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Assessment of Total Suspended Particles and Particulate Matter in different sites of Jabalpur City

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Abstract - *Rapid urbanization and growth of motor vehicles impose a serious effect on human life and its environment in recent years. The purpose of the study was to investigate the level of air pollutants in Jabalpur city from 21Nov to 29Nov 2017. Vehicle count and air quality was analyzed. This has been determined by collecting the samples (both air pollution and traffic data) from different squares of Jabalpur city. Four sampling sites were selected are as follows: 1.Shastri Bridge Square (Bloomchowk), 2.Ranitaal Square, 3.DamohNaka Square, and 4.Collectorate Square. The samples were analysed for various parameters of air pollution are TSP (Total Suspended Particles) and Particulate Matter (PM2.5, PM10).* TSP and *PM concentrations were significantly higher than the CPCB recommended levels. It is necessary to control emissions from vehicular exhaust to reduce the level of pollutants in the ambient air in urban areas.*

***Key Words*: Pollutants TSP, PM2.5, PM10, Morning, Afternoon, Evening, Air quality;**

1. INTRODUCTION

In current scenario the air quality remains one of the major environmental issues in modern society (Tiwary & Colls, 2010). Air pollution is a major issue around the world, which affects not only climate change but also people's health. The air we breathe is an essential ingredient for our wellbeing and a healthy life. Unfortunately polluted air is common throughout the world (EPHA, 2009). India is the one of the largest developing country and its economic expansion over the past decades has been one of the strongest in the world history. Such an economic expansion increases uses of fossil fuels and automobile emissions.

India has made rapid strides in industrialization, and it is one of the ten most industrialized nations of the world. Particulate pollutants have major negative impacts on climate and health. They also play significant role in environmental changes. Rise in number and types of vehicles along with lack of smooth traffic flow due to congested and narrow roads results in frequent traffic jams. The respirable particulate matter and fine particulate matter are of more concern from public health point of view (Rajesekhar et al, 2001). These particle of smaller size, particularly of 1 m cause health hazards as these are most liable to enter the respiratory tract and get lodged in the air spaces of lungs. Thus, it is necessary to evaluate the status of suspended particulate matters in the existing air quality of any area for the better management practices. An attempt have been made in the present study to evaluate the status of suspended particulate matter (SPM) in the city of Jabalpur and some strategies for controlling air pollution have also been discussed.

2. Materials and Methods

A detailed study was carried out to collect baseline information related to various work done on the subject, methodology used and what were their observations. It includes review of books, journal, website, and magazines to understand the present status of work on traffic related air pollution and air quality and their relation. This step provided framework and basic knowledge for further research.

2.1 Sampling site

Jabalpur is located in central part of India. It is situated at 23°9′38″N 79°56′19″E. Atmosphere of Jabalpur is affected by emissions from vehicle exhaust, factory, particulate matter and moderate concentrations of surface ozone that predominantly arise during the summers have been shown to be detrimental to human health and destructive to vegetation (NRC, 1991). In this study, the status of ambient air quality due to the presence of different pollutants in the environment of Jabalpur is monitored.

3. Methodology

Pollutants under study include Total Suspended Particles (TSP) and Particulate Matter (PM10, PM2.5). To quantify SPM emissions and to study the ambient air pollution due to vehicular emissions, four traffic crossings (Shastri Bridge Square, Ranitaal Square, DamohNaka Square, and Collectorate Square) have been identified after a thorough survey of the city. The potential sources of these air pollutants in Jabalpur are vehicular traffic, diesel generator sets, and household construction activities. TSP, PM10, PM2.5 were measured at different sites from morning to evening (6:00 am to 10:00 pm).

