ISSN 2229-5518

Investigation of Air pollutant CO_X, NO_X, SO_X and NH_3 in Heavy Vehicular traffic Areas of Bauchi metropolis, north eastern-Nigeria

P. V. Stephen, E. O. Ekanem, A. M. Shibdawa, Alheri Stephen.

Department of Chemistry, Abubakar Tafawa Balewa University, Bauchi, Nigeria

Corresponding author: stephen.polmix@gmail.com

Abstract : Air samples were measured for the oxides of nitrogen (NO_X), oxide of sulphur (SO_X), oxide of carbon (CO_X) and ammonia (NH_3) using Gas alert Microclip XT(1,2,3 and 4) Gas detector and Gasman Detectors from Muda Lawal market, Central market, Gidan Mai,by the motor park, Wunti by the traffic, ATBU by the gate, Awalah by the tipper garage and the control Results obtained showed that the concentrations of NO_X range from0.02-0.06ppm, was below USEPA allowable limit (10ppm) SO_X 0.02-0.06ppm, exceeded the USEPA allowable limit (0.017ppm) CO_X 16.00- 34.50ppm, exceeded the USEPA allowable limit (9ppm) and NH_3 0.01-0.05ppm. Strong correlation exist between some air pollution indices in the sites with correlation at $\alpha = 0.005$.Thus the city is not under the threat of traffic pollution. This finding could serve as baseline information for the traffic management policy in the state

Keywords: CO_X, NO_X, SO_X, NH_3, Vehicular,

Introduction

Vehicular pollution refers to the release of noxious gases from internal combustion engines of motor vehicles into the atmosphere, thus polluting the ambient air quality of the environment (Joshua, 2011). According to Schwatz (1994), the release of noxious gases such as CO_X, SO_X, NO_X, chemicals vapours and particulate matters could lead to air pollution. Hence, air pollutants are either particulates or gases. Gaseous and particulate pollutants may share some common sources, but create distinctly different kinds of problem.

Carbon monoxide (CO) is a nearly ubiquitous product of incomplete combustion of carbon-containing fuels. Outdoor sources include motor vehicles; engines on motorboats, lawnmowers, chain saws, and other devices that require fossil fuel combustion; residential wood burning; improperly adjusted gas-burning and oil appliances; coal combustion; and tobacco smoking (Hampson *et al*.,1992 & Hagberg *et al*.,1985).

Nitrogen oxides are reactive substances commonly understood to encompass nitric oxide (NO), nitrogen dioxide (NO_2), nitrogen trioxide, nitrogen tetroxide (N_2O_4), and di-nitrogen penta oxide

(N_2O_5). These compounds are referred to collectively as "NO_X." Gaseous nitric acid (HNO_3), a major source of particulate nitrate, is formed when NO_2 reacts with hydroxyl radicals during the day and when N_2O_5 reacts with water vapor at night (USEPA; 1993)

Sulfur dioxide (SO_2) is a highly irritating, colorless, soluble gas with a pungent odor and taste. In contact with water, it forms sulfurous acid, which accounts for its strong irritant effects on eyes, mucous membranes, and skin Lipsett; (2001).

Vehicular polluted environment is deadly and it is also a retarding agent to the socio economic development of a nation. The effects of air pollution are diverse and numerous. Air pollution can have serious consequences for the health of human beings, and also severely affects natural ecosystems. Human exposure to these air pollutants due to traffic is believed to constitute severe health problems especially in urban areas where pollution level are on the increase (Abam, and Unachukwa., 2009). There are numerous health problems associated with high concentration of these pollutants, for example NO_2 is responsible for immune system impairment, exacerbation of asthma, and chronic respiratory diseases; reduce lung functions and cardiovascular diseases (Schwela, 2000). A similar study confirms that there is a prevalence of chronic bronchitis and asthma in street cleaners exposed to vehicle pollutants in concentrations higher than WHO recommended guidelines, thus, leading to significant increase in respiratory problems (Raaschou,1995).

Materials and Methods

Instrument: Gas alert Microclip XT(1,2,3 and 4 Gas detector and Gasman Detectors.

Samples: air pollutants were drawn from different point within and around the experimental sites (heavy vehicular areas), the sites were ; Muda Lawal market, Central market, Gidan Mai,by the motor park, Wunti by the traffic, ATBU by the gate, Awalah by the tipper garage and the control was at Kagadama Buli foot path free from pollutants.

