AJES
ASIAN JOURNAL OF ENVIRONMENTAL SCIENCE ■ VOLUME 7 | ISSUE 1 | JUNE, 2012 | 111-115

A CASE STUDY

Analysis of air pollutants by deducing mean, SD, frequency distribution of data and also predicting correlation between common gaseous exhausts and particulates

■ D. SARALA THAMBAVANI AND J. MAHESWARI

Article Chronicle :
Received :
15.12.2011;
Accepted :
10.04. 2012

SUMMARY: Urbanization and industrialization have resulted in rapid deterioration of India's air quality. In view of this, monitoring was conducted in Virudhunagar town which is known as trade centre of Tamil nadu. In this study area, three sampling points selected for the analysis were residential (Site1), heavy traffic (Site 2) and industrial area (Site 3). Air quality at different selected locations in study area was analyzed 24/8 hrs basis throughout the study period (Dec. 2010 to May 2011).Monthly average and standard deviation values were calculated for major air pollutants like, PM_{10}, $PM_{2..5}$, $SO_{x,}$ NOx and box plots showed the variation of pollutants among the sites about the mean value. Histogram also established for pollutants showed, frequency distribution for each pollutant. The correlation study of the gaseous pollutants (SO_x and NOx) with particulate pollutant PM_{10} was reported and the correlation of NOx with PM_{10} were found to be significant .From the average concentrations of PM_{10}, $PM_{2.5}$, SO_x, NOx in ambient air in Virudhunagar indicated probably that particulate matter such as PM_{10}, $PM_{2.5}$ in excess may cause irritation, throat infection and increasing allergy diseases.

HOW TO CITE THIS ARTICLE : Sarala Thambavani, D. and Maheswari, J. (2012). Analysis of air pollutants by deducing mean, SD, frequency distribution of data and also predicting correlation between common gaseous exhausts and particulates. *Asian J. Environ. Sci.,* **7** (1): 111-115.

Key Words :
$PM_{10,}$ $PM_{2.5,}$ $SO_{x,}$ NOx, Correlation, Air pollutants

Author for correspondence :
D. SARALA THAMBAVANI
Department of Chemistry, Sri Meenakshi Govt College for Women, MADURAI (T. N.) INDIA
E-mail: slp.aicrpam@gmail.com

See end of the article for **Coopted authors'**

Air pollution is the serious problem of our environment and threat to life and human health .Transportation is the major source of air pollutants in towns and cities. Among the various pollutants emitted from vehicles like NOx , $SO_{x,}$ suspended particulate matter (PM_{10}), respirable particulate matter ($PM_{2.5}$) were primary pollutants and are harmful to the living beings. Also, urbanization and industrialization lead to formation of oxides of sulphur and oxides of nitrogen. As a result of this, the quality of the environment gradually deteriorated .NOx and SO_x if present in excess in ambient air, affect the respiratory tract causing irritation and increasing air way resistance (Parida *et al.*, 2003).

Particulate matter has both natural and anthropogenic sources. Natural sources of primary particulate matter include windblown soil and material particles, volcanic dust, sea salt spray, biological materials such as pollen spores and bacteria and debris from forest fires. Wind blown agricultural soil and dust from roads, construction sites and quarrying operations all contribute particulate pollution .It may include a broad range of chemical species including elemental and organic carbon compounds ;oxides of silicon ,aluminum and trace metals ,sulphates ,nitrates and ammonia (Sharma and Pravez, 2003). Several investigators (Mohanty, 1998 and Schwartz, 1994) have studied the chemical composition of gaseous pollutants in different parts of India. Therefore reports on SO_X and NOx get associated with particulate matter.

Therefore, the objective of the present study was to characterize estimate and find out correlation of particulate matter with gaseous air

pollutant concentration in ambient air .Our present study area, Virudhunagar is a quiet town of moderate size in the district of Virudhunagar in Tamil Nadu state. It is well connected to Madurai and other places of Tamil Nadu through highways.

Selection of sampling stations :

Ambient air quality monitoring was conducted in three sampling stations in Virudhunagar town .The monitoring station and brief description of activities causing pollution are given in Table 1.