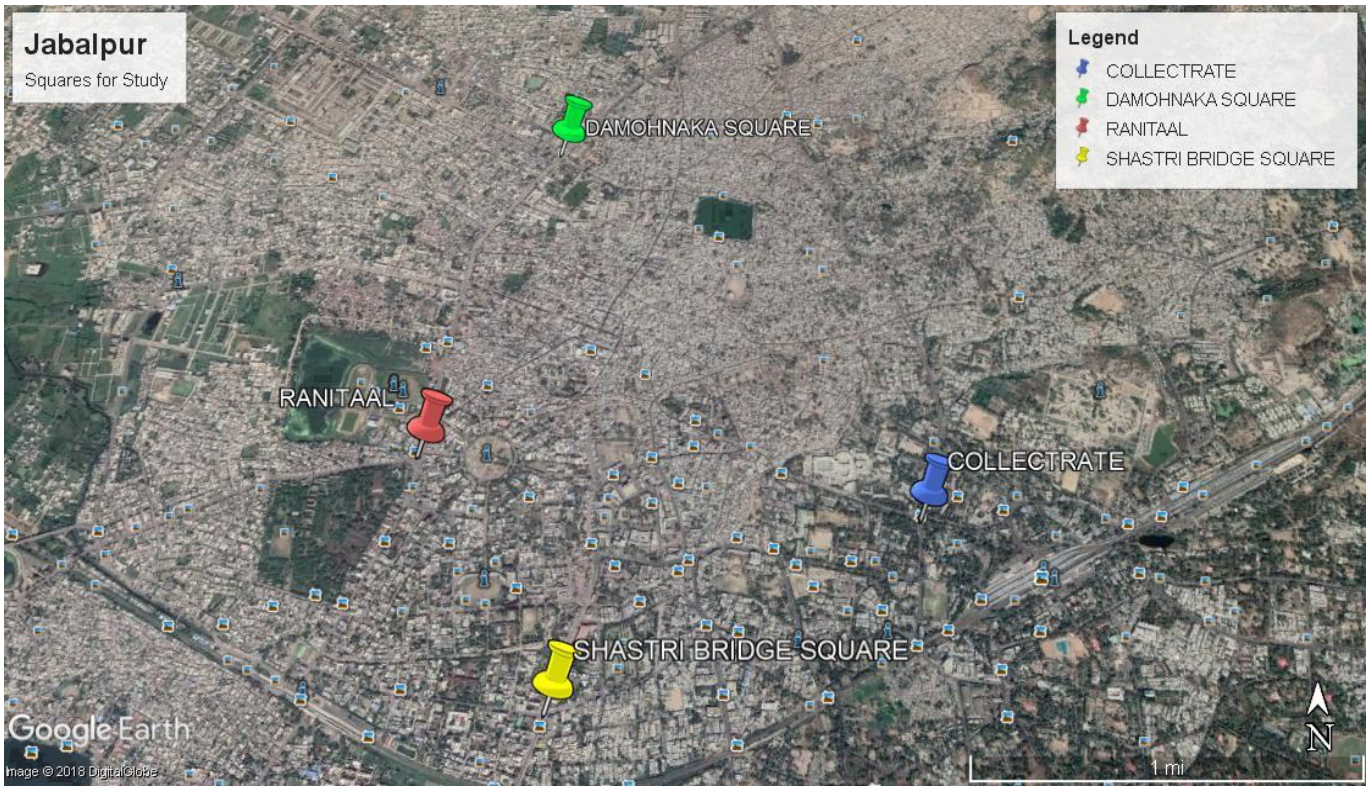

Fig -1: Map of the study area

For the collection of samples of total suspended particles (TSP) and particulate matter (PM10, PM2.5) in selected sites were monitored by the instrument Aerocet 831 (aerosol mass monitor) digital Monitor. The air monitoring was done on working days excluding Sunday and local holidays in good climatic conditions in order to get consistent results. For further analysis whole portion of day time is divided into different portion of day time as morning, afternoon and evening according to different time duration. These classifications are done as follows:

- MORNING - 6am to 12am
- AFTERNOON - 12am to 6pm
- EVENING - 6pm to 10pm

4. RESULTS AND DISCUSSION

The air monitoring samples were analyzed during different portion of day i.e. morning, evening and afternoon.

- MORNING – Study time taken between 6 am to 12 am.

The average concentration values of the pollutants particulate matter for the months of November 2017 have been plotted in graphs for the four sites of Jabalpur. It is that portion of the day in which generally schools of Jabalpur opens, people go to their workplace or engage in their business activities.

