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STUDY OF VEHICULAR AIR POLLUTION – A CASE STUDY OF DELHI

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ABSTRACT

This research is focus on how the concentration of five pollutant i.e. NO_2, NO, 0_3, PM_{10}, $PM_{2.5}$ changes in the absence and presence of vehicle during the 24 hour a day and diurnal variation taking R K Puram location in Delhi from Jan to Dec 2014. A correlation test also performs between NO_x and O_x. Statistical analysis shows that during day wise variation of O_3 and NO_2, the concentration build up is high on Sunday as compared to other days whereas in particulate matter the concentration is high on Thursday. Diurnal variation of NO_2 and O_3 shows that the concentration of O_3 is high between 8:00am to 18:00 pm and for No_2 it is high from 16:00pm to 1:00am and crosses the permissible limit. On monthly basis NO_x value is high during summer season due to high solar insulations and O_3 value is high on summer season, the concentration of $PM_{2.5}$ and PM_{10} is found maximum in November. NO_X and O_X is generated mostly by vehicular emission and therefore on daily average, it can be stated that vehicular emission contributes 59% of NO_x of the O_x.

KEYWORDS: Diurnal, NO2, NO, 03, PM10, PM2.5, etc.

INTRODUCTION

The capital of India Delhi attracts population from different states, due to which the urbanization is expanding at rapid rate and made Delhi rank 13 amongst top city with higher number of population density which is 11050 people per sqkm. With the increase in the population, the quantity of vehicle is also increasing which causes air pollution and it exceeds the limit of air quality index.

Particles can come in almost any shape or size, and can be solid particles or liquid droplets. We divide particles into two major groups. These groups differ in many ways. One of the differences is size, we call the bigger particles PM10 and we call the smaller particle PM 2.5.

BIG: The big particles are between 2.5 and 10 micrometers (from about 25 to 100 times thinner than a human hair). These particles are called PM10 (we say "P M ten", which stands for Particulate Matter up to 10 micrometers in size). These particles cause less severe health effects.

SMALL: The small particles are smaller than 2.5 micrometers (100 times thinner than a human hair). These particles are called PM 2.5 (we say "P M two point five", as in particulate matter up to 2.5 micrometers in size).

The smaller particles are lighter and they stay in the air longer and travel farther. PM10 (big) particles can stay in the air for minutes or hours while PM2.5 (small) particles can stay in the air for days or weeks. And travel? PM10 particles can travel as little as a hundred yards or as much as 30 miles. PM2.5 particles go even farther; may hundreds of miles.

LITERATURE SURVEY

The method for sampling of particulate pollutants is based on the size of the particulates to be sampled. Suspended particulate matter (SPM) and Respirable suspended particulate matter (RSPM) were analyzed using Respirable Dust Sampler (RDS) APM 460 and operated at an average flow rate of 1.0-1.5 m^3 min-1. Pre-weighted glass fibers filter paper (GF/A) of whatman and cup were used as per standard methods. The Respirable particulate matter (RSPM) was collected on glass fiber filter paper and suspended particulate matter was collected by gravity settling method. Samples

were collected continuously for 48 hrs. every week at 1-hourly intervals. The sampling and analysis method was followed in accordance to USEPA Method.

NOx were measured with help of RDS APM 460 with gaseous attachment APM 411 by sucking air into appropriate reagent for 48 hrs. every week at 1-hourly intervals and after air monitoring it procured into lab and analysis for the concentration level. NOx were collected by bubbling the sample in a specific absorbing sodium hydroxide for NOx solution at an average flow rate of 0.2-0.5 min-1. The impinger samples were put in ice boxes immediately after sampling and transferred to a refrigerator until analyzed. The concentration of NOx was measured with standard method of Modified Jacob- Hochheiser method (1958).

Ozone contained air sample is scrubbed counter recurrently in a wetted wall absorbed by a 2 % solution of buffered, neutral potassium iodide in water. The yellow color of the solution is measured photometrically and recorded continuously on strip chart recorded.

DATA ANALYSIS

The purpose of this part is to present the result of the research data analysis and present the result answering each of the research Question about vehicular air pollutants, explained along with the statistical procedures utilized. What computer technology can now facilitate in term of data input, analysis and output was once prohibitive because of the required human effort.

