 71◦52' to 74◦15' covering geographical area of 30247.90 km2. The District experiences arid type of climate. Unlike many other cities with arid climate, Bikaner has long and very hot summers, mild and relatively short winters, dust storms and a monsoon season. The climate in Bikaner is characterized by significant variations in temperature having two seasons monsoon (June to September) and winter (October-February). In the summer season temperatures lie in the range of 28-45 °C (82.4-119.3°F) and in the winter, it is cold with temperatures lying in the range of 5-23.2 °C (941.0-73.8°F). Annual rainfall is in the range of 260-440 mm (10-17 in). The city is known for woolen industries, two wheelers, fertilizers, textiles, ceramics, food industries, chemical, Food aids, Plaster textiles etc.

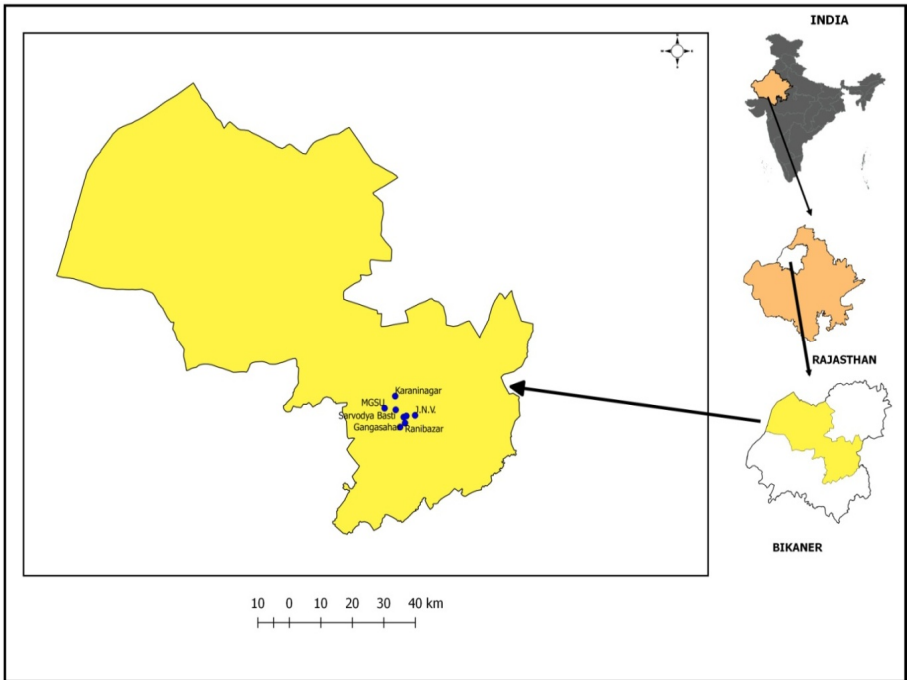

Figure 1: Monitoring Sites for Study

AIR SAMPLING: The main concern of the study was to measure the concentration of respirable dust at different sampling sites in Bikaner city [6]. The Sampling was carried out form march, 2018 to June, 2018 between 8.00 AM to 6.00 PM. The Sampling Sites were selected on the basis of traffic load, location of industrial area, sensitivity of the location from air pollution point of view etc. Total eight sampling sites including Karninagar industrial area, Ranibazar industrial area, Kotegate, J.N.V. circle, Sarvodya Basti, Ganga shahar and PBM hospital were selected for the investigation while MGS University Campus was selected as control due its location is outside area near Nal Village (Fig.1). Details of characteristics of different sites are given in table 1.

