International Journal of Scientific Research in Science, Engineering and Technology
Print ISSN: 2395-1990 | Online ISSN : 2394-4099 (www.ijsrset.com)
doi : https://doi.org/10.32628/IJSRSET

Assessment of Increasing Level of Concentration of Nitrogen Dioxide and Sulphur Dioxide in Ambient Air with Respect to Various Air Pollutants at Varanasi

Sateesh Kumar Pandey
Department of Chemistry, SBPG College, Baragaon, Varanasi
B. N. Yadav
Department of Chemistry, SBPG College, Baragaon, Varanasi

Article Info
Volume 8, Issue 5
Page Number : 334-338
Publication Issue :
September-October-2021
Article History
Accepted : 10 Sep 2021
Published: 20 Sep 2021

ABSTRACT

This paper deals with the study of concentratuion of Nitrogen dioxide and sulphur dioxide , a strong air polluting gas at Varanasi, generated from brick industries. The study was performed at four different sites of Varanasi at monthly intervals. The results indicate that the concentration of NO2 and SO2 is higher than the permissible limit at all the study sites except at control site.

Keywords : Nitrogen dioxide, sulphur dioxide, polluting gas.

I. INTRODUCTION

With the advancement of science and technology, rapid growth and their requirements, increasing industrialisation is the order of the day. Different industrial effluents are the main source of environmental pollution in all over the world. Rapid growth of population, rapid industrialization with the wide sphere of human activities have resulted into the greater exploitation of the environment.

Air composition also varies from place to place and time to time, and it is the composition of constituents in the particular microenvironment which affects growth and development of the biota present in it (Edwards *et al.*, 1998; Jonnalagadda and Baloji, 1991). CO_2, SO_x and NO_x may be present in higher proportion in the place where fuel combustion is taking place (Li *et al.*, 1999) in proportion of sulphur containing gases are reported to be relatively high in the paddy growing areas also (Yang *et al.*, 1998; Taylar *et al.*, 2003; Mueller *et al.* 2004).

During general survey of Varanasi, various sources of pollution have been marked which include industries, locomotives, automobiles (heavy and light vehicles), aircrafts, open refuge burning, various kinds of kitchen stoves which may use LPG or kerosene oil, domestic furnace, electricity generators, dead body cremation etc.

In varanasi the transportation through road can be divided in two types. One is the bussy road, from these area the automobile run very shlowly and other is open or National high way road from this road the automobile run very fast. As already stated Varanasi is an ancient city so it consists of traditional and narrow roads which ultimately lead to traffic congestion, during which excess amount of pollutants are emitted by incomplete combustion of fuels. Due to clumping of tall buildings and poor ventilation in some areas the emitted pollutants remain confined at lower level in the atmosphere.

By advancement in science and technology the variety of pollutants is also increasing (Cacac *et al.*, 2001). The rate of contamination of the environment during the last three decades have been much more than that during the last two centuries. This geometrical increase in the rate of pollution has ruined the quality of air (Schmidt, 2000; Cooper and Jenkins, 2003; Elbir *et al.*, 2004 and De Sentis *et al.*, 2004). Due to the rapid increase in pollution sources and the pollutants release, the ecosystem of the earth is getting disturbed (Postal and Heise, 1988). Increase in gases such as carbon dioxide, sulphur dioxide, etc. result in global warming (Philander, 1998; Richardson, 2000; Bennett and Willis, 2000; Bradshaw *et al.*, 2004; Toda Kei, 2004 and Chaulya, 2003), which would ultimately be responsible for glacial termination (Runnegar, 2000; Monnin *et al.*, 2001 and Schiermeie, 2001). Jacobson (2000) has studied the post glacial changes in the vegetation.

Currently, about 60-70% of acidic rainfall is caused by sulphur compounds and about 30-40% by nitrates. The oxidation processes (i.e., Nitrogen, sulphur oxides → Nitric, sulphuric acids) occur only at higher relative humidities (>70%). Oxides of nitrogen and sulphur in atmosphere are the cause of acid rain (Larssen and Carmichael, 2000). The pH value of rain was correlated with the concentration of atmospheric oxides of nitrogen and sulphur in Indonesia by Gillett *et al.* (2000). The impact of acid rain on calcium nutrition and forest health has been studied by Dehayes *et al.* (1999). Impact of acid rain on limestone and dolomite has been studied by Parvez and Pandey (1990). Pollution level at Agra was studied by Parmar *et al.* (2001). Damage to Taj Mahal of India due to atmospheric sulphur dioxide has been studied by Goyal (1980). Gojstad (2000) reported that the acidity in rain checks the biodiversity and controls the biotic composition of that area.