Table 1 : Ambient air monitoring stations in Virudhunagar town

Site No.	Location of the site	Type of the site
1.	Madura coats colony	Residential area
2.	Pavali	Traffic area
3.	Perali	Industrial area

Field study and instrumentation :

The period of measurement ranged from summer to summer. From the study locations, air samples were collected on the basis of 24 hours average and the samples were analyzed in the laboratory. The parameters monitored for ambient air quality were suspended particulate matter (PM_{10}), respirable particulate matter ($PM_{2.5}$), sulphur dioxide (SO_x), oxides of nitrogen (NOx) with the help of ambient fine dust sampler model APM-415 of envirotech with provisions for gaseous sampling. Particulate matters collected separately in a preweighed glass fibre filter paper on 24 hour average drawing air flow at 1.1m^3/min , SO_2 and NOx were measured by absorbing air on potassium tetra chloro mercurate and sodium hydroxide solution, respectively. SO_2 was determined by west Gaeke – spectrophotometric method and NOx was determined by Jacob hosch hieiser spectrophotometric method (Pope Ardeen *et al.*, 2002).

Data analysis :

Data obtained in this analysis were tabulated and used for descriptive statistical calculations like mean, average, minimum, maximum and standard deviation of the pollutants. The test of significance for correlation was performed by students 't'test and the correlation study between the parameters was done by graph method (Keeler *et al.*, 1990).

For statistical analysis, statistical packages like MAT-LAB, SPSS, and Microsoft EXCEL were used for box plots, histograms and correlation diagrams. All statistical significance tests were 2-tailed and the confident index set at 95 per cent, a level of P-value =0.05 to be statistically significant. Discriptive statistics were shown as mean and standard deviation.

National ambient air quality monitoring programme :

The nation wide programme was initiated in 1984 and the network distributed over 28 states and 7 union territories .The national work is operated through the respective State Pollution Control Boards, the National Environmental Engineering Research Institute (NEERI), Nagpur and also through the Central Pollution Control Board (CPCB).As Virudhunagar town was not coming under NAAQS regular monitoring programme, this work was carried out to analyze the air pollution in this area. For the air pollution control view of the area analyzed should be divided in to 3 categories residential, commercial and industrial (Sarath *et al.*, 2009).

Variability in pollutant concentration :

For comparison of distribution and concentration levels common air pollutants during the study period for different sites box plot was drawn (Fig. 1). Fig. 1(a) indicates that concentration of PM_{10} have higher values in site 2, which indicates that due to vehicular population, congestion, badly managed roads high traffic density. Fig. 1(b) indicates that, there was significant increase in the mean concentration level of PM 2.5 in the site 2 during the study period from June 2010 to May 2011.Particulates in the respirable ranges are responsible for most of the particle threats to human health because of their small size range (Gaikwal, 2004). The levels of RSPM (PM2.5) declined in the case of S_1 and S_3.In S_1 the distribution above the mean level was less in the case of S_1 than S_2 and site 3 has shown very least distribution of values. A different trend was seen in the case of SOx (Fig. 1(c)) which has shown very wide distribution at S_2. In Fig. 1(d) it was observed that wide range of distribution above the mean level was shown by almost all the selected sites and higher value was observed in S_2.

Frequency distribution of pollutants :

Atmospheric data generally presented as average concentrations and standard deviations assuming that concentrations data generally fit a systematic Gaussian distribution (Gaikead, 2004). Average and standard deviations of the concentration of pollutants and the frequency distribution of pollutants are given in Fig. 2. In Fig. 2(a) the ambient air concentration of PM_{10} was observed with the mean value of 106.6(µg/m^3) and SD=24.48 for S_1. And the values observed for site2 and site 3 were 291.2(µg/m^3) and SD=84.20, 189.4 (µg/m^3) and SD=5.20 for site 3. But in site 2 maximum mean and SD values were obtained for S_2 during the study period. Fig.1(b) provides some information about the behaviour of dataset $PM_{2.5}$.In order to understand the maximum frequency of pollutants analyzed were identified with the peaks observed in histograms (Fig. 2).The mean and standard deviation of particle size $PM_{2.5}$ have been shown in Fig. 2(b) as 106.6,24.48 for S_1.PM2.5 also shown higher mean and SD in S_2 and the values observed were 291.2 µg/m^3, 84.20µg/m^3 and minimum variation between data points also

