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Contributions of vehicular traffic to carbon monoxide emissions in Enugu Metropolis, Nigeria

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ABSTRACT

Air pollution generated through combustion of fossil fuels presents difficult environmental challenge to societies as it could degrade the environment, affect human health and quality of life. Vehicular emissions are major contributors to air pollution in urban areas as they contain harmful gases.The levels of carbon monoxide has been investigated in two locations of Enugu metropolis (high traffic 'old park' and low traffic 'caritas university'), in order to determine its pollution status with regards to air. EL-USB-CO analyser used for the analysis indicated variations in the levels of CO for the period of study. The results obtained revealed that the concentrations of CO in high traffic (HT) area is higher than that of low traffic (LT) and is unacceptable compared with the Federal Environmental Protection agency (FEPA) Nigeria set limit. The dispersion pattern of the pollutant showed that the extent of spreading depends on the traffic population of the area. This strongly suggests that vehicular emission contributes to the levels of carbon monoxide in the environment.

Keywords: Carbon Monoxide, Vehicular Emission, High Traffic, Low Traffic, Enugu Metropolis

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INTRODUCTION

Pollution is the introduction of substances or energy into the air, water or soil environment directly or indirectly by man thereby having deleterious effects to such an extent that it will endanger human health, amenities or eco resources [1]. Air pollution is the contamination of air by the discharge of harmful substances which can cause health problems including burning of eyes and nose, itchy irritated throat and breathing problems [2]. It has been reported that some chemicals found in polluted air could cause cancer, birth defects, brain and nerve damage, long term injury to the lungs and breathing passages in certain circumstances. The concentrations of such chemicals beyond a limit, and exposure over a certain period are extremely dangerous and can cause severe injury or even death. The climate change results from the alteration in the balance between incoming and outgoing radiation elements in the atmosphere over a considerable period of time. This change is a result of changes in the quality of air over a period [3].

Anthropogenic sources of air pollution include products of combustion such as nitrogen oxides (NOx), carbon oxides (COx), sulphur oxides (SOx). Indeed motor vehicles produce more air pollution than any other single human activity [4]. Nearly about 50% of global CO emissions from fossil fuel combustion come from gasoline and diesel powered engines. In the city centres especially on highly congested streets, traffic can be responsible for as much as 90-95% of the ambient CO levels, thereby posing a significant threat to human health and natural resources [5]. Savile (1993) [6] reported that as from 2007 more than half of the world's population are projected to live in urban areas, and almost all the world's total population growth will be in urban areas of developing countries by 2030. The rapid growth of a city has a profound impact on the air quality situation, which arises as a result of increased

vehicular emissions. This is especially true in the developing world, mainly due to high proportion of old, poorly maintained vehicles and poor fuel quality [7,8]

CO is a colourless and odourless gas which when released into the atmosphere plays an important role in global, regional and urban atmospheric chemistry by affecting the concentration of hydroxyl radical (OH) and the cycle of tropospheric ozone (O_3) [9]. CO is considered an indirect green gas due to its close coupling to atmospheric methane (CH_4), a strong green house gas [10, 11]. CO is often found to be a toxic air pollutant in urban air and indoor air [12, 13].

Most studies on air pollution and exposure to air pollutants have been conducted in developed countries [14, 15, 16, 17]. There is limited information on exposure to air pollution in developing countries [7, 18, 19].

The population and residents of Enugu city, the economic and administrative capital of Enugu city has increased rapidly in the last decade (more than 3million residents), and in the absence of a reliable public transport system, air pollution has worsened because of an increased number of old second-hand cars, taximotorbikes (popularly called okada), substandard gasoline and other products imported into the country. There is presently no available data on emission and impact of air pollution in Enugu state, but it is anticipated that air pollution will become a major health problem if adequate mitigation measures are not taken. This study presents the levels of CO in high traffic (HT) and low traffic (LT) areas of Enugu metropolis.

The study area

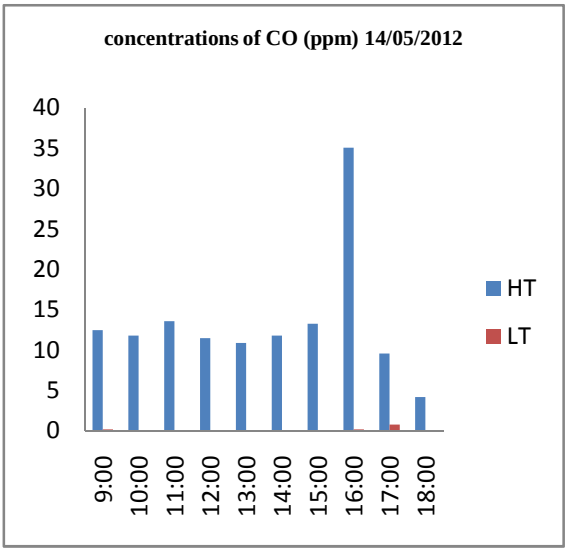
Enugu ($7^{o}26^{I}$E, $6^{o}19^{I}$N) was the administrative capital of the defunct eastern Nigeria until the late 1970's when it was decentralized. It is economically vibrant and the most industrialized state in the south eastern Nigeria with official population of about 3million. The study is focused on a high traffic area (HT) popularly known as old park and a low traffic area (LT) caritas university. The HT axis accommodates the largest market in Enugu state (Ogbete main market) and a host of motor parks. These motor parks and the market contribute to the traffic bottlenecks in the area. Usually CO is associated with vehicle exhausts and engines [12, 13]. Caritas university is cited about 3KM away from Enugu urban area.

