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ANALYSIS AND MONITORING OF AMBIENT AIR QUALITY IN REWA CITY, (M.P.) INDIA

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ABSTRACT
Air pollution is considered to be primarily an urban problem as the rate of industrialization and unsystematic urbanization increases day by day. It has become a major environmental problem faced by the people globally in both developing and developed countries. The aim of this study was to assess the monthly variations of SPM, RSPM, SO_2 and NO_X in ambient air of Rewa city. The results revealed that the ambient air of Rewa city is deteriorated by particulate matters (SPM, RSPM) and least by gaseous pollutants (SO2, NOx).

Keywords: Air pollution, SPM, RSPM, SO_2 and NO_X

I.   INRTODUCTION

Air pollution is one of the major serious problems on the worlds. It causes health related problems such as respiratory disease, skin problems, risk of developing cancer and other serious ailments. Pollutants in to the air by means of various natural as well as anthropogenic means, released in the air due to various industrial as well as commercial activities and construction works increase in the number of vehicles. The high level of pollutants which contribute to ambient air pollution are sulfur dioxide, nitrogen oxides, suspended particulate matter, Respirable suspended particulate matter, and hazards pollutants air pollution affects every one of us.

Air pollution can cause health related problems and may be death. Because a large share of air pollution is caused by combustion of burning fossil fuels such as coal, petroleum, and oil, the reduction of these fuels can reduce air pollution drastically titanium dioxide has been researched for its ability to reduce air pollution. Burning of municipal solid west create the high air pollution also. Ambient air related to the air in the usual environment in which human live. Ambient air monitoring is the invigilating of the quality of the air in particular area or polluted city. It is not related to monitoring the emissions from chimney stacks. The topical ambient air quality can be divided by a number of sources such as motor vehicles and power station emissions. The common matters monitored include dust deposition, SPM, RSPM and SO_X, NO_X. Air pollution is considered to be primarily an urban problem as the rate of industrialization and unsystematic urbanization increases day by day. It has become a major environmental problem faced by the people globally in both developing and developed countries.

Some workers have observed higher concentration of SO_2 in the ambient air as compared to present investigation (Mukhopadhyay and Mukherjee 2013, Nandanwaret al. 2014). Various researches have been carried out byRani et.al, 2011; Chakrabarti and Mitra, 2014; Richhariya, 2015; Simbi et.al, 2017; Dwivedi and Tripathi, 2018 toevaluate the ambient air pollutants (SO_2, NO_x and SPM). Hasan et.al, (2018) observed that Nitrogen oxides has an important role in the formation of ozone in the atmosphere and sulphur dioxide is a highly reactive gas which affects the environment.

Road side dust by vehicular exhausts and various other anthropogenic activities contain considerable concentrations of particulates and gaseous pollutants. Present research work was undertaken to monitor the ambient air quality of Rewa city (M.P.).

II. MATERIALS AND METHODS

Site selection- The present research work was undertaken in Rewa city, which is situated on the north-eastern part of Madhya Pradesh state, central part of India.

Sampling and monitoring- Ambient air quality monitoring in different sites of Rewa city has been investigated for six months i.e., January 2018 to June 2018 on monthly basis. On the basis of anthropogenic activities and relative traffic load, air quality monitoring at six selected sites of Rewa city have been carried out viz; Civil Lines, Prakash square, Jaistambh square, Transport Nagar and Old bus stand along with control site (APS University Campus) of Rewa.

Sampling was carried out at the six different locations using Respirable Dust sampler (Envirotech model APM 460 BL-411) and Gaseous pollutants sampler (Envirotech model APM 443) for 8 hours in a day at an average flow rate of 1.5 LPM as per the standards of Central Pollution Control Board (India). Monitoring is carried out once in a month at sampling sites. Suspended particulate matters (SPM) and Respirable suspended particulate matters (RSPM) were collected on the dust cup and glass fabric filter paper (GRA-3) respectively. Samples for determination of gaseous pollutants (SO_2 and NOx) were collected by bubbling air samples in Sodium tetra chloromercurate and Sodium hydroxide arsenate absorbent solutions respectively in impingers at flow rate of 1.5 LPM. These samples were analyzed for SO_2 and NO_X spectrophotometrically.

III. RESULTS

The monthly ambient air concentrations of suspended particulate matter (SPM), Respirable particulate matters (RSPM), Sulphur dioxide (SO_2) and Nitrogen oxides (NO_X) have been monitored at six sites of Rewa city during the year Janauary 2018 to June 2018. Figure-1 to Figure-4 deals with monthly concentrations SPM, RSPM, SO_2 and NO_X respectively observed in the ambient air at selected sites for six months.