Table 1: DETAIL OF SAMPLING SITES IN BIKANER CITY WITH THEIR CHARACTERISTICS

S.N.	MONITORING SITES	GPS LOCATION		CHARACTERISTICS OF MONITORING SITES
		LATITUDE	LONGITUDE	
1.	Sarvodyabasti	28° 01' 47'' N	73° 17' 30'' E	Residential zone
2.	Ganga shahar	27° 59' 23'' N	73° 17' 50'' E	Residential zone
3.	J.N.V. circle	28° 00' 37'' N	73° 20' 35'' E	Commercial zone
4.	Kotegate	28° 01' 05'' N	73° 18' 42'' E	Commercial zone
5.	Ranibazar industrial area	28° 00' 24'' N	73° 19' 09'' E	Industrial zone
6.	Karni industrial area	28° 03' 09'' N	73° 16' 52'' E	Industrial zone
7.	P.B.M. Hospital	28° 00' 45'' N	73° 19' 38'' E	Silent zone
8.	MGSU campus	28° 01' 59'' N	73° 15' 31'' E	Silent zone

MEASUREMENT OF RESPIRABLE SUSPENDED PARTICULATE MATTER (PM_{10}) BY CYCLONIC FLOW TECHNIQUE: Air is drawn through a size-selective inlet and through a 20.3x25.4 cm (8x10 inch) filter at a flow rate which was typically 1132 L/min. Particle with aerodynamic diameter less than the cut point of the inlet were collected by the filter. The mass of these particles was determined by the difference in filter weights prior to and after sampling. The concentration of PM_{10} in the designated size range was calculated by dividing the weight gain of the filter by the volume of air sample [9].

CALCULATIONS

Calculation of volume of air sampled:

$$V=QT$$

Where,

V = Volume of air sampled in m^3

Q = Average flow rate in m^3/min

T = Total sampling time in min

Calculation of PM_{10} in Ambient air:

$$C\ PM_{10} = (W_f - W_i) / V \times 106$$

Where,

C PM_{10} = Concentration of PM_{10}, $\mu g/m^3$

W_f = Final weight of filter in g

W_i = Initial weight of filter in g

106 = Conversion of g to µg

V = Volume of air sampled, m

Table 2: Concentration of RSPM in ambient air at different monitoring sites inBikaner City

S.N.	MONITORING SITES	CONCENTRATION OF RSPM ($\mu g/m^3$)					REMARKS
		MARCH	APRIL	MAY	JUNE	AVERAGE	
1.	SARVODYABASTI	66.3	64.7	68.4	67.6	66.75	LIGHT POLLUTED
2.	GANGA SHAHAR	198.8	196.3	204.6	201.4	200.27	HEAVY POLLUTED
3.	J.N.V. CIRCLE	118.2	122.6	129.3	125.6	123.92	MODERATELY POLLUTED
4.	KOTEGATE	287.4	292.4	297.5	296.8	293.52	HEAVY POLLUTED
5.	RANIBAZAR INDUSTRIAL AREA	249.6	244.4	255.7	253.2	250.72	HEAVY POLLUTED
6.	KARNI INDUSTRIAL AREA	211.2	209.7	217.4	215.5	213.45	HEAVY POLLUTED
7.	P.B.M. HOSPITAL	158.4	161.3	166.8	163.5	162.50	MODERATELY POLLUTED
8.	MGSU CAMPUS	27.5	26.1	31.7	29.3	28.65	CLEAN

