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# Assessment of Ambient Air Pollutant at Malviya Industrial Area over Jaipur, India

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## Abstract

*The present study reported the concentration of air pollutants ($PM_{10}$, SPM, $NO_2$, $SO_2$) at Malviya Industrial Area (MIA) over Jaipur during 2014. The diurnal and seasonal average of $PM_{10}$, SPM, $NO_2$, $SO_2$ has been determined from RSPCB air pollution datasets for the year 2014. The value of $PM_{10}$ and SPM shows the high variability at MIA during the study period. The daily mean concentration of SPM, $PM_{10}$, $NO_2$ and $SO_2$ ranged from $4.5\times10^1$ µg/m$^3$ to $4.82\times10^2$ µg/m$^3$, $2.4\times10^1$ µg/m$^3$ to $3.55\times10^2$ µg/m$^3$, 8.06 µg/m$^3$ to $5.54\times10^1$ µg/m$^3$ and 4.06 µg/m$^3$ to 9.31µg/m$^3$, respectively during the study period. The seasonal characteristic of air pollutant during different seasons of the year 2014 is also investigated. The concentration of $PM_{10}$ is found highest ($1.54\times10^2 \pm 4.76\times10^1$ µg/m$^3$) and lowest ($6.81\times10^1 \pm 2.97\times10^1$ µg/m$^3$) during winter and monsoon season, respectively.*

**Keywords:** MIA, SPM, $PM_{10}$, $NO_2$, $SO_2$.

## Introduction

In the present scenario, the air quality of urban areas is deteriorating day by day. The rapid and unsystematic urbanization and industrialization become a main environmental concern for developed as well as for developing countries. The short term variations of air pollutant are responsible for deficits in pulmonary functions, cardiovascular disease, neurobehavioral effects, morbidity and mortality[1,2]. The every increase in the concentration of fine particulate the air pollution was associated with approximately a 6%, and 8% increased the risk of cardiopulmonary and lung cancer mortality, respectively[3]. The air quality concern becomes the major issue in most of the Indian cities. The air quality of Jaipur is deteriorating day by day due to increase in a number of vehicles on roads, fast urbanization, and industrialization and reached at the alarming condition[4, 5]. The numbers of registered vehicles which are running on roads are increasing very fast. The registered vehicles are increasing 8-10 % annually in Jaipur (Transport Department, Rajasthan Government). The previous studies reveal that the anthropogenic emission from motor vehicle produces more air pollutants than any other single human activity. The major anthropogenic sources of air pollutants are industrial emissions, domestic fuel burning, emissions from power plants and transportation activities. The anthropogenic airborne particles like smoke, smog, bio mass burning, vehicular emission etc. come from four source categories: transportation sources (e.g. automobiles), industrial processes, fuel combustion and nonindustrial fugitive sources (e.g. construction work). The two-wheelers are the major vehicle mode in Jaipur city and its share in total number of registered vehicles is about 70 per cent, followed by four-wheelers, which constitute about 20 percent, and buses constitute less than one percent of the total registered vehicles in Jaipur city during 2014-15 (RTO, Jaipur). The measurement of air pollutant over Jaipur is important than any other location in North western India due to its location downward to the Thar Desert. The various studies were carried out on ambient aerosol particles and its composition in Jaipur[6-8].

Therefore, the measurement of air pollutant over an urban area is crucial for understanding its concentration and its effect on a human being. The Government of India initiated the National Ambient Air Quality Monitoring Programme (NAAQM) for monitoring the air pollutant over different locations in India. The monitoring of air pollutant is useful to report the air quality of particular location[9]. The present work gives a detailed analysis of the diurnal and seasonal features of air pollutant over Malviya Industrial Area in Jaipur during January to December, 2014. The results obtained from the observations are discussed in consecutive sections.

## Materials and Methods

**Study Area:** Malviya Industrial Area (26.85, 75.82) is situated in the eastern side of Jaipur city. There are many industries and educational institute situated in Malviya Industrial Area (MIA). The Rajasthan State Pollution Control Board (RSPCB) continuously measured the air pollutant at 6 sites in Jaipur i.e. Ajmeri Gate, Boards office Jhalana Dungri, Chandpole (CP), Malviya Industrial Area(MIA) RIICO Office, RO Vidhyadhar

Nagar (N), Vishwakarma Industrial Area (VKIA). The MIA is one of the six sites where the continuous measurement of air pollutant is going on. Jaipur is the capital of the biggest state of India 'Rajasthan' and known as Pink City.