The average concentration of PM2.5 were found to be 111.11(μg/m³), 133.16(μg/m³), 174.19(μg/m³) and 83.42(μg/m³) respectively, values of all the monitoring stations were above the permissible limit 60μg/m³ declared by revised NAAQS, CPCB 2009-10. The average concentration of PM10 were found to be 472.65(μg/m³), 926.46(μg/m³), 1371.47(μg/m³) and 600.81(μg/m³) respectively, values of all the monitoring stations were above the permissible limit 100μg/m³ declared by revised NAAQS, CPCB 2009-10. The average concentration of TSP were found to be 573.36(μg/m³), 1869.28(μg/m³), 1259.76(μg/m³) and 816.46(μg/m³) respectively, values of all the monitoring stations were above the permissible limit 360μg/m³ declared by revised NAAQS, CPCB 2009-10. The highest PM2.5 concentration was in DamohNaka Square about 2 times more than that of permissible limit. The highest PM10 concentration was in DamohNaka Square about 12 times more than that of permissible limit. The highest TSP concentration was in Ranital Square about 4 times more than that of permissible limit. So among overall parameters, polluted square was Ranital Square in all squares of Jabalpur during morning.

- AFTERNOON - Study time taken between 12am to 6pm.

It is that portion of the day in which generally closing of schools happens. During this time lunch has to be held for the Peoples who are in their workplace and business activities and also the closing of colleges and educational institutes. The average concentration of PM2.5 were found to be 164.95(μg/m³), 88.84(μg/m³), 78.75(μg/m³) and 58.65(μg/m³) respectively, values of all the monitoring stations were above the permissible limit 60μg/m³, except the Collectorate square which is under the permissible limit declared by revised NAAQS, CPCB 2009-10. The average concentration of PM10 were found to be 557.13(μg/m³), 816.21(μg/m³), 901.00(μg/m³) and 585.80(μg/m³) respectively, values of all the monitoring stations were above the permissible limit 100μg/m3 declared by revised NAAQS, CPCB 2009-10. The average concentration of TSP were found to be 687.45(μg/m³), 1278.36(μg/m³), 1148.96(μg/m³) and 817.75(μg/m³) respectively, values of all the monitoring stations were above the permissible limit 360μg/m³ declared by revised NAAQS, CPCB 2009-10. The highest PM2.5 concentration was in ShastriBridge Square and the highest PM10 concentration was in Damohnaka Square about 9 times more than that of permissible limit. The highest TSP concentration was in Ranital Square about 3 times more than that of permissible limit. So among overall parameters, polluted square was DamohNaka Square in all squares of Jabalpur during afternoon.