The maximum SPM concentration (520.55 µg/m³) was recorded in the ambient air of Transport nagar (520.55 72 µg/m³) during January month to be followed by Prakash chowk (462.72 µg/m³), Old bus stand (440.87 µg/m³), Jaistambh (390.23 µg/m³), Civil lines (189.44 µg/m³) and University campus (190.03µg/m³). The concentrations of SPM in the ambient air of selected sites during February, March, April, May and June varied between 120.76 to 520.55 µg/m³ being minimum and maximum at University campus and Transport nagar respectively.

The observed RSPM values of various sites were found in the range of 50.44 to 135.30 µg/m³ during January month. The ambient air of Transport nagar and University campus exhibited higher and lower concentrations of RSPM respectively during six months analysis. During February, March, April, May and June ambient air RSPM concentrations were estimated in the range of 44.32 to 124.28 µg/m³, 41.33 to 115.48 µg/m³, 40.79 to 98.99 µg/m³, 35.92 to 73.68µg/m³ and 32.44 to 58.97 µg/m³during respectively. The lower concentrations were recorded for the ambient air of university campus during six months. On the other hand, there was higher concentrations of RSPM in the ambient air of Transport nagar was found during analysis.

The ambient air SO_2 concentrations were estimated in the range of 25.65 to 43.18 µg/m³. Out of six sampling sites, the ambient air of Old Bus Stand exhibited highest concentrations of SO_2 during all six months whereas the lowest concentration was estimated for ambient air of University campus throughout the sampling periods of this year. Out of six study sites, Old bus stand showed highest value of NO_X concentration in the ambient air whereas, the lowest concentration was estimated for the ambient air of University campus during this period. The ambient air samples showed NO_X concentrations in the range of 16.00 to 72.06 µg/m³ with maximum and minimum at Old bus stand and University campus respectively.

Average concentrations of four pollutants have been computed from the basic data during the year Janauary 2018 to June 2018 table 1. Results revealed monthly variation in pollutant concentrations in the ambient air of Rewa city. Average concentrations of SPM was found maximum in the ambient air of Transport nagar (384.79 ± 57.69) during six months to be followed by Prakash chowk (367.16 ± 51.80), Old bus stand (341.76 ± 43.77), Jaistambh (303.87 ± 32.55), Civil line (162.38 ± 9.17), and University campus (155.42 ± 11.73). The ambient air of Old bus stand also exhibited maximum average concentration of RSPM (97.54 ± 12.98) during six months to be followed by Transport nagar (73.68 ± 13.16), Prakash chowk (69.23 ± 5.84), Jaistambh (40.78 ± 2.67), Civil line (47.86 ± 3.98) and University campus (40.78 ± 2.67). The estimated average concentration of SO_2 was

observed to be maximum in the ambient air of Old bus stand (34.69 ± 3.82) followed by Jaistambh (32.91 ± 6.13), Transport nagar (32.11 ± 3.03), Prakash chowk (26.74 ± 2.99), Civil line (23.54 ± 2.22) and University campus (20.80 ± 1.19).The Old bus stand ambient air exhibited maximum concentration of NO_X (55.53 ± 14.12) during this year to be followed by Transport nagar (54.28 ± 12.41), Jaistambh (41.69 ± 6.72), Prakash chowk (35.85 ± 7.39), Civil line (27.18 ± 6.81) and University campus (17.45 ± 0.54).