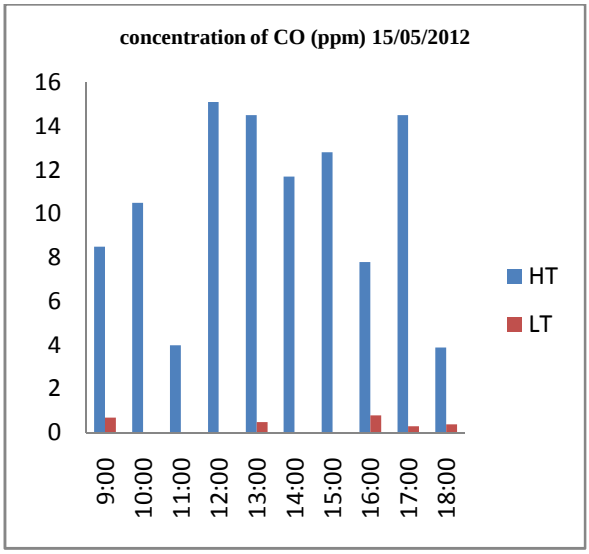
MATERIALS AND METHODS

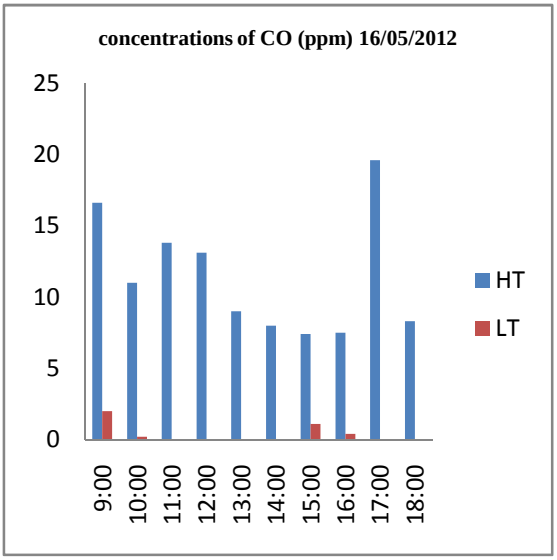
In this research, a high traffic (HT) and a low traffic (LT) area were identified for sampling. El-USB-CO data logger, a carbon monoxide data logger was used in this study.This data logger measures and stores up to 32,500 Carbon Monoxide (CO) readings over a 0 to 1000 ppm measurement range and -10 to +40°C (14 to +104°F) operating temperature range. The logger was set to record data at five minutes interval and was placed at each sampling location at a height of 3m above the ground. The sampling was conducted for six days (Monday to Saturday),the data were later transferred to a personal computer (PC's) by plugging the module of the logger straight into the PC's USB port and running the purpose designed software under Windows operating system.

