A FORENSIC EXAMINATION OF CONCENTRATION LEVELS OF CO GAS EMITTED FROM VEHICLES IN A SEMI URBAN CITY IN NIGERIA

By
Mukoro Ejiro', Muhammad Nda', Ruth OmozokpiaUmesi
Department of Civil Engineering
Department of Quantity Surveying
Federal Polytechnic Bida, Niger State, Nigeria.

Abstract

Concentration levels of pollutant gases such as carbon monoxide (CO) are on the rise in cities in Nigeria. Over 60% of these levels are as a result of by-product of fuel and diesel engines of combustion vehicles. The study carried out to investigate the concentration levels of CO in Minna Metropolis showed maximum values at one instance of 600ppm and minimum values of 61 ppm. These values are indicative of high levels of carbon monoxide within .the city. Government agencies suggest policy makers should enact policies to reduce the emission levels by applying strict vehicular laws and regulations.

1.0 Introduction

One of the key indicators of the quality of life is a clean environment, which can be further disaggregated in terms of water, noise and air qualities. During the last 200 years, humans began to significantly alter the composition of the atmosphere through pollution. Although air is still made up mostly of oxygen and nitrogen gases, mankind, through its pollution activities, has increased the levels of many trace gases and in some cases, released new gases into the atmosphere (Akanni, 2008)

Industrial development and the establishment of large urban areas with high densities of motor vehicles have resulted in increased emissions of pollutants in the atmosphere. (Deloor Abdel Shaheed 1994)

Air pollution may be described as contamination of the atmosphere by gaseous, liquid, or solid wastes or by-products that can endanger human health and welfare of plants and animals, attack materials, reduce visibility or produce undesirable odours (ogueleka, 2005), Although some pollutants are released by natural sources like volcanoes, coniferous forests, and hot springs, the effect of this pollution is very small when compared to that caused by emissions from industrial sources, power and heat generation, waste disposal, and the operation of internal combustion engines. Fuel combustion is the largest contributor to air pollutant emissions, caused by man, with stationary and mobile sources equally responsible. The air pollution problem is encountered outdoor as well as indoor.

Sources that are major contributors to pollutants in the atmosphere include and not restricted to power plants, industries, factories, automobiles, as well as generating sets. These sources are the main contributors of oxides of Nitrogen, sulphur, carbon monoxide, carbon dioxide, particulates, hydrocarbons and volatile organic compound Ogwueleka (2005).

All fuel burning appliances have the potential to produce CO in varying concentrations. Carbon produces carboxyhaemoglobin which affects oxygen delivery to body tissues resulting in anoxemia. At about 50% this causes seizure and coma in man (Walker E, Hay A)

Rural Urban migration and the quest for better standards of living have increased the population in cities of Nigeria. This has led to increase in the need for motorised vehicles as well as other sources of transportation. Recent evidence has shown that motorised vehicles are the major source of air pollution in urban areas. While transportation engineers are tasked with solving problems of congestion and improved flow in arterial roads and Highways, the environmental impact is often ignored.

A new study by the Indian institute of tropical meteorology IITM reveals that that inhaling of pirticulate matter PM2.5 and ground level ozone reduces life expectancy of indians by an average of 3.4 years with residents of Delhi losing an average of 6.3 years. Future increases in PM2.5 concentrations may actually worsen the situations.

Sachin Guide, an author with IITM is quoted as saying that upward trends in transportation, industrial and energy sectors, urbanization, population growth in India along with climate change will significantly raise the levels of pollutants in India.

Monitoring air quality concentrations is pivotal to understanding the extent of air pollution and ensuring a proportionate and cost-effective response. Presently, there are no coordinated and continuous assessments of local air quality undertaken by the Federal Ministry of Environment or any other government body tasked with pollution control. Implicitly, Nigerians living and working in major cities do so in an environment devoid of a standard against which the air they breathe can be assessed or managed. That air pollution is injurious to public health, is a fact that has been less obvious in Nigerian public health and environmental policies. At its best, the FEPA regulatory framework put in place by the Federal Government in 1991 is a statement of intent, which recognizes issues without adequately tackling them. However, the newly established National Environmental Standards and Regulation Enforcement Agenc' (NESREA), has outlined the vision of ensuring a cleaner and healthier environment for all Nigerians

Nigeria being a developing nation is at risk and coupled with the poor institutional infrastructure to deal with environmental pollution, a large number of the population would continue to suffer cardiovascular diseases, breathing and asthmatic conditions.