Gas alert Microclip XT(1,2,3 and 4) Gas detector and Gasman Detector were used. They are instruments that are used to perform automatic analysis of air samples through the use of output signals.The gas detectors has the sensors that detects the gases automatically depending on the direction of the flow of the gases and their concentrations were displayed

Results

Result from this show that the concentration of CO in all the sites exceeded USEPA standard with Muda Lawal having the highest concentrations of 32.50ppm which exceeded USEPA standards or allowable limit of (9ppm).The concentration of SO_X with 0.06ppm from Muda Lawal has the highest which also exceeded the USEPA allowable limit of 0.017ppm, NO_X with 0.06ppm which is below the USEPA allowable limit of 10ppm and NH_3 with 0.05ppm. Central market had the lowest concentration of CO with 21.52ppm which exceeded USEPA standards or allowable limit of (9ppm), NO_X with 0.02ppm at Wunti, SO_X with 0.02ppm and NH_3 with 0.01ppm at ATBU.

Discussion

CO is a more deadly pollutant and higher level of it generally occurs in areas with heavy traffic congestion. CO causes harmful health effects by reducing the delivery of oxygen to the body organs and tissues. It does this by combining with hemoglobin of blood to form carboxy-hemoglobin which interferes with the oxygen carrying capacity of blood, resulting in a state tissue hypoxia (Neil, 1997). The atmospheric CO along the corridors of the roads when compared with values reported in literature was found to be higher than 1.6 – 3.8 ppm, an average range of atmospheric concentration of urban air pollutants in Athens, Greece (Kalabokas

et al., 1999). Also, the values reported in this study were higher than range of 0.7 – 1.9 ppm in Jahara, Kuwait (Ettouney *et al*., 2010).

The average value of the concentrations of NO_x obtained in this study were 0.02-0.06ppm. Also, when the levels of NO_x were compared with values reported in literature, the mean concentration of NO_x was found to be lower than 35 – 108 ppm reported in Athens, Greece (Kalabokas *et al*., 1999), and fell within 0.20 – 0.521 ppm reported for Calabar metropolis, Nigeria (Okafor *et al*., 2009) but was within the limits set by FEPA (1991) for NO_x which is 0.06 ppm. This is most likely due to high traffic density and stationary fuel combustion process emissions from running of generators (Etiuma *et al*., 2006) which is very common within the metropolis due to erratic power supply.

The average value of the concentrations of SO_x obtained in this study were 0.01-0.06ppm, the concentration of SO_x is lower than ranges of 3.21 – 5.18 ppm, 7.4 – 15.5 ppm, and 16 – 64 ppm reported by Ayodele and Abubakar (2010), Ettouney *et al*. (2010), and Kalabokas *et al*. (1999), respectively. At some sites the emission values were within 0.14 ppm (average of 24hrs) limit of USEPA (2001) ambient air quality standards.

The average value of NH_3 in the atmosphere at the studied sites ranged between 0.01 – 0.05 ppm. This range is lower than 0.861 – 4.300 reported for Calabar metropolis, Nigeria (Okafor *et al*., 2009). NH_3 sources in the atmosphere are animal waste, ammonification of humus, followed by emissions from soil, loss of NH_3 based fertilizer from soil and industrial emission (Okafor *et al*., 2009). Low concentrations of NH_3 from this study may be due to unavailability of some of these sources. Similar to NH_3 which is relatively very low at the studied sites, which could indicate fewer hazards due to this pollutant.

Table I**.** Average Mean Concentration of air pollutants samples and measured using air detectors in (ppm)

Sample location	**[a]CO(ppm)**	**[b]NO_X(ppm)**	**[b]SO_X(ppm)**	**[b]NH_3(ppm)**
Awalah	16.00±0.81	0.03±0.01	0.04±0.00	0.03±0.02
Muda Lawal	32.50±0.57	0.06±0.00	0.06±0.01	0.05±0.02
Gidan Mai	22.50±0.44	0.04±0.02	0.04±0.00	0.02±0.00

ATBU	24.00±0.61	0.03±0.00	0.02±0.01	0.01±0.00
Wunti	27.00±0.71	0.02±0.01	0.04±0.00	0.04±0.01
Central Market	21.50±0.56	0.05±0.02	0.05±0.03	0.03±0.01
Control	0.23± 0.04	0.01± 0.00	0.01±0.00	0.02±0.00

a = Gas alert Microclip/MaxXT(1,2,3 and 4Gas detector); b = Gas Man air detector

Table II: US – EPA Standard for Six Principal Pollutants.