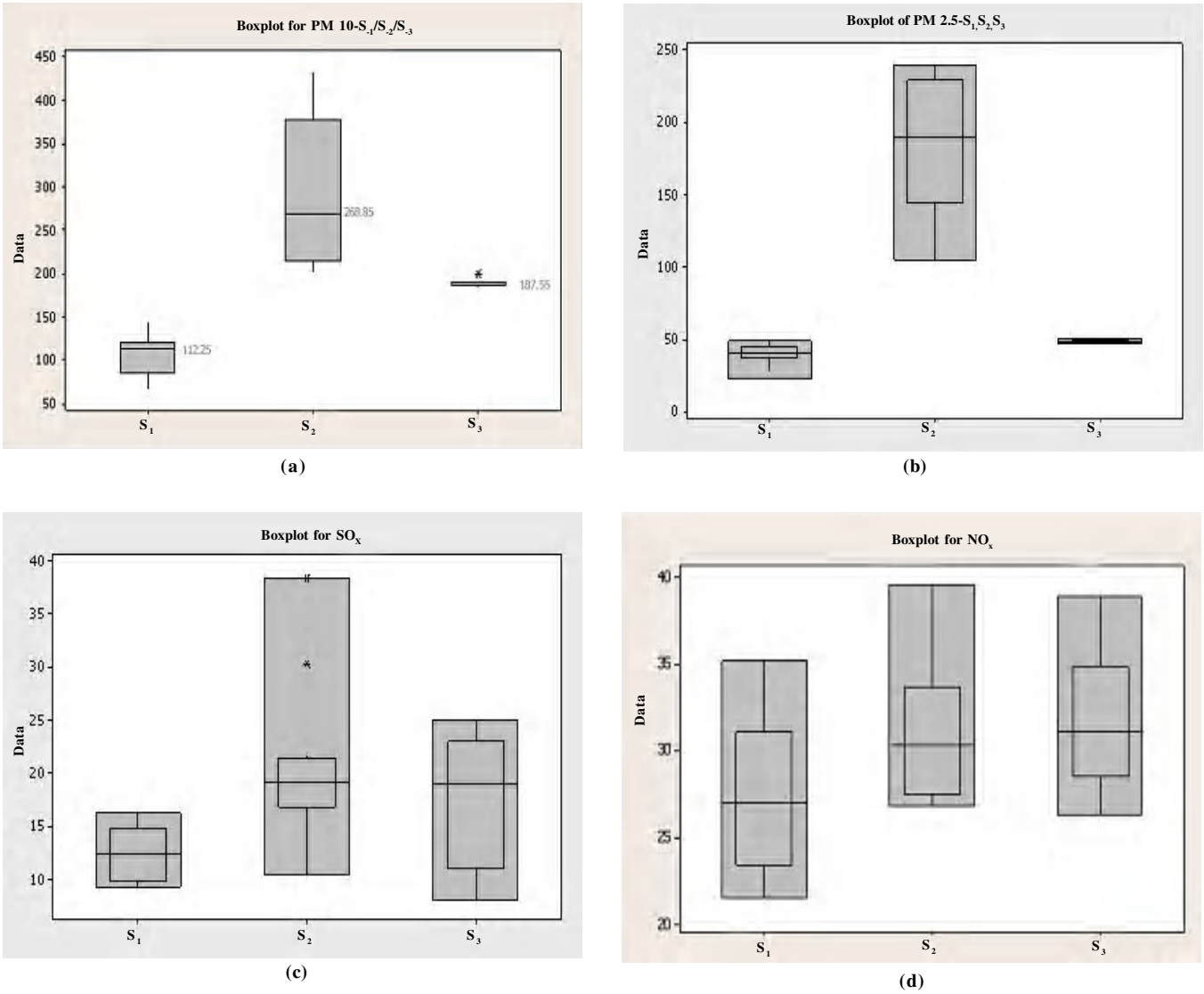
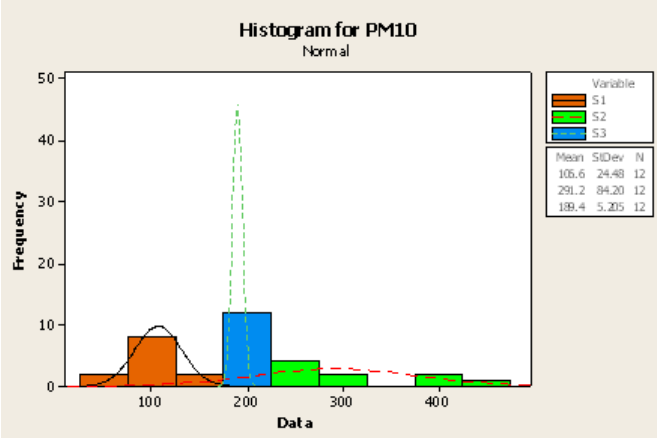