**Synoptic Meteorology:** Jaipur experiences a semi-arid climate with medium rainfall (~65 cm). The ambient meteorological parameters obtained from the wunderground site for 2014[10]. The rainfall values are taken from Department of Water Resource, Government of Rajasthan[11]. The meteorological parameters are presented in Figure-1. The average temperatures were high during the summer season in April through June with an average monthly value ranging from 31°C to 37°C. The highest average relative humidity (RH) took place in August (rainy season). RH exhibits two maxima, one during monsoon and other is observed in January (in winter). The highest difference between the maximum and minimum RH took place during the pre-monsoon season due to the high diurnal variation of the temperature. The wind speeds generally follows the temperature trend over the location[12].

## Results and Discussion

The present study analyses the air pollutant concentration (SPM, $PM_{10}$, $NO_2$, $SO_2$) at Malviya Industrial Area (MIA) of Jaipur. The main focus of this work is to analyze the air pollutant concentration at the industrial area during January to December, 2014. This study presents the analysis of air pollutant during the study period.

**Diurnal and Seasonal variation of air pollutant over Malviya Industrial Area (MIA): Diurnal variation of air pollutant over Malviya Industrial Area (MIA) during 2014:** The diurnal concentration of SPM, $PM_{10}$, $NO_2$ and $SO_2$ shows the high variability over the study location. The daily variation in concentration of SPM, $PM_{10}$, $NO_2$ and $SO_2$ at MIA is shown in Fig. 2. The daily mean concentration ranged from $4.5\times10^1$ $\mu g/m^3$ to $4.82\times10^2$ $\mu g/m^3$, $2.4\times10^1$ $\mu g/m^3$ to $3.55\times10^2$ $\mu g/m^3$, 8.06 $\mu g/m^3$ to $5.54\times10^1$ $\mu g/m^3$ and 4.06 $\mu g/m^3$ to 9.31$\mu g/m^3$, respectively during the study period. Further, it was observed that the average value of these pollutants were $2.06\times10^2\pm8.32\times10^1$ $\mu g/m^3$, $1.04\times10^2\pm5.4\times10^1$ $\mu g/m^3$, $3.77\times10^1$ $\pm9.70$ $\mu g/m^3$ and $6.52\pm1.17$ $\mu g/m^3$, respectively during January to December, 2014. The SPM and $PM_{10}$ show the high variability over the study location. The value of $PM_{10}$ was seen to exceed the permissible limit (100 $\mu g/m^3$) which ultimately causes various health problems for human beings. The value of $NO_2$ and $SO_2$ were below the permissible limit but the value of SPM was very high at the monitoring sites among all four pollutants. The minimum value of $PM_{10}$ and SPM was found during the rainy season (03 September) while the maximum value was found during 26 February and 10 May, respectively.