It is evident from the results that air quality of Rewa city is deteriorating mainly due to particulate pollutants. Out of six sampling sites, the average concentrations of SPM in the ambient air of all the sites exceeded the standard value (200µg/m^3) prescribed by CPCB, New Delhi. The average SPM concentrations in the ambient air of only two sites (Civil lines and University campus) were observed below the prescribed standard value. Only two sites of Rewa city (Old bus stand and Transport nagar) showed RSPM concentrations in the ambient air above the standard value (100 µg/m^3) prescribed by the CPCB, New Delhi. On contrary, other sites registered RSPM concentrations in the ambient air below the prescribed standard value. Gaseous pollutants (SO_2 and NO_X) were always found to be below the standard value (80 µg/m^3) prescribed by the CPCB, New Delhi throughout the study period. The basic data have been computed with suitable statistical approach (ANOVA) to observe the significant changes in concentrations of various pollutants (Table 2). Results revealed that there was significant difference in SPM, RSPM, SO_2 and NO_X concentrations in ambient air of Rewa city between different months.
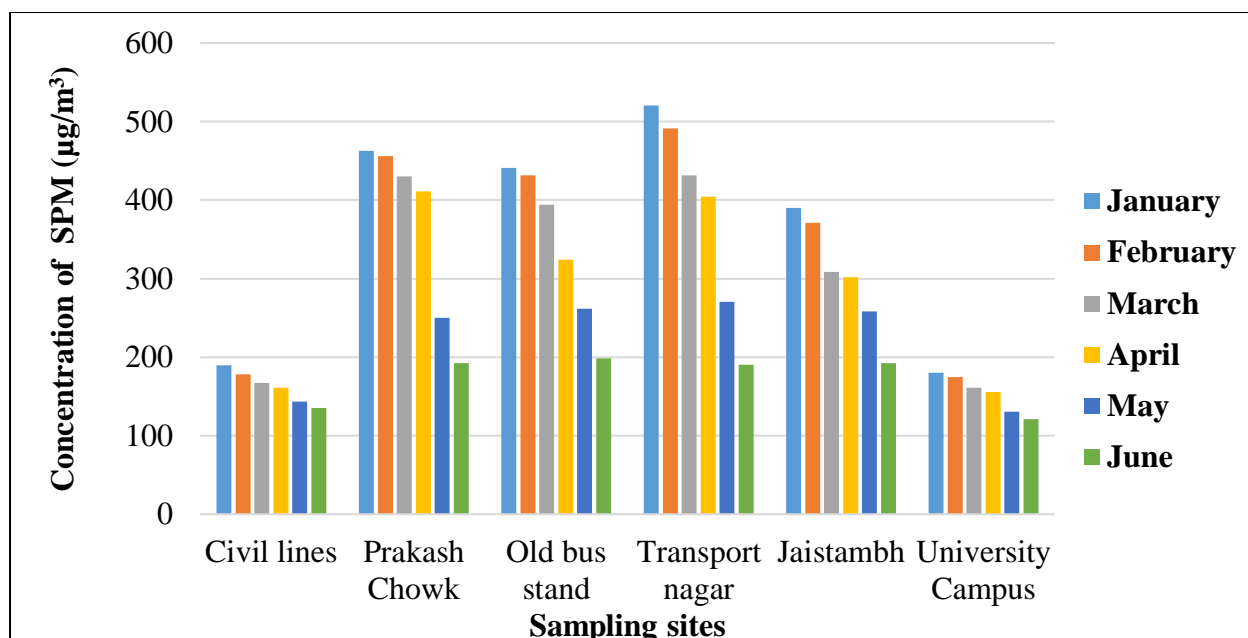