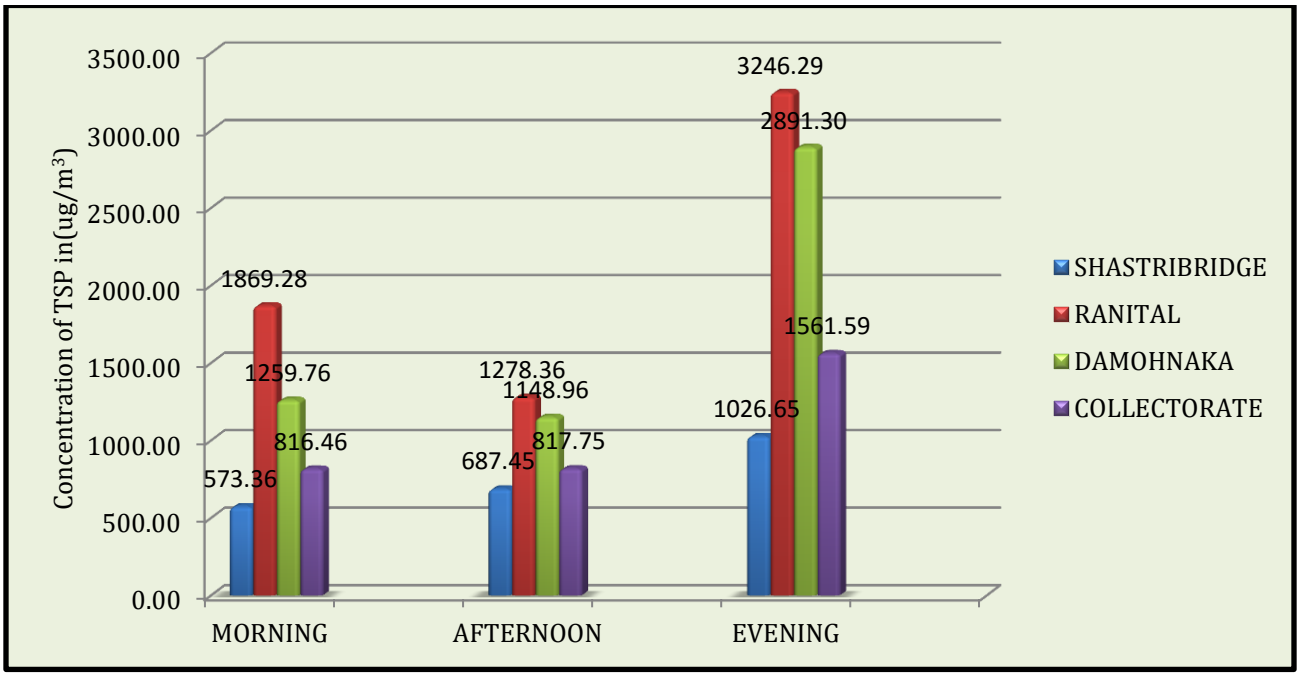

Chart -1: Variations of TSP (μg/m³) Contents at Different Sites of Study Area

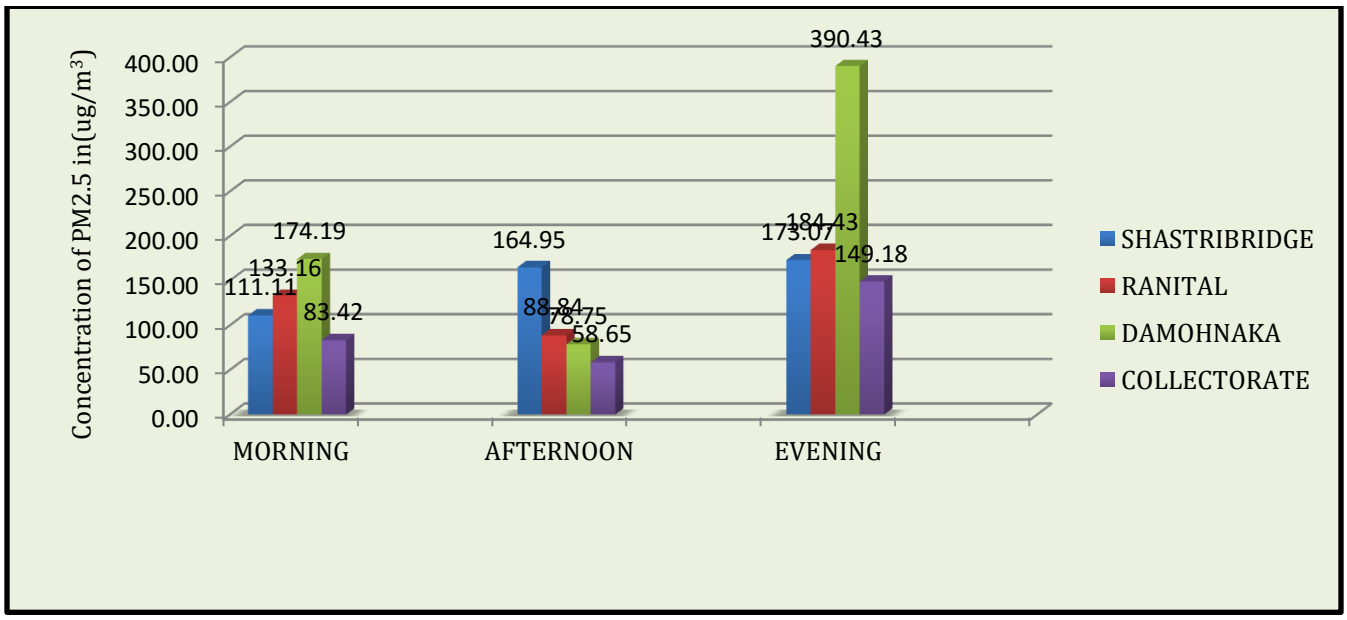

Chart -2: Variations of PM2.5 (µg/m³) Contents at Different Sites of Study Area

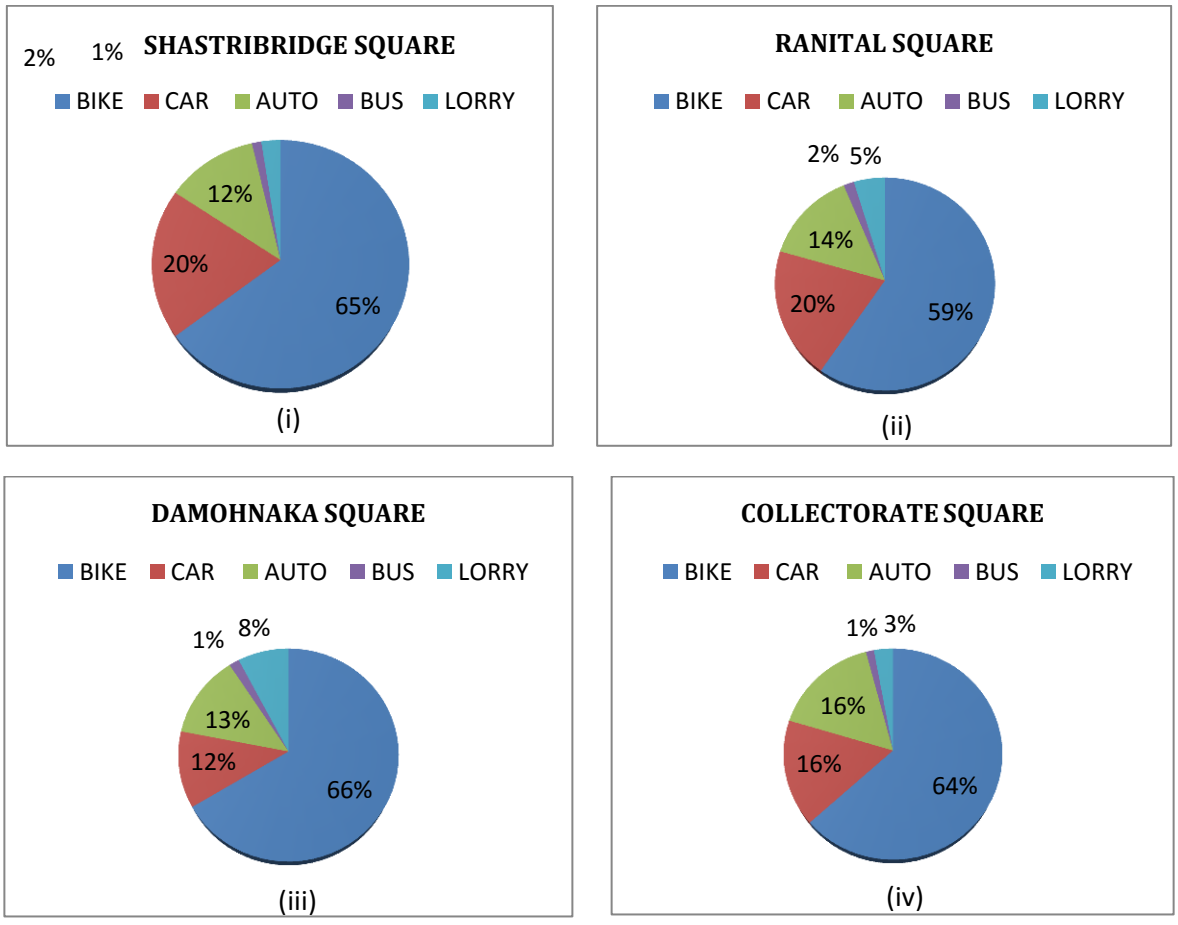

Chart -3: The above graphs (i), (ii), (iii) and (iv) shows the total vehicle density during the sampling time at different sites of Study Area

- EVENING - Study time taken between 6pm to 10pm.

It is that portion of the day in which generally closing of offices happens. It is very important duration of day as far as commercial activity in Jabalpur is considered on normal working days. The average concentration of PM2.5 were found to be 173.07(µg/m³), 184.43(µg/m³), 390.43(µg/m³) and 149.18(µg/m³) respectively, values of all the monitoring stations were above the permissible limit 60µg/m3 declared by revised NAAQS, CPCB 2009-10. The average concentration of PM10 were found to be 816.79(µg/m³), 2109.70(µg/m³), 2556.02(µg/m³) and 1208.28(µg/m³) respectively, values of all the monitoring stations were above the permissible limit 100µg/m³ declared by revised NAAQS, CPCB 2009-10. The average concentration of TSP were found to be 1026.65(µg/m³), 3246.29(µg/m³), 2891.30(µg/m³) and 1561.59(µg/m³) respectively, values of all the monitoring stations were above the permissible limit 360µg/m³ declared by revised NAAQS, CPCB 2009-10. The highest PM2.5 concentration was in DamohNaka Square about 5 times more than that of permissible limit. The highest PM10 concentration was in DamohNaka Square about 24 times more than that of permissible limit. The highest TSP concentration was in Ranital Square about 8 times more than that of permissible limit. So among overall parameters, polluted square was DamohNaka Square in all squares of Jabalpur during evening.