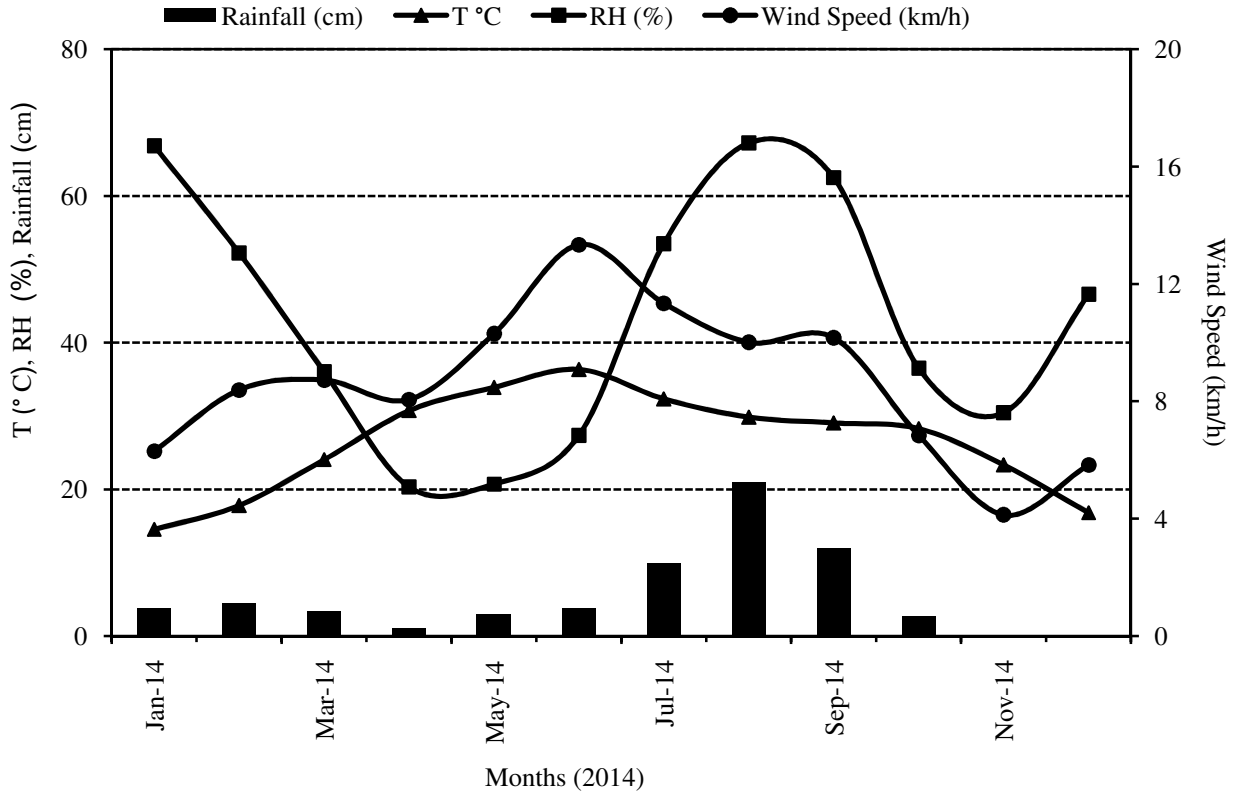


**Figure-1**
**Synoptic meteorology of Jaipur**

**Monthly variation of air pollutant at Malviya Industrial Area (MIA):** The variability of the monthly average of air pollutant over MIA from January 2014 to December 2014 has been shown in Figure-3. The monthly average of air pollutant shows the high variability over the study location. Monthly mean is computed using the daily averages available for the respective month.