Carbon monoxide is a colourless, odourless, non irritant and poisonous gas which is lighter than air with molar mass of 28. It is highly toxic at higher quantities to humans and animals (ChidiUhuegbu).

Many Scholars and indeed Nigerians have made effort in monitoring ambientair quality by measuring concentration levels of primary pollutants in the atmospHere especially at arterial roads and intersections,

F.I Abam and G,OUnachukw conducted research of vehicular emissions in selected areas in Calabar Nigeria at eight meters away from the edge of the road. Maximum value for Carbon Monoxide recorded was 8.7ppm. Oguntoke and Yussuf also assessed levels of CO in Abeokuta city using the gasman auto sampler (ATEX4 model). Co values ranged from 73mg/m3to 83mg/rn3.

ChidiUhuegbu(20 13) carried out measurements of Carbon monoxide in selected parts of Lagos State using the Carbon Monoxide detector (Model DSM 8922). Results obtained showed a minimum of 45ppm and a maximum of 835ppm.

Ndoke and Jimoh(1999) studied pollutants along a busy road in Minna and obtained concentrations of CO at 1 5ppm while CO2 was as high as 5000ppm.Ndoke et al (2006) also studied CO2 emissions at Kaduna and Abuja and found out that districts with heary traffic conditions revealed higher levels of Co2

1.1 Description of the study Area

I Minna is a city in West Central Nigeria. It is the capital of Niger State. It can be termed suburban as it is a developing city. It occupies a land area of 490ha. It is 100km from Abuja City of Nigeria. Its climate lies between the Sahel and Guniea Savannah regions. Its wet season occurs between May and November while its dry season occurs between December and April.

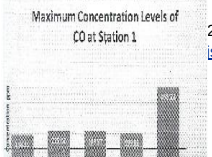
Vehicle registration in Nigeria has seen an increase from 600,000 in 1989 to a little less than one million in 2008 Balogun and F.R.S.C (2008). The road transport in I Niger State is further characterized by motorcycles and tricycles most of wlich have two stroke high pollution engines. Also total registered vehicles in Niger State have increased from 5676 in 2004 to 2768 in 2009 (National Bureau of Statistics 2009).

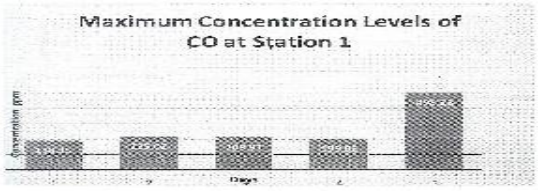
1.2 Materials and Methods

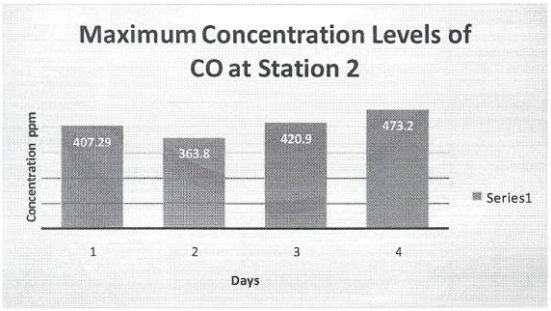
An aeroqual 500 series gas analyser was used to undertake this study. A carbon Monoxide sensor is fitted to the aeroqual series gas analyser to obtain carbon monoxide concentration values in parts per million. Four focal stations which are major intersections within the Minna Metropolis were selected for the investigation. These included the Kpankungu roundabout, The Obansanj o Complex Intersection, Tunga Market Intersection and the FUT Minna intersection at Bosso, The equipment was held at a distance not more than 0.5m off the edge of the road in the downwind direction, Measurements were taken at 2-3 mm intervals for a period of Six hours per location. This was repeated for four working days per location's station for optimal results.