Fig. 1 : Size distribution of PM_{10}, $PM_{2.5}$, SO_x, NOx concentrations at three monitoring stations (Data: concentration of pollutants in µg/m³) S_1 : site 1(madura coats colony), S_2 :Site2 (Pavali), S_3 :Site3 (Perali).

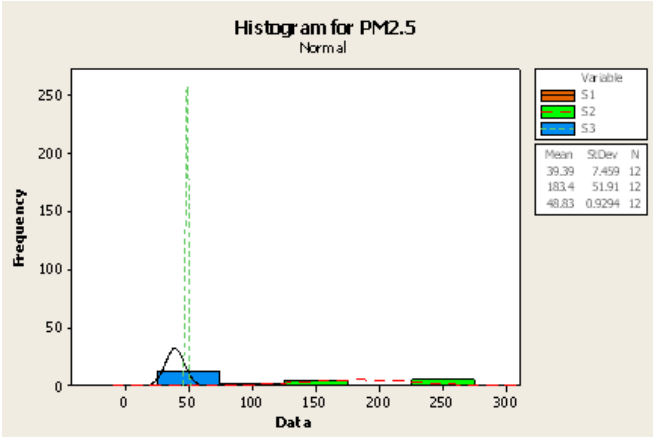
observed at S_3.The results for SOx are also given in Fig. 2 (c). Parameters presented in these figures. provide some information about the data set. It could be seen from Fig. 2(c) that the SD and the mean concentration values of the measured species were also closed to each other. From the Fig. 2(c) it was inferred that high concentration of SOx recorded in S_2 and the recorded mean and SD were20.5µg/m³, 7.24µg/m³. Almost same trend was seen in the mean and SD of NOx in S_1 and S_2 (Fig. 2 d) and the values sited were 31.25±3.89 µg/m³ and 31.88 ±3.83 µg/m³.

Correlation between the pollutants :

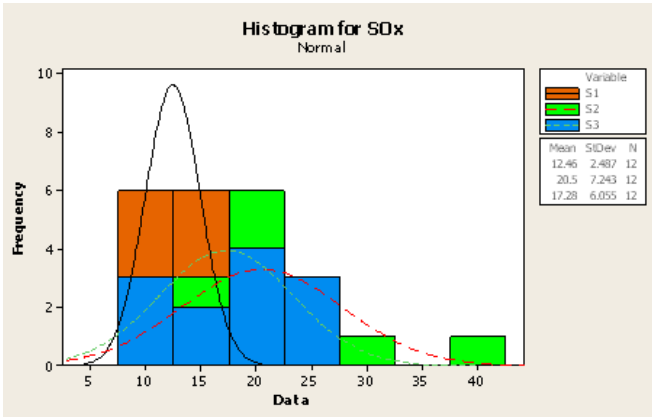
In environmental studies similar fluctuations of two parameters are related to a common reason like common source (Soner Erduron and Tuncel, 2001). Results of the present study are presented in Fig. 3.The relationship between PM_{10} and SO_x has been established in Fig. 3 (a).The figure illustrates that negative correlation between PM_{10} and SO_x with the 'r' value of -0.386 and correlation coeffient was not strong enough to decide the correlation between PM_{10} and SO_x There was a sinificant relationship shown between PM_{10} and NO_x with r =0.437 [Fig. 3 (b)].The relationship between SO_x and NO_x was established in Fig. 3 (c) (Singh and Sharma, 2008). The figure illustrates no significant correlation between SO_x and NOx (r =0.159).