POLLUTANT	**SAFE CONCENTRATION ZONE**	**AVERAGE TIME**
	μg/m^3 , ppm, ppb, mg/m^3	
Carbon monoxide	9ppm (10mg/m^3)	8- hours
Sulphur dioxide	0.017ppm (50μg/m^3)	24-hours
Nitrogen dioxide	10ppm	1-hour
Ozone	0.075ppm	8-hours
Lead	0.015μg/m^3	
Particulate matter (Pm10)	150μg/m^3	24-hours
Particulate matter (Pm2.5)	15.0μg/m^3	24-hours

Source: US Environmental Protection Agency (2010).

Conclusion /Recommendation

From the findings of this study, the results showed that traffic emissions in Bauchi metropolis include pollutants like CO_x, NO_x and SO_x and NH_3. The concentrations of the CO_x, NO_x and SO_x measured, with few exceptions, at some sites were above the AQI stipulated by USEPA This implies that traffic emission within Bauchi metropolis is not within the safe limits. Hence, the results reveal that transport-related pollution in Bauchi metropolis is significant with potentially hazardous health consequences.

It is therefore, recommended that motorization growth should be largely checked by environmental regulations agencies most especially in Bauchi state, Nigeria

Reference

Abam. F. T & Unachukwu .G. O (2009).Vehicular emission and air quality standard in Nigeria. *European Journal of Scientia Research* **34.** (4), 550-560**.**

Ayodele, J. T. and Abubakar, F. (2010), “Sulphur dioxide as indoor pollutant in Kano Municipality Kano-Nigeria”, *Journal of Environmental Chemistry and Ecotoxicology*, Vol. 2 No. 1, pp. 9 – 13

Etiuma, R., Uwah, I. and Etiuma, A. (2006), “Level of nitrogen dioxide (NO_2) in Calabar city, Nigeria and health implications, *International Journal of Chemistry*, Vol. 16 No. 4, pp. 229 – 233

Ettouney, R. S., Zaki, J. G., El-Rifiai, M. A. and Ettouney, H. M. (2010), An assessment of the air pollution data from two monitoring stations in Kuwait, *Toxicology and Environmental Chemistry*, Vol. 92 No. 4, pp. 655 – 668

FEPA, (1991), *Guidelines and Standards for Environmental Pollution Control in Nigeria*. Federal Environmental Protection, Agency Press, Lagos, Nigeria

Hampson NB, Norkool DM. (1992) Carbon monoxide poisoning in children riding in the back of pickup trucks. JAMA. **267:** 538–540.

Hagberg M, Kolmodin-Hedman B, Lindahl R, *et al* (1985). Irritative complaints, carboxy-hemoglobin increase and minor ventilatory function changes due to exposure to chain-saw exhaust. *Eur J Respir Dis* **66.** 240–247.

Joshua, B. (2011). Lagos plans to bar heavily 'smoking' vehicles from roads.latest news, breaking news, business, finance analysis, comments and views from Nigeria. Retrieved 29 June, 2011.

Kalabokas, P. O., Viras, L. G. and Repapis, C. (1999), "Analysis of the 11 – years record (1987 - 1997) of air pollution measurements in Athens, Greece, Part I: primary air pollutants", *Global Nest Journal*, Vol. 1 No. 3, pp. 157 – 167

Lipsett M.J (2001)**. Oxides of nitrogen and sulfur**. In: Sullivan JB, Krieger GR, (Eds). Clinical Environmental Health and Toxic Exposures. 2nd ed. Philadelphia, Pa: Lippincott Williams & Wilkins, 818–832. .

Neil, C. (1997). Hazards of Burning Tyres. Academic Press, New York

Okafor, P. C., Ekpe, U. J., Ibok, U. J., Ekpo, B. O., Ebenso, E. E. and Obadimu, C. O. (2009), "Atmospheric corrosion of mild steel in the Niger Delta region of Nigeria. Part I: Characterization of the Calabar, Cross River State Environment", *Global Journal of Environmental Sciences*, Vol. 8 No. 1, pp. 9 – 18.

Raaschou, N. O (1995). Traffic-related air pollution: Exposure and health effects in Copenhagen Street cleaners. Archives of Environmental Health **50.** 207-13. http://um.ase.ro/no15/7.pdf

Schwartz, N. D (1994). Emission of Air pollutants ICI Ltd, Runicom

Schwela, D. (2000). Air pollution and health in urban areas. Reviews on Environmental Health.**15(12):** 13-24**.**

US Environmental Protection Agency, [USEPA] (2001), "EPA criteria for air quality", Retrieved January 21, 2010 from http://www.epa.gov/air/criteria.html.

US Environmental Protection Agency, [USEPA] (2010). Standards for Six Pollutants. Environmental Quality Washington DC.