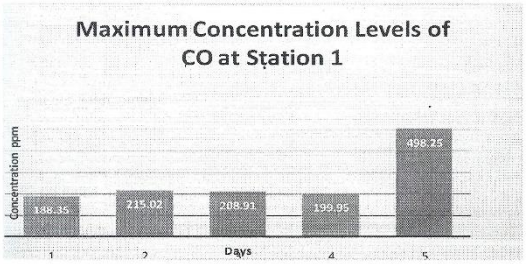
1.3 Results

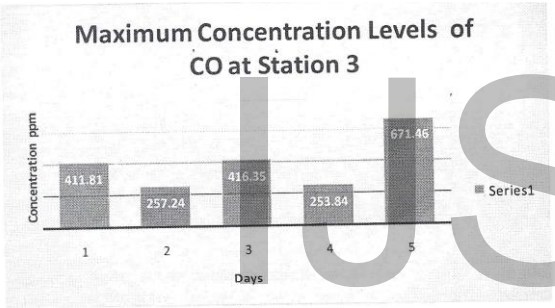
The results of the field measurements of CO at various intersections at Minna are shown belowli

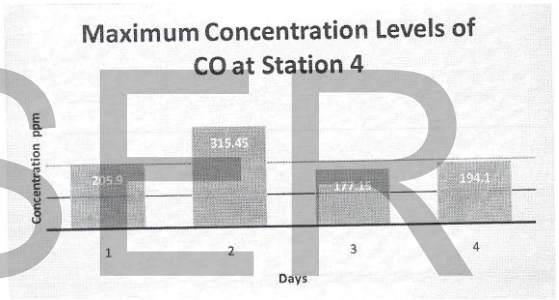


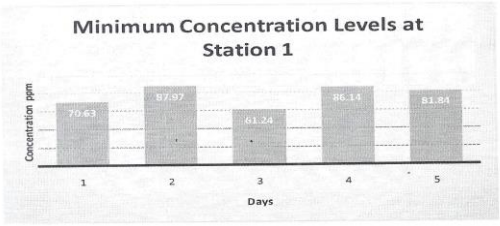

Maximum Concentration Levels of CO at Station 1
Concentration ppm
Days

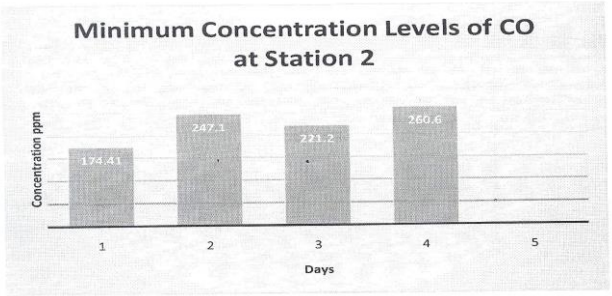

Maximum Concentration Levels of CO at Station 2
Concentration ppm
407.29
363.8
420.9
473.2
Series1
1
2
3
4
Days

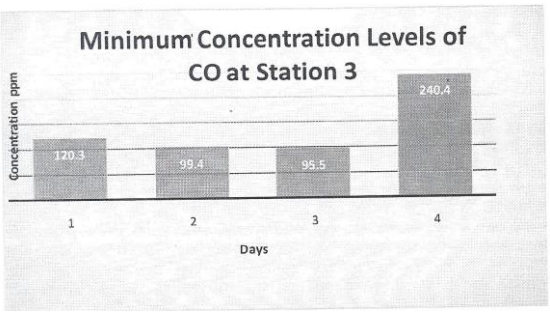

Maximum Concentration Levels of CO at Station 1
Concentration ppm
188.35
215.02
208.91
199.95
498.75
Days

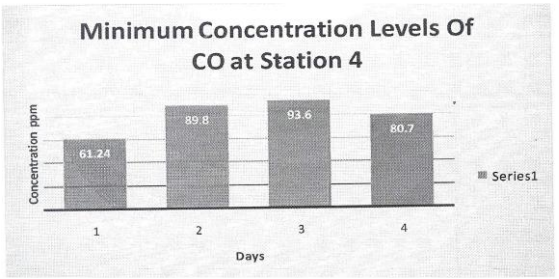

Maximum Concentration Levels of CO at Station 3
Concentration ppm
411.81
257.24
416.35
253.84
671.46
Series1
1
2
3
4
5
Days


Maximum Concentration Levels of CO at Station 4
Concentration ppm
205.9
315.45
177.15
194.1
1
2
3
4
Days