Statistical analysis was carried out using open source software 'R' version 3.1. Particulate Matter data was analyzed for performing ANOVA to predict statistical significance of monthly variation in concentration of particulate matter.

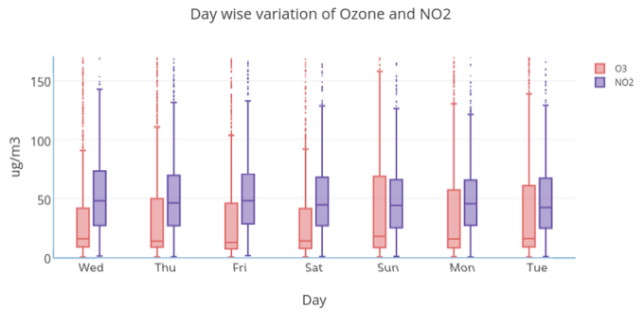

Fig -1: Day wise variation of O_3 and NO_2

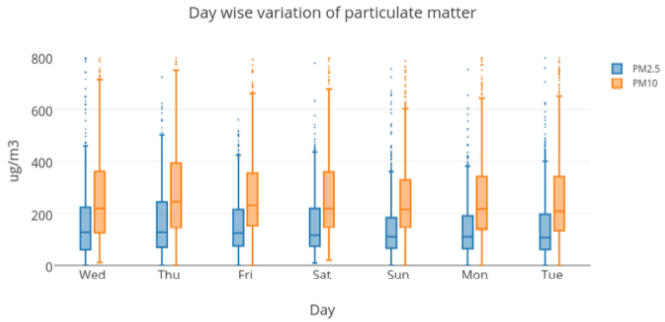

Fig -2: Day wise variation of Particulate matter

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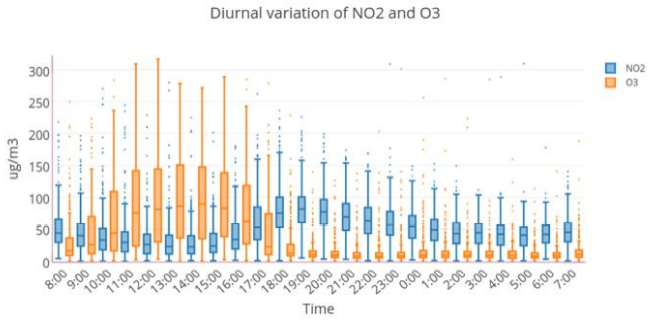