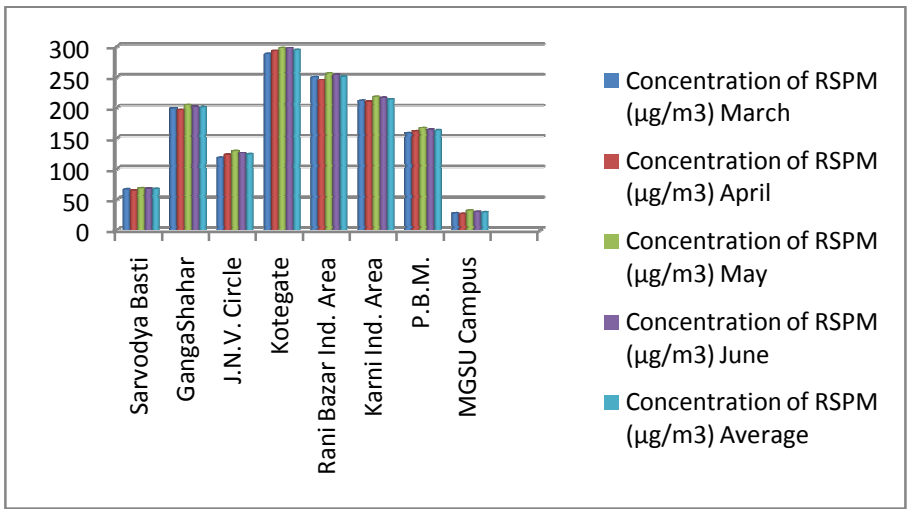

Figure 1: Concentration of RSPM in ambient air at different monitoring sites in Bikaner City

RESULTS AND DISCUSSION

The present study was focused on the assessment of Respirable Suspended Particulate Matter (RSPM) concentration in various areas of Bikaner city of western Rajasthan. The analysis of RSPM was done at Industrial, Commercial, Residential and sensitive location of the City (fig.1) During March – June 2018. Resultsof the study has shown that average concentration of PM_{10} at study sites ranges from 28.65µg/m^3 to 293.52µg/m^3 with highest levels at Kotegate 297.5µg/m^3 followed by 255.7µg/m^3 at Ranibazar industrial area. Only at Sarvodya basti and MGSU campus, PM_{10} levels were close to its standard prescribed by NAAQS whereas in other sites the levels were far exceeding. The Highest concentration of RSPM was observed at Kotegate297.5µg/m^{3}in May month which may be due to heavy traffic, intersection railway crossing and vehicles rush, Similarly Ranibazar industrial area which is RICCO zone having lots of woolen industries and other Industries, where concentration of RSPM was observed as 255.7µg/m^3. Same as this another Industrial area of Bikaner City Karni Nagar Industrial Areas having many factories, industries like Cermics, chemical, Food aids, Plaster Textiles etc, found concentration of RSPM 217.4µg/m^3.

It was interesting to notice that the level of RSPM at both residential sites selected under the investigation were significantly different. At Sarvodya Basti site, the average concentration of RSPM level was reported as 66.75µg/m^3, while it was very high at Ganga Shahar site as 200.27µg/m^3. It may be due to good plantation at Sarvodya Basti site and its location away from major highway, the Ganga Shahar is situated near the National highway (No. 89) and it is also important to note that the area of Ganga Shahar is not rich in plantation point of view.

The average concentration of RSPM at P.B.M. Hospital (Silent zone) was observed 162.50µg/m^3. The increase of RSPM at silent zone is big issue and reason ofthis may be its located at National Highway. The outcomes of the study shows that the RSPM level has exceeded the maximum permissible limits prescribed by the National Ambient Air Quality standards, However It was noted that the level of concentration of RSPM was found to be well under the maximum permissible limits at control site (MGSU campus) near Nal village The results of the present study are fairly supported by the earlier findings. [7-11].

It was observed that higher concentration of different air pollutants in Bikaner city has raised the health related problems in people of the city. Excessive concentration of SO_x, NO_x, RSPM, SPM, CO_2, CO etc. cam lead to hazardous impact on human health. Symptoms of such effects are eye irritation, headache, skin related problem, breathing problems, Asthma, nauesa etc. Due to such polluted conditions, the patients related to air born disease are increasing rapidly in recent years in the city. (Table 3). Therefore, the present investigation was carried out to know the severity of air pollution related issues, in Bikaner city with special reference to respirable dust concentration in different zones of the city.