Air-borne sulphur oxides (SO_2, SO_3) produced naturally or from human activities (such as the combustion of fossil fuels etc.) can be absorbed by rainwater and snow, forming H_2SO_3 and H_2SO_4 respectively:

$$SO_2 + H_2O \rightarrow H_2SO_3$$

$$SO_3 + H_2O \rightarrow H_2SO_4$$

However, scientific study still lacks some essential informations about the actual impact of the automobile exhaust and brick industries on the surrounding population and its management.

Materials and Methods:

Various study sites are:

Site-I : Bhelkhan

Site-II : Chamaun

Site-III : Chamaraha

Site-IV : Babatpur Airport (Control Site)

For ambient air quality monitoring at the various sub-sites of Brick kilns and Roadside. Air samples are collected and analysed using High Volume air Sampler (Envirotech APM - 410). Gaseous pollutants are sampled intermittently for 8 hours, however High Volume Samplers are run for 24 hrs. at the sampling points, for the particulates present in the ambient air (Cadle, 1975 and Manahan, 1983).

The concentration of SO_2 is calculated as follows :

Concentration of $SO_2 = (\mu g\ SO_2/ml \times V)/V\ air$

Where, $\mu g\ SO_2/ml$ = Value from standard curve

V = Total volume of absorbing solution

V air = Volume of air in m^3 (flow rate x time)

With the above mentioned method the concentration of SO_2 at various selected sites has been computed.

The concentration of nitrogen dioxide is calculated as follows:

Nitrogen dioxide in µg m^{-3}

$$= \frac{\mu g \ NO_2 / ml \times V}{Vair \times 0.35}$$

Where, µg NO_2 ml^{-1} = Value from standard curve

V = Total volume of absorbing solution

Vair = Volume of air in m^3 (flow rate × time)

0.35 = Overall average efficiency

Sulphur dioxide quantity (µg m^{-3}) of stack emission of the brick industry at different study sites

Table-I

Month	*Study Sites*			
	I	**II**	**III**	**IV (C)**
May 2003	195.95±4.76	225.38±2.89	231.81±7.89	18.31±0.89
Jun	195.76±4.09	226.18±5.98	232.100±14.09	18.00±1.45
July	-	-	-	-
Aug	-	-	-	-
Sept	-	-	-	-
Oct	-	-	-	-
Nov	197.52±6.06	227.25±4.87	-	14.62±1.09
Dec	197.31±3.00	227.81±1.78	236.31±8.98	16.51±1.48
Jan 2004	196.50±4.43	223.71±2.89	235.51±5.89	16.89±1.65
Feb	196.35±7.00	224.53±6.09	233.16±8.29	17.41±1.87
Mar	195.52±2.59	225.61±4.90	233.02±9.45	17.91±1.09
Apr	194.31±2.09	223.31±4.898	234.62±4.76	18.02±1.50

± = Standard Deviation

Quantity of nitrogen dioxide (µg/m^3) of stack emission of the brick industry at different study sites

Table-II

Month	*Study Sites*			
	I	**II**	**III**	**IV (C)**

May 2003	46.06±4.00	44.73±2.05	40.65±2.78	16.16±2.04
Jun	46.03±2.98	44.00±2.80	40.09±2.76	16.00±1.00
July	-	-	-	-
Aug	-	-	-	-
Sept	-	-	-	-
Oct	-	-	-	-
Nov	47.15±2.65	43.46±1.87	-	15.13±0.68
Dec	46.81±1.76	44.52±1.54	42.56±1.65	15.62±0.39
Jan 2004	46.95±2.87	43.21±2.09	41.21±2.68	15.63±1.00
Feb	46.13±3.50	43.53±2.09	41.08±2.89	15.99±0.39
Mar	46.00±2.79	43.78±2.09	41.00±2.51	16.00±0.98
Apr	46.27±2.65	44.15±1.87	42.47±2.03	16.23±1.98