Figure-1 Monthly concentration of SPM (µg/m^3) in the ambient air at various sites of Rewa city
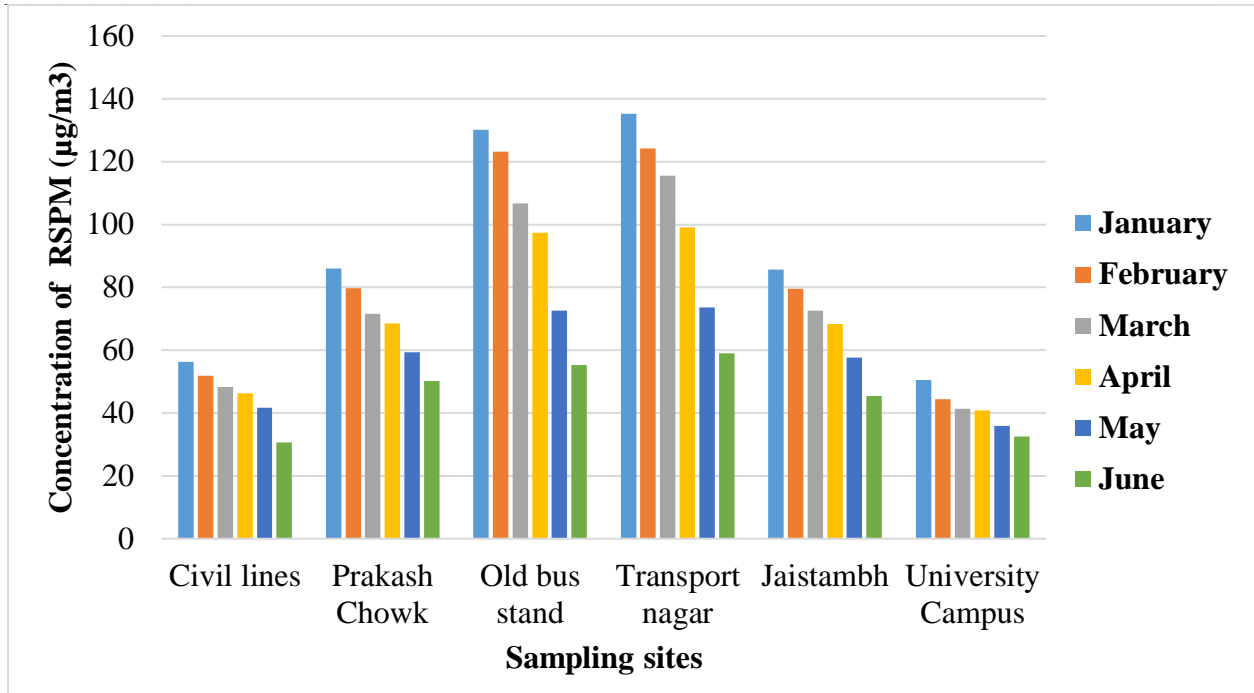
Figure-2 Monthly concentration of RSPM (μg/m³) in the ambient air at various sites of Rewa city
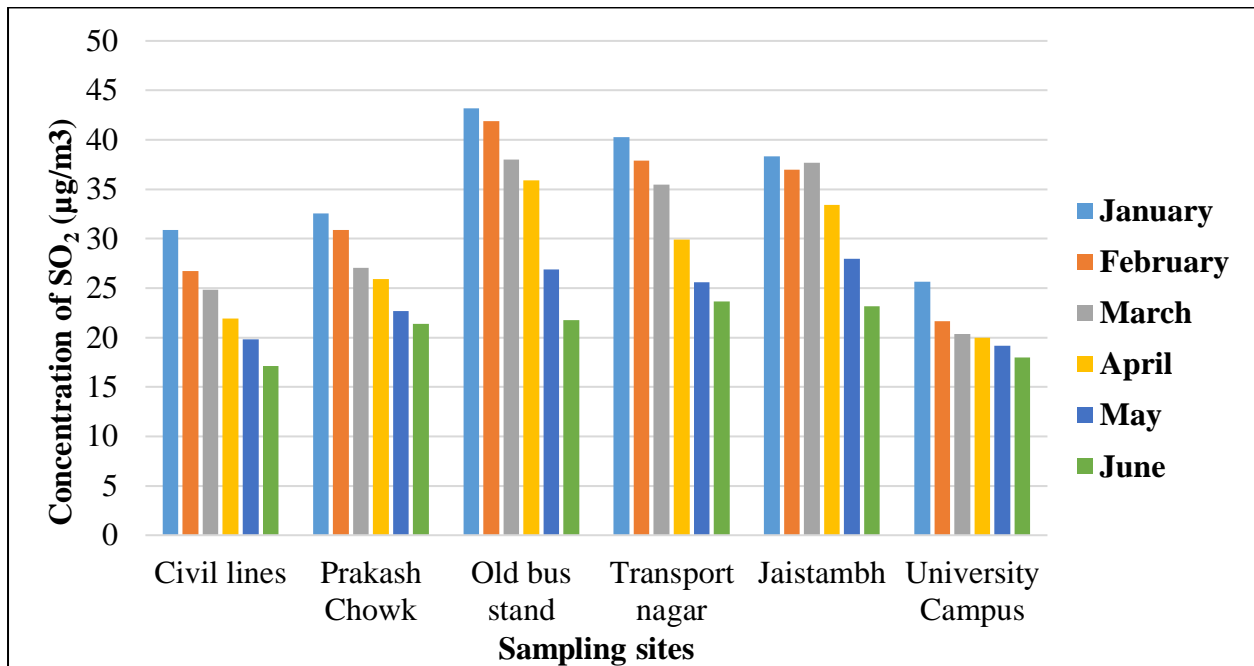