Table 3: Yearly Average Asthma Patients affect by Air Pollution in Bikaner City*

S.NO.	YEAR	AVERAGE ASTHMA PATIENTS
1.	2009	434
2.	2010	517
3.	2011	190
4.	2012	708
5.	2013	844
6.	2014	870
7.	2015	780
8.	2016	912
*(SOURCE: DEPARTMENT OF RESPIRATORY MEDICINE, PBM HOSPITAL BIKANER)		

CONCLUSION

The study clearly revealed the level of air pollution for RSPM was very high in industrial area while it was lowest in silent zone. The presence of high concentration particulate pollutants has a significant negative impact on the ambient air quality status of Bikaner city as in terms of Air Quality Index. The air qualities are giving the holistic view of air pollution levels. Air pollutants show diurnal variations in their levels. During the daytime, solar heating causes maximum turbulence and strongest vertical motions. This causes the maximum amount of momentum exchange between the various levels in the atmosphere.

The present investigation revealed that Bikaner has moderate to high RSPM load, so there is an urgent need to develop a strategy to combat the growing menace of air pollution in the urban environment. The main source of the pollutants appears to be vehicular emission as its concentration is highest in the sites located in the busy commercial zones of the city with high transport density. The problem becomes more severe because it originates from human activities that are often part of a vibrant, urban culture including construction, industrial exhaust, automobile emission and other anthropogenic activities. Therefore, a major part of pollutant emissions in cities are due to traffic, an appropriate transport design in the urban area is needed, planning for controlling illegal parking, maintenance of vehicles on time and ban 15 year old diesel vehicles, proper implementation of earlier orders of the Air (Prevention and Control of Pollution) Act, 1981 and policies of RSPCB & CPCB can help to reduce the air pollution in the Bikaner city.

REFERENCES

1. Badhwar, N., Trivedi, R.C. and Sengupta, B. (2006).Air Quality status and trends in India. Indian Journal of Air Pollution control, Volume 6,71-79.
2. Barman, S.C., Kumar, N. and Singh, R. (2010).Assessment of urban air pollution and its probable health impact. Journal of Environmental Biology, Volume 31(6) 913-920.
3. Central Pollution Control Broad (CPCB, 2000).Air Quality status and trends in India. National ambient air Quality Monitoring series: NAAQMS/14/2000 -2016 163
4. Charan, P.D. and Sahel, H. (2014).Study of respirable dust in ambient air of Bikaner city and its impact on human health. Applied Journal of Hygiene, Volume 3(1), 11-14
5. Healy, D., Silvari, V., Whitaker, A., Lopez, J., Trepat, E. and Heffron, E. (2007). Linking urban field measurements of ambient air particulate matter to their chemical analysis and effects on health.In Proceedings of the 6th International Conference on Urban Air Quality, Limassol, Cyprus.
6. IS 5182 Part 23 Method of Measurement of Air Pollution: Respirable Suspended Particulate Matter (PM) cyclonic flow technique.
7. Kumar, A., Garg, A. and Pandel, U. (2011).A Study of ambient air quality status in Jaipur City (Rajasthan, India), Using Air Quality Index. Nature and Science, Volume 9(6), 38-43.
8. Kumar, A.V., Patil, R.S. and Nambi, K.S.V. (2001). Source apportionment of suspended particulate matter at two traffic junctions in Mumbai, India. Atoms. Environ. Volume 35,4245-4251.
9. Lamare, R.E. and Chaturvedi, S.S. (2014). Suspended particulate matter in ambient air of Shillong city, Meghalaya. India. Ind. J. Sci. Res. and Tech, Volume 2(6), 37-41.
10. National Air Quality Index, CPCB (2013). Central Pollution Control Board
11. National Ambient Air Quality Standards, (2009). Ministry of Environment and Forest, Government of India.
12. Nidhi.and Jayaraman, G. (2007). Air quality and respiratory health in Delhi. Environment Monitoring and Assessment. Volume 135, 313-325.
13. Ravindra, K., Mittal, A.K. and Grieken, V.R. (2001). Health risk assessment of urban suspended particulate matter with special reference to polycyclic aromatic hydrocarbons: A review. Reviews on Environment Health, Volume 16, 169-189.
14. World Health Organization (2018). Environmental Health Information Geneva.

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