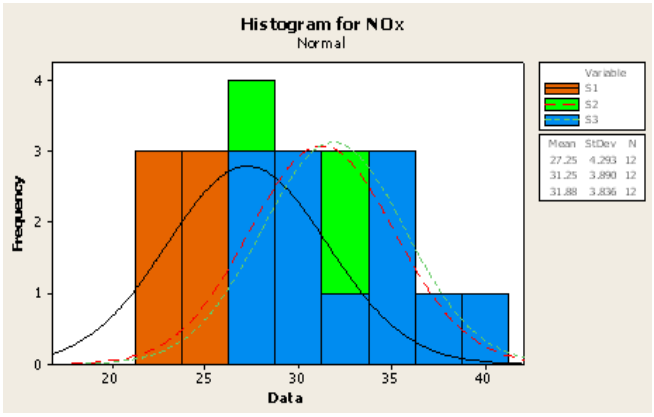
(a)



(b)



(c)



(d)

Fig. 2 : Frequency distribution of pollutants and average, standard deviations of the Concentration of pollutants (frequency: concentration of pollutants in µg/m³) S_1 : site 1(Madura coats colony), S_2 : Site2 (Pavali), S_3 :Site3 (Perali).

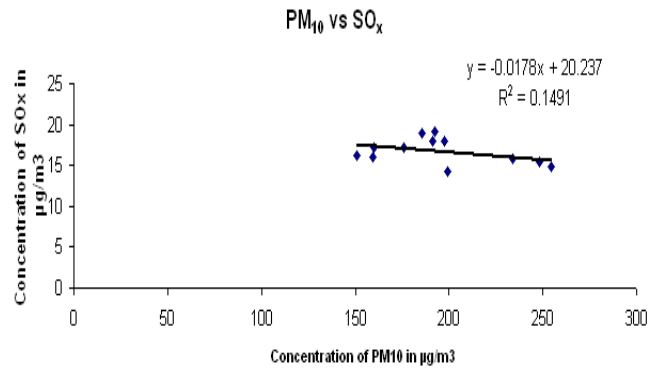


Fig. 3(a): Correlation diagram of PM_{10}-SOx

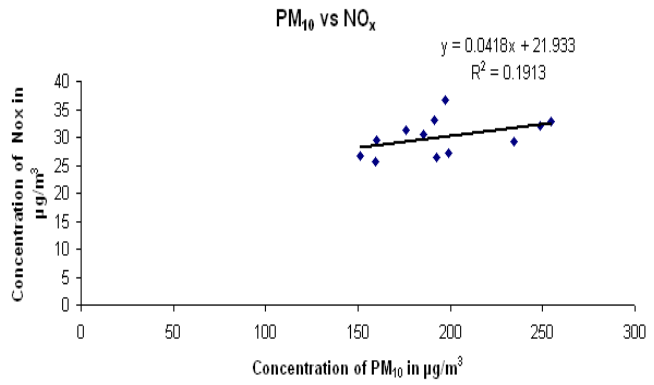


Fig. 3 (b): Correlation diagram of PM_{10}-NO_x

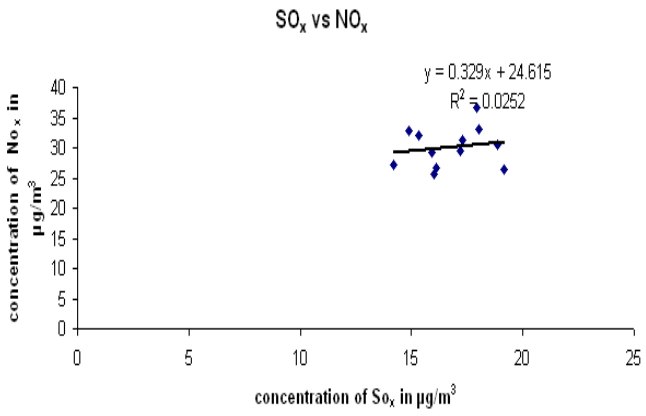


Fig. 3 (c) : Correlation diagram of SO_x-NO_x

Conclusion :