Figure-3 Monthly concentration of SO₂ (μg/m³) in the ambient air at various sites of Rewa city.
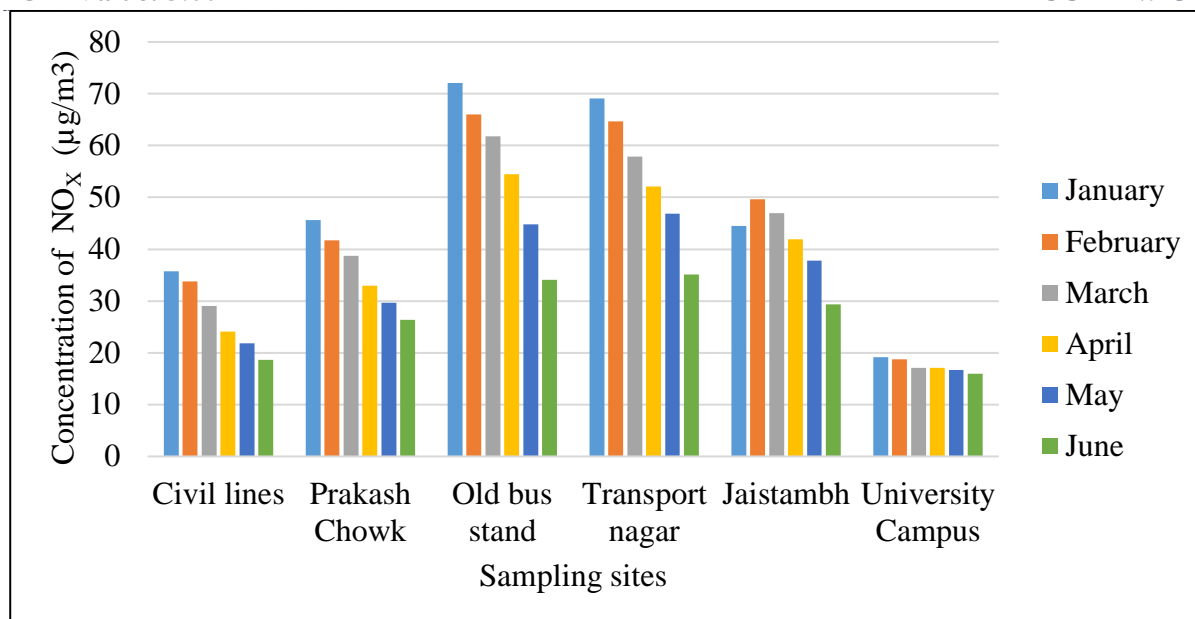
Figure-4 Monthly concentration of NO_X ($\mu g/m^3$) in the ambient air at various sites of Rewa city.

Table-1 Average concentrations of SPM, RSPM, SO_2 and NO_X in the ambient air at various sites in Rewa city.

Pollutant type / Sampling Sites	SPM	RSPM	SO_2	NO_X
Civil line	162.38 ± 9.17	47.86 ± 3.98	23.54 ± 2.22	27.18 ± 6.81
Prakash Chowk	367.16 ± 51.80	69.23 ± 5.84	26.74 ± 2.99	35.85 ± 7.39
Old bus stand	341.76 ± 43.77	97.54 ± 12.98	34.69 ± 3.82	55.53 ± 14.12
Transport nagar	384.79 ± 57.69	73.68 ± 13.16	32.11 ± 3.03	54.28 ± 12.41
Jaistambh	303.87 ± 32.55	57.67 ± 6.57	32.91 ± 6.13	41.69 ± 6.72
University Campus	155.42 ± 11.73	40.78 ± 2.67	20.80 ± 1.19	17.45 ± 0.54

Table-2 One way ANOVA showing the significant changes during six months analysis.

Pollutants	F-Value	P-value
SPM	40.74	P<0.0001***
RSPM	33.96	P<0.0001***
SO_2	14.82	P<0.0001****
NO_X	16.04	P<0.0001***

* Significant

'F ' value at 5 and 30 d.f. on 0.05% level is 3.32

IV.   DISCUSSION

Air pollution is a serious environmental problem throughout the world which causes tremendous loss to human health and environment. Over Population, urbanization and industrialization led to serious air pollution related problems worldwide. Air pollution is considered to be primarily an urban problem in Rewa city as the rate of urbanization increases. Growing air pollution has emerged as a serious concern in the city with vehicular emission and dust contributing a major share of the deteriorating air quality. Urban air pollution episodes are primarily due to increased concentrations of pollutants, viz. local meteorology, emissions and dispersion conditions.

The ambient air of six sampling sites of Rewa has been monitored and analyzed for SPM, RSPM, SO_2 and NOx concentrations. Results demonstrated average SPM concentrations in ambient air at various sites of Rewa city in range of 155.42 to 162.38 $\mu g/m^3$ during six months in year 2018. The SPM concentrations obtained under present investigation are consistent with the concentrations reported by various workers for other Indian cities.