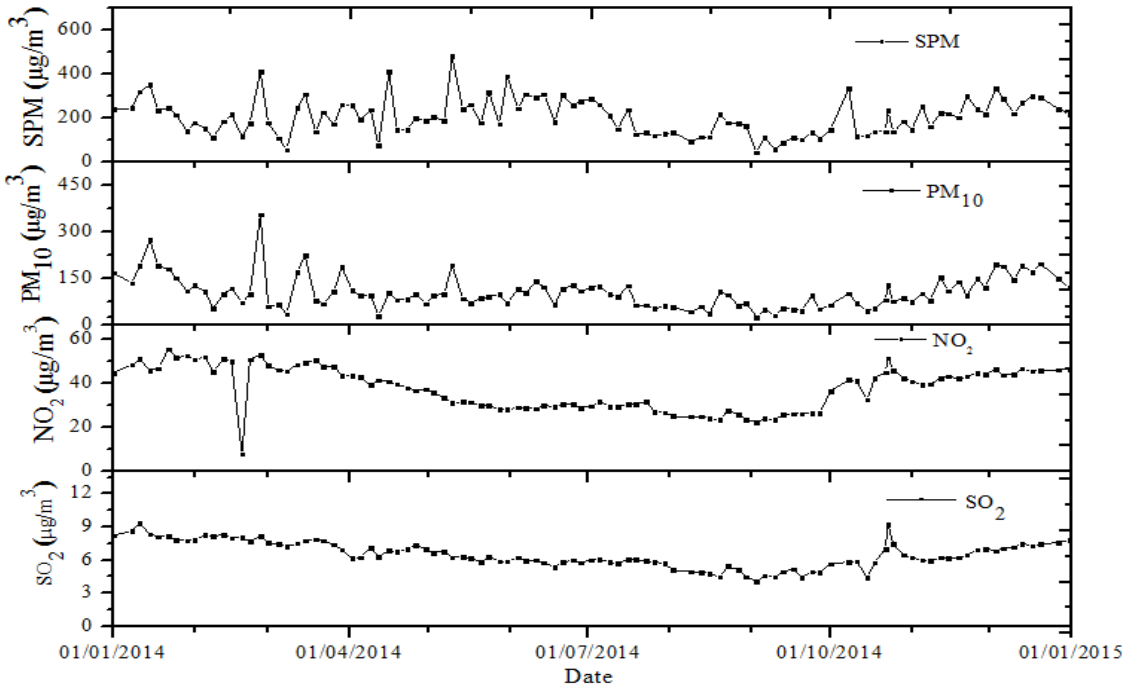


**Figure-2**
**Daily variation of air pollutant at Malviya Industrial Area during 2014**

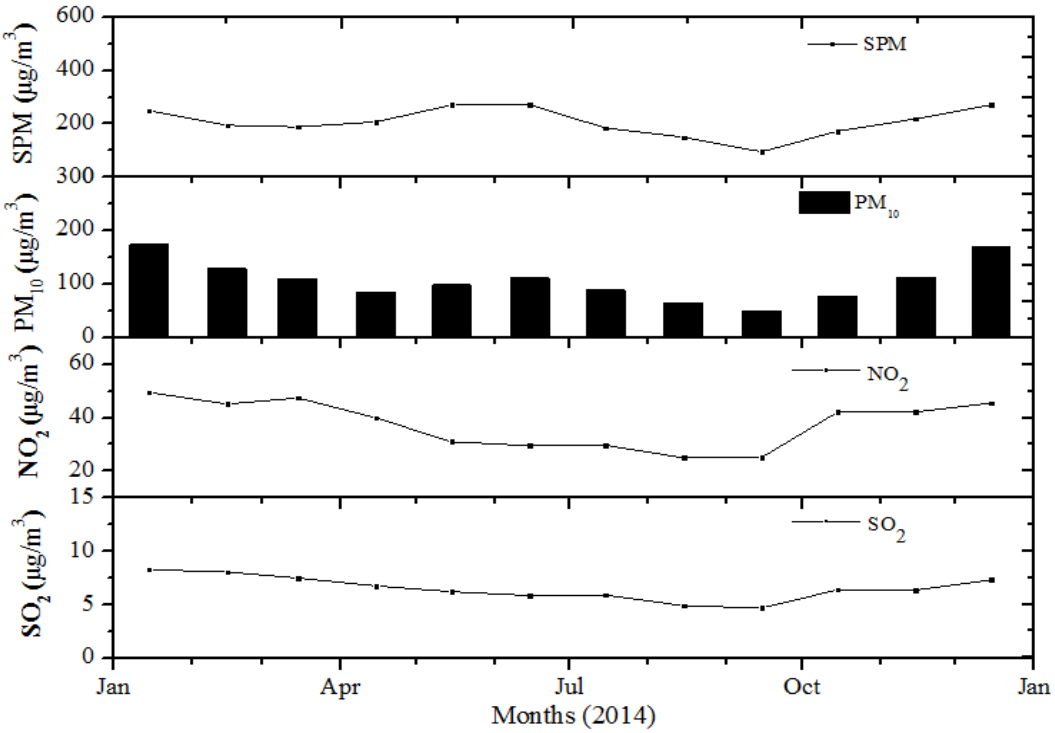


**Figure-3**
**Monthly variation of air pollutant at Malviya Industrial Area during 2014**

The concentration of $PM_{10}$ and SPM varies between $4.9\times10^1$ µg/m$^3$ to $1.74\times10^2$ µg/m$^3$and $9.6\times10^1$ µg/m$^3$ to $2.72\times10^2$ µg/m$^3$ respectively. The average concentration of $PM_{10}$ was found lowest and highest in the month of September and January, respectively. The monthly average concentration of SPM was found maximum and minimum during September and June, respectively. The monthly value of $NO_2$ and $SO_2$ concentration were well below the standard limit. It ranged from $2.50\times10^1$ µg/m$^3$ to $4.95\times10^1$ µg/m$^3$ and 4.69 µg/m$^3$ to 8.29 µg/m$^3$, respectively. The average concentration of $NO_2$ and $SO_2$ was found the maximum in January month.

**Seasonal variation of air pollutant at Malviya Industrial Area (MIA):** The seasonal characteristics of air pollutant during different seasons of the year 2014 has been shown in figure 4. Figure 4 shows that the value of $PM_{10}$ is found highest ($1.54\times10^2$ $\pm4.76\times10^1$ µg/m$^3$) and lowest ($6.81\times10^1\pm2.97\times10^1$ µg/m$^3$) during winter and monsoon season, respectively. The lowest concentration of $PM_{10}$ and SPM was found during monsoon season due to washing out of air pollutant by rain. This figure also shows the seasonal behaviour of $NO_2$ and $SO_2$with higher concentration in winter and lower during monsoon season. The higher value of $PM_{10}$, $NO_2$, $SO_2$ during winter season may due to stable atmospheric condition.