Air quality monitoring at different selected locations of Virudhunagar town clearly showed that particulate pollutants were the major polluting parameters (Wagh and Shrivastava, 2004). The higher concentration of SOx and NOx in Pavali due to heavy traffic junction and in Perali was due to industries and the NOx level was found high in traffic junction and in industrial area .The overall ambient air quality was good in winter than summer in the case of Virudhunagr. PM_{10} and NOx, were closely related at higher pollutant concentration due to the rate of transformation reaction of NO_2 in to NO_3^- was high due to heavy traffic junction (Senthinathan, 2008). SO_x and NOx were not significantly correlated and average value of SO_2 and NOx at Pavali was higher than average value of other sites.

Acknowledgement :

Authors thank the Secretary, Director (S.F) of VHNSN College for providing research facilities and permission to do research work. Authors also thank Dr G.Ramanathan, Assistant Professor, Department of Microbiology for his technical support .Authors also thank Mr. M. Pradeep, B.E., M.B.A. (Bradford) who helped in statistical calculations and authors gratefully acknowledge C.R.Chandrasekaran, Head Department of Chemistry for his valuable moral support.

Coopted Authors' :

J. MAHESWARI, Department of Chemistry, V.H.N.S.N.College, VIRUDHUNAGAR (T.N.) INDIA
E-mail: maheswarivaseekaran@gmail.com

REFERENCES

Gaikwad, R.W. (2004). Analysis of industrial pollutants by correlation and regression technique. *Indian J. Environ. Prot.,* **24**(2): 138-143.

Keeler,G.J. *et al.*, (1990). Transported acid aerosols measured on southern Ontario. *Atmos.Environ*., **24** A, 2935-2950.

Mohanty, S.K. (1998).Ambient air quality status in Koraput. *Indian J.Environ.,* **19**(3): 193-199.

Parida, M. *et al.*(2003). Analysis of transport related SPM. *Indian J.Environ. Prot.,* **23**(8): 864-871.

Pope Ardeen, C. *et al.,* (2002). Lung cancer cardiopulmonary mortality and long term exposture to fine particulate air pollution. *J. Am. Med. Assoc*., **287**:1132-1141.

Schwartz, J.(1994). Airpollution and daily moratility;A review and metal analysis. *Environ. Res.*, **64**:36-52.

Senthinathan, T. (2008). Measurements of urban ambient air quality of Chennai city, *Indian J. Air Pollution Control*, **8** (1): 35-47.

Sharma,R.K. and Pravez, S. (2003). Study of seasonal variation in ambient particulate of drug city. *Indian J.Environ. Prot*, **23**(8): 893-896.

Singh, S.N. and Rajnikant Sharma (2008). Ambient particulate matter concentration study in a mixed urban and rural environment in India. *Indian J. Environ. Prot.,* **28** (10): 942-945.

Soner Erduran, M. and Semra, G. Tuncel (2001). Sampling and analysis of gaseous pollutants and related particulate matter in a Mediterranean site:Antalya-Turkey. *J.Environ.Monit.*, **3**: 661-665.

Sarath, K. *et al.* (2009) .Contribution of vehicular activity to air pollution in Hyderabad, India. Measurements, chemistry and analysis. *Indian J. Air Poll. Control*, **9**(2): 37-40.

Wagh, S.P. and Shrivastava, V.S. (2004). Heavy metals by ICP-AES and their correlation regression study. *Indian J. Environ. Prot.,* **284**(2): 129-133.

****
******