The higher SPM levels in the ambient air of Rewa city may probably be attributed to the rapid increase in vehicular population and construction works going on in the city. No major air polluting industries are established in the study area thus, current study suggesting that vehicles could be the major source for increasing air pollution. Apart from vehicular emissions, burning garbage and backyard wastes in Rewa city continues significantly to the SPM levels. On an average RSPM concentrations in ambient air of Rewa city has been monitored in the range of 40.78 to 47.86 $\mu g/m^3$. Almost similar RSPM concentrations have been observed in ambient air of some cities of India.

The average SO_2 concentrations in selected sites have been recorded in the range 20.80 to 23.54 $\mu g/m^3$. Almost similar concentrations have been reported by Horaginamuni and Ravichandra (2010), Yadav et al. (2012). The average NOx concentrations in selected sites have been recorded in the range of 17.45 to 27.18 $\mu g/m^3$. These concentrations under present investigation are in conformity with the findings of Chauhan (2010), Jahangir et al. (2011), Chaurasia et al. (2013), Nair et al. (2014) and Nandanwar et al. (2014).

This study illustrates that SPM concentrations in the ambient air of Rewa exceeded the maximum permissible limit prescribed by CPCB, New Delhi (200 $\mu g/m^3$), except at all the sites in June month and Civil lines and University Campus in all six months. Similarly, the RSPM concentrations have been observed below the standard permissible limit of 100 $\mu g/m^3$ given by CPCB, except at Old Bus stand and Transport Nagar in January, February and March.

This study reveals significant differences in SPM, RSPM, SO_2 and NOx concentrations in the ambient air between six monitoring sites of Rewa city. Results demonstrated higher concentrations of pollutants in the ambient air at Transport Nagar , Prakash Chowk and Old Bus stand. The excessive levels of pollutants in the ambient air at these locations may be attributed to poor traffic management, growth of two, three and four wheeler vehicles, illegal parking of vehicles, road congestion and construction works going on in the city.

Statistical analysis revealed significant monthly variation in pollutant concentrations in the ambient air of Rewa city. Higher concentrations of SPM, RSPM, SO_2 and NOx have been observed during January and February months, moderate during March, April and May months and low during June month. This variation in pollutant concentrations during different months under present study may be attributed to variation in wind velocity, temperature, relative humidity as well as periodic rainfall. Almost similar pattern of seasonal variation of pollutant concentrations has been observed by previous workers (Ravindra et al., 2003, 2007; Shukla et al., 2010; Nair et al., 2014; Kanawade et al., 2014; Mishra and Shrivastava, 2017).

During January and February month accumulation of certain pollutants is because of its cool and calm conditions. During that time there is increased atmospheric stability, which in turn allows for less general circulation and thus more stagnant air masses. It prevents an upward movement of air, hence atmospheric mixing is retarded and pollutants are trapped near the ground. During June month results in large amount of precipitation and increased humidity, while rain became responsible for the 'washing off' of ambient air pollutants, leading to lower concentrations. A previous study showed that precipitation can effectively scavenge particles either smaller than 30 nm or larger than 400 nm (Laakso et al. 2003). All parameters showed a clear monthly variation with the maximum concentration in winter and lower during the monsoon, which is consistent with a previous study at the semi-urban site in India (Hyrarinen et al., 2010).

Low humidity and high wind speed facilitate concentration of pollutants in the atmosphere during March, April and May months. The summer season of this region is characterized by strong wind speed, maximum temperature, low humidity and occasional showers. The strong wind speed might have carried away the pollutants to long distances and prevented them, specially the SPM from settling down to the ground. This might have resulted the moderate concentrations of pollutants during these months.

Ambient air quality monitoring results show that high concentrations of pollutants were observed at Transport Nagar, Prakash chowk and Old Bus stand and moderate at Jaistambh and Civil lines in comparison to control site (University Campus).

V.   CONCLUSION

Ambient air pollution is something that we cannot absolutely ignore in present time.Ambient air pollution mainly generates from the anthropogenic clutters that are general sources of ambient air pollution, includes using of fuels from vehicles. Industrialization, factorial facilities, municipal waste burning and lighting with polluting fuels also includes as the ambient air pollution. Ambient air pollution creates various types of health risks. The health impact range from increased hospital and emergency room meeting to enhanced risk of untimely death. From the above study, it was observed that pollution by particulates are mainly responsible for ambient air pollution in Rewa city primarily caused by vehicular emissions

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