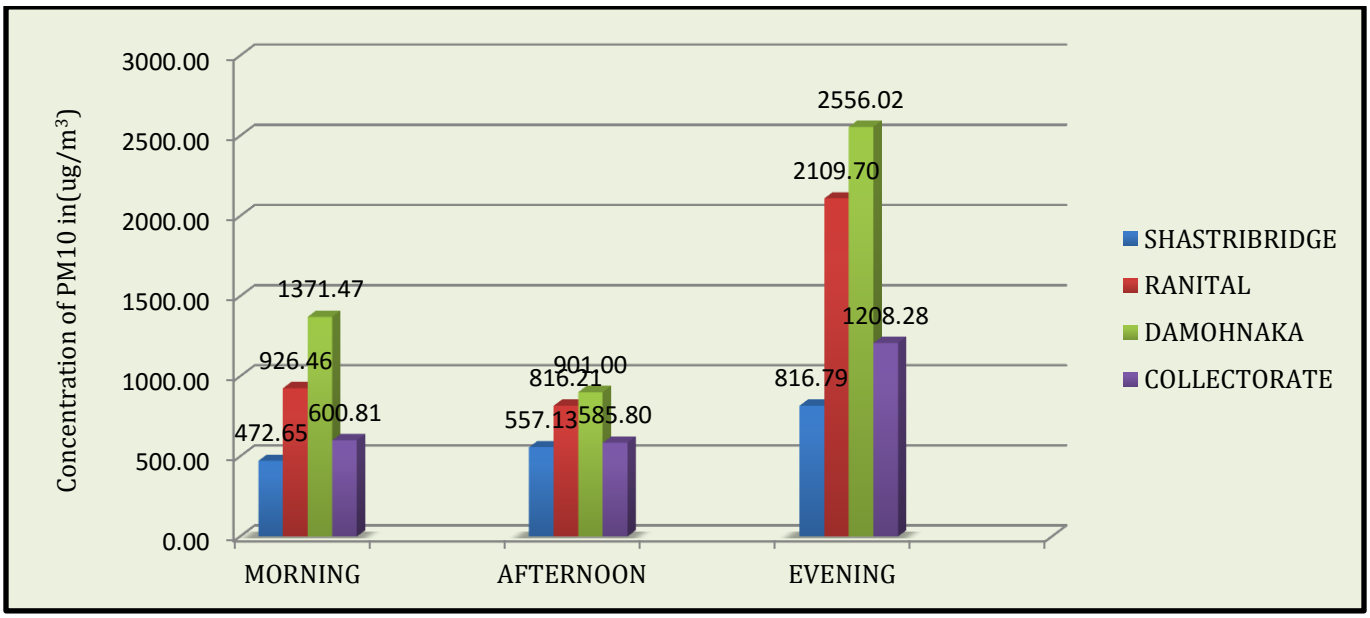

Chart -4: Variations of PM10 (µg/m³) Contents at Different Sites of Study Area

5. CONCLUSION

From the above mentioned graph (Chart -1), it is observed that TSP conc. was found to be maximum during different portion of day (i.e. morning, evening and afternoon) at Ranital Square in comparison to all other sites. Ranital Square is the high traffic zone with the highest concentration of TSP. This is due to stagnant traffic, vehicular exhaust, road digging, etc.

From the above mentioned graph (Chart 2 and 4), it is observed that PM2.5 and PM10 conc. were found to be maximum during different portion of day (i.e. morning, evening and afternoon) at DamohNaka Square in comparison to all other sites. Only the PM2.5 concentration was found to be maximum in afternoon at ShastriBridge Square. This is due to the heavy traffic, vehicular exhaust, sand along the sides of the roads, which is dusty in nature, is not removed periodically etc. From the study it can be concluded that in afternoon conc. of all the pollutants was low due to less traffic, dust.

By this study it can be concluded that ambient air monitoring has become an important topic for research. All the selected sites are commonly showing the highest concentration of the pollutants within the city- the reason being the growing number of automobiles and poorly and congested roads. Poorly maintained auto rickshaws are also the main cause of pollutants. This can be reduced by properly maintained and eco-friendly mass transportation system. To control vehicle emission, regular checking for fitness and up gradation of fuel quality and tightening of vehicle emission regulations should be adopted. Public transport system must be improve and phasing out of grossly polluting commercial vehicle.

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