± = Standard Deviation

Results and Discussion: The analysis of stack emission of brick kilns at all the selected three sites of brick industries showed variation in quality and quantity of their emission. It depends upon the quality of the fuel used and also upon the type of the kiln. The brick industry of site I (Bhelkhan) was a fixed chimney type and its kiln capacity was 29,000 bricks per day which is higher than that of the other industries. It also consumed 5.5 tonnes of coal per day, which is even more than double the amount used by the brick industry at site II (Chamaun). In light of the above it seems that highest quantity of the flue gases should come from the brick industry of site I. However, analytical results revealed moderate level of SO_2, NO_2 and particulate matters. This may be due to presence of a pair of settling chambers and the greater stack height, that could have reduced the particulate level in the stack to a considerable extent (Habla, 1999). According to Aslam (1999) velocity of the stack emission was lower, however height of the stack was greater which could have provided sufficient time for the pollutants to react and adsorb to the surface of the particulates and allow their settling, thus height of the stack would have played an important role in settling of the particulates matter.

The brick industry of site II (Chamaun) was a fixed chimney type and its kiln capacity was 12,000 bricks per day, which is lower than that of the two other industries. In the case of the stack emission of the brick industry at site II (Chamaun) the particulate matter concentration was found to be much higher, this may be due to absence of settling chamber and low stack height. Velocity of the emission was also recorded to be higher which may be due to lower stack diameter as a result all the pollutants, discharged directly into the atmosphere.

Analysis shows that the brick industry at site III (Chamaraha) was the most polluted site. This brick industry which consisted of one movable and one fixed chimney has a high kiln capacity i.e. 15,000 bricks production in a day which is 3,000 more than that of the brick industry at site II. Both the brick industries were devoid of pollution control devices. Particulate matter in the stack, at the kiln of site III, was much more than that of other two sites. Height of the stack of the brick industry at sites II and III were smaller than that of site I. Due to low stack height, the pollutants are released at a low height, which remains suspended in the air very close to the earth surface, thus affecting the growth. Similar observations for low height stacks were also reported by Boev *et al.* (1998) and Selgrade (2000).

References:

1. Edwards, R.D. E.J. Yurkow and P.J. Lioy (1998). Seasonal deposition of house dusts on household surfaces. Science of the Total Environment, 224 (1-3) : 11: 69-80.
2. Jonnalagadda, N.S. and R. Baloji. (1991). Studies on the level of SO_2, NO_2, NH_3 and HCl in ambient air of Harare, Zimbabwe. Environ. Inter., 17(5) : 461-467.
3. Li, Y.F., Y.J. Zhang, G.L. Cao, J.H. Liy and L.A. Barrie (1999). Distribution of seasonal SO_2 emissions from fuel combustion and industrial activities in Shanses Prorinca, China, with 1/6 degree X1/4 degree longitude/latitude resolution. Atmospheric Environment, 33(2) : 257-265.
4. Yang, Z., L. Kong, J. Zhang, L. Wang and S. Li (1998). Emission of bioferic sulphur gases from Chinese ice paddies. Science of the Total Environment, 224 (1-3) : 1-8.
5. Postel, S. and L. Heise (1988). Reforesting the Earth Worldwatch, Washington, D.C. (Paper No. 83) : 66.
6. Smith, K.R. (2000). Environmental health for rich or for all? Bulletin of the World Health Organisation, 78(9) : 1156.
7. Cacac, F., R. Cipollini, G. Depetris, M. Rost and A. Troiani (2001). A new sulfur oxide, OSOSO, and its cation likely present in the Io's atmosphere : Detection and characterisation by mass spectrometric and theoretical methods. J. American Chemical Society, 123(3) : 4778.
8. Mueller Stephon F., Elizabeth M. Bailey and Jimmie J. Kelsoe (2004). Geographic sensitivity of fine particle mass to emissions of SO_2 and NO_x. Envi. Sci. Tech. 38 (2) : 570-580.
9. Cooper David M and Alan Jenkins (2003). Response of acid lakes in the UK to reductions in atmospheric deposition of sulphur. Sci. Total Envi. 313 (1-3) : 91-100.