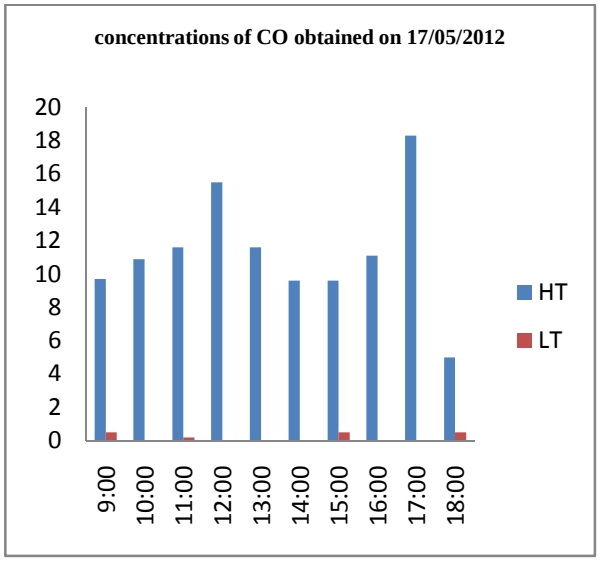
RESULTS AND DISCUSSION

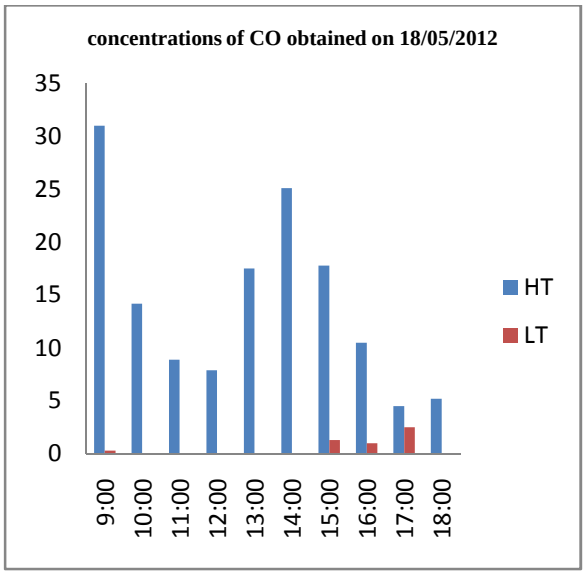
Mans activities have reached a level at which the natural system are disturbed i.e. the atmosphere, land, sea as well as plants and human beings. This has contributed to increase in traces of CO in the last century. This is as a result of continued industrial growth and development of urban areas. It has become necessary to seriously consider environmental management as a project of high importance if improved quality of life is to be guaranteed. The hourly mean concentrations of carbon monoxide presented in figure 1-6 indicated variations between the periods studied. Figure 1-6 showed the levels of CO at a high traffic (HT) and a low traffic (LT) in Enugu metropolis. Generally there was a high CO level in HT than LT in all the periods of study. HT and LT presented the highest hourly mean CO level of 35.1ppm at 16:00hrs of 14/05 and 1.1ppm at 15:00hrs of 16/05 respectively. On the whole, an average of 11.99ppm and 0.30ppm were recorded at HT and LT areas respectively. An increase in concentration was noticed between 12:00-14:00 in HT,this may be attributed to incomplete combustion of gases and high level of traffic jam observed in the area as a result of commercial activities going on in the area [21].

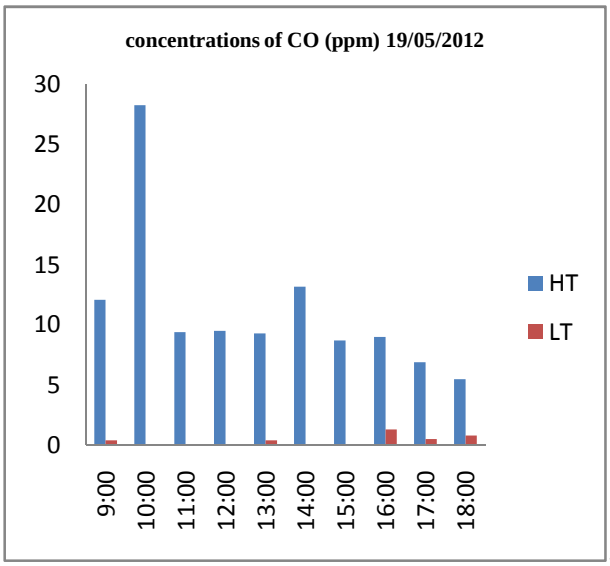

concentrations of CO (ppm) 14/05/2012
40
35
30
25
20
15
10
5
0
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
HT
LT


concentration of CO (ppm) 15/05/2012
16
14
12
10
8
6
4
2
0
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
HT
LT


concentrations of CO (ppm) 16/05/2012
25
20
15
10
5
0
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
HT
LT


concentrations of CO obtained on 17/05/2012
20
18
16
14
12
10
8
6
4
2
0
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
HT
LT


concentrations of CO obtained on 18/05/2012
35
30
25
20
15
10
5
0
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
HT
LT


concentrations of CO (ppm) 19/05/2012
30
25
20
15
10
5
0
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
HT
LT

The FEPA (Federal Environmental Protection Agency) allowed daily average limit for CO is presently 10ppm [24]. The levels of CO obtained in HT ranged from 8.6-35.1ppm and are slightly higher than the national standards. These observed levels of CO may be as a result of heavy traffic around the location, since vehicular emissions are major sources of CO levels in the atmosphere. The results of this study are in line with the findings of [22], that traffic pollutants like CO are higher in concentration at road sides or high traffic areas. [22] also reported that young men and middle aged men serving as motorway tollgates attendants in Italy, subjected to exposure to traffic pollution have their fertility impaired. The levels of CO in this study is above the safe limit and brings to mind that road side vendors are under severe threats of health hazards associated with CO exposure. Greiner and Charles (1999) [23] also reported that CO is a slow poison that kills by reducing the oxygen supply in the blood.LT which are remote from vehicular traffic gave very low concentrations of CO. Temporal variations were observed in all the sampling areas, this may be attributed to high and low traffic jam.

CONCLUSION

The results from this study showed that concentrations of CO are higher in high traffic area than the low traffic area. High traffic area showed concentrations higher than the regulatory standards, this calls for urgent need for policy readjustments, continuous monitoring and control of source point emission as well as legislative and enforcement supports from stakeholders and government agencies and proper awareness for the citizenry for health hazards associated with air pollution.

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