Fig -3: Diurnal variation of NO_2 and NO_3

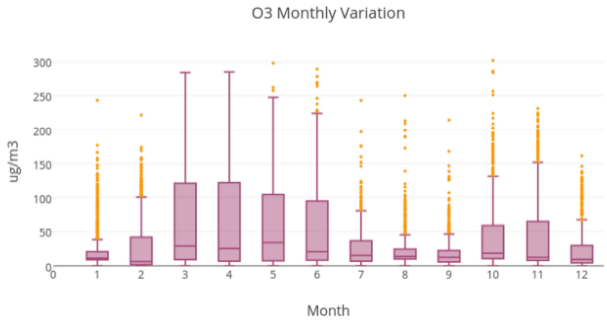

Fig -4: O_3 monthly variation

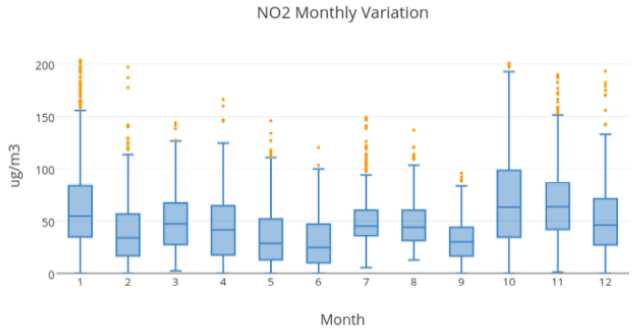

Fig - 5: NO_2 monthly variation

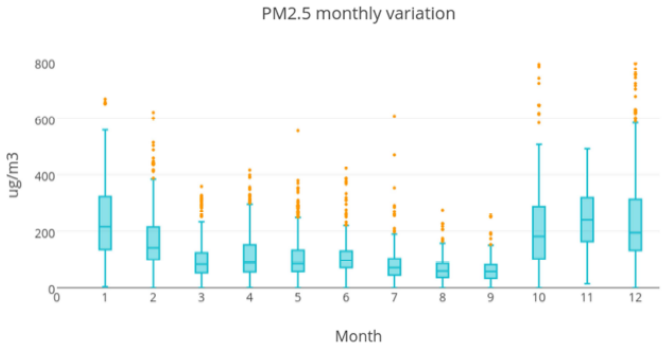

Fig -6: $PM_{2.5}$ monthly variation

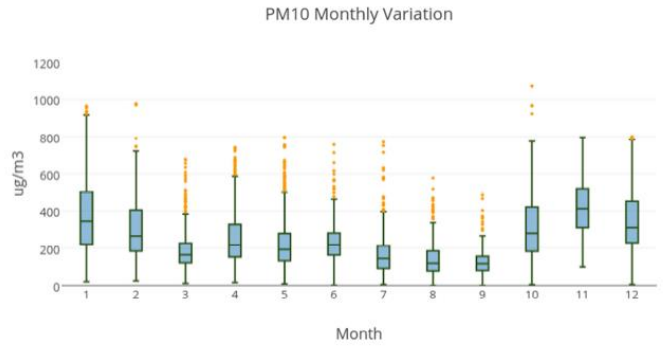

Fig -7: PM_{10} monthly variation

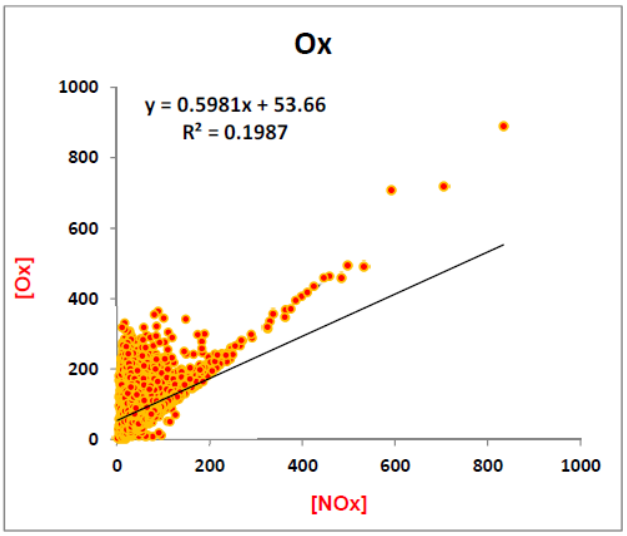

Fig -8: Relation between O_x and NO_x

CONCLUSION

The results and discussions by concluding the findings and making recommendation for possible further research.

Day wise variation
Ozone value is high on Sunday because of solar insulation, which converts NOx in to Ozone (Fig-1). NOx value is high on Friday due to 2 reasons, inversion phenomena and use of room heating devices that emits NOx (Fig-1).

PM10 and PM2.5 varies in a similar way on day basis (Fig-2). On Thursday, the concentration build up is high due to inversion phenomena leading to low mixing height.

Diurnal variation
Due to the large vehicle crowd starting from the morning the concentration of ozone is start increasing from 8am to 18 pm and after that it reduces dramatically from 18pm to 7am whereas in the case of NO_2, the case is different from the ozone, the concentration is high on 8 am and then decreases up to the 14pm and then increases from 16pm to 7am (Fig-3).

Monthly variation
During summer the concentration of the ozone (Fig-4) is found to be maximum, NO_2 (Fig-5) is high on October month whereas the $PM_{2.5}$ (Fig-6) and PM_{10} (Fig-7) shows increase in November.

Correlation between O_x and NO_x
In order to find the relationship between O_x and NO_X, a scatter plot of the two is created and is shown in (Fig. 8.) It is found that 59% of NO_x is O_x. Vehicular emission contributes 59% of NO_x of the O_x.

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