The seasonal variation of the air pollutant shows the high variability over the study location. The high concentration of air pollutant during winter may due to local emission.

## Conclusion

The present study reported the daily, monthly and seasonal concentration of air pollutant at Malviya Industrial Area during January to December, 2014. The concentration of $PM_{10}$ and SPM shows the high variability at MIA. The $PM_{10}$ values were found higher than the standard value (100 µg/m$^3$) for about 46 % of observations, on the other hand, $NO_2$ and $SO_2$ are under the standard value (80 µg/m$^3$) at Malviya Industrial Area during 2014.

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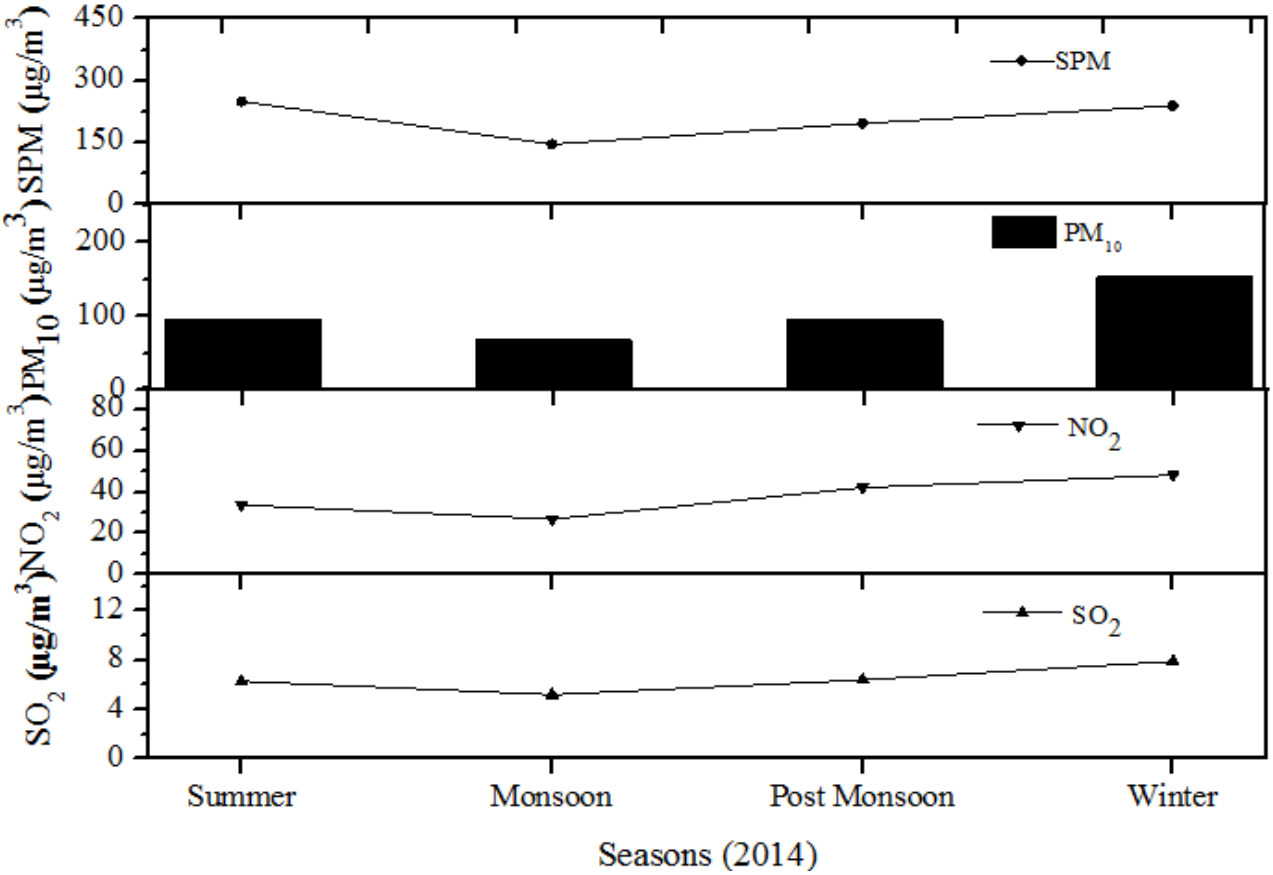


**Figure-4**
**Seasonal variation of air pollutant at MIA**

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