Minimum Concentration Levels at Station 1
Concentration ppm
70.63
87.97
61.24
86.14
81.84
1
2
3
4
5
Days


Minimum Concentration Levels of CO at Station 2
Concentration ppm
174.41
247.1
221.2
260.6
1
2
3
4
5
Days





The lowest value of CO concentration recorded is 61,24ppm at both Tunga and Kpakungu Intersections while the lowest values at Obasanjo complex and FUT Minna intersections are 95.Sppm and 174.4ppm respectively. The peakvalue recorded is 671.4ppm at the Obansanjo Complex Station. Other peaks include 473.2ppm at FUT Minna, 315.4ppm at Tunga and 498.2ppm at Kpakungu. This is made evident by the busy nature of the intersection at Obasanjo Complex as a densely commercial active area where vehicular emissions are from motorcycles, tricycles as well as motor vehicles,trucks and lorries. This value is also corrobated by Chidi's maximum value of 635ppm in parts of Lagos.

The results show a major increase in the trend of Carbon Monoxide generated within the City in comparism to l5ppm maximum value seen by Ndoke and Jimoh in 2001. While these values are obtained at centimeters away from the emission points they do not reflect the actual concentration levels at residential areas within the City. This can only be modeled considering dispersion parameters such as wind velocity, temperature, etc or by actual measurements at such receptor points. However people with Heart conditions, asthma and breathing problems should not stay out for long at these areas during the day to avoid severity of conditions instigated by inhaling trace amounts of air polluted by carbon monoxide.

1.5Conclusions and Recommendations.

The US environmental protection agency stipulates in its revised edition not more than 5Oppm averaged at an hour be exceeded in residential areas above once in a year. More work is required to determine concentrations at receptor points in residential areas. Policy makers should consider mitigation measures to reduce the risk of increased CO levels from vehicular emissions. Improved transport systems, ban on aged vehicles and strict vehicle regulationsbe implemented as well as improved urban planning for developing cities in the country.

References

Anjaneyelu, M.V.I.R, Harikrishna, M., Chenchuobulu, S. (2008) Modeling Ambieht Carbon Monoxide Pollutant due to road Traffic. World Academy of Science, Engineering and Technology. Internal Journal of Environment, Chemical,

Ecological, Geological and Geophysical Engineering. Vol 2, 2008.

* Cornelius. O.Akanni (2010)Spatial and seasonal analysis of traffic — related

* pollutant concentrations in Lagos Metropolis, Nigeria. African Journal of Research.5 (11) 1264-172

Chidi. C. Uhuebu (2013) Measurment of Carbon Monoxide Emission in some selected areas in Lagos State.

Deloor Abdel Shaheed. (1994) Modelling air pollution near arterial roads and highways. University of WollongPhd Thesis Unpublished

Dotun, 0 (2011) how clean is the air Nigerians breathe. Nigeria world feature article (nigeriaworld. corn) dotunolowoporoku@wwe.ac.uk

Efe, S. I (2008) Spatial distribution of particulate air pollution in Nigerian cities: implication for human health. Journal of environmental health. 7 (2)

F.l Abam, G.O Unachukwu. (2009) Vehicular Emissions and Air Quality Standards in Nigeria.

OkeolaOlumayok.in Francis. AppolloniaOkhimamhe (2013). African Technology

Policy Studies Network ATPS 2013. Vehicular Carbon Emissions Concentration

Level in Minna Nigeria the Environmental Cum Climate Change Implication ATPS

working Paper No II.N

Oguntoke 0, YussufA.S (2008d Health) Air pollution arising fromVehicular Emissions and the assbciated Health problems in Abeokuta metropolis. International Journal of Agricultural Sciences, Environment and Technology ISSN1595-9694. 8 (2).

P.N Ndoke, 0.D Jimoh.(2001) Impact of Traffic Emission on Air Quality in a developing City of Nigeria. www. Journal.au.edu/au 222-227

P.N Ndoke, Akpan, U.G, Mary K.E (2007) Contribution of vehicular traffic to carbon dioxide emission in Kaduna and Abuja, Northern Nigeria www.academic direct. org

United State Environmental Protection Agency (1990). National Ambient Air Quality Standards. Revised Standards.