Assessment and Monitoring of Carbon Monoxide (CO)
Concentrations in High Traffic Areas (HTA) of
Maiduguri Metropolitan of Borno State, Nigeria

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ABSTRACT

The research investigated the carbon monoxide concentrations in heavy traffic areas of Maiduguri metropolitan between three weeks has been performed. Maiduguri City is located at latitudes 11 42N and 12 00 N and longitudes 12.54 and 13 14 E and has a land area of 543 km² in the Northern-Eastern region of Nigeria. The high concentration of Carbon monoxide (CO) pollutants in high traffic area of Post office of Maiduguri city. The high traffic area (HTA) was selected for the research and the concentration of Carbon monoxide was monitored and measured, monitoring and measurement were planned daily between 8:00 a.m. to 8:00 p.m. for three weeks. The average result obtained was the highest point of 36 ppm and lowest point of 12 ppm in the three weeks, the highest point is above both WHO and FEPA points of 25 ppm and 30 ppm, respectively.

Keywords: Air pollution, Carbon Monoxide, High Traffic Area (HTA), Maiduguri Municipal Council (MMC).

I. INTRODUCTION

Carbon monoxide (CO) is a gas which is colorless and odorless when unconfined into the atmosphere affect the concentrations level of hydroxyl radical (OH) in the chemistry of global and regional and urban atmosphere. Carbon monoxide is referred as an indirect green gas because of its close connection to atmospheric Methane (CH₄) and other greenhouse gases. Carbon monoxide is frequently found to be one of the toxic Air Pollutant in Urban air and indoor air [1]. Virtually around 50% of worldwide Carbon Monoxide emissions are from fossil fuel combustion such as diesel-powered and gasoline engines. In the metropolitan centers particularly on extremely congested roads, Stream of traffic can be liable for as much as 90-95% of the atmospheric CO levels, in that way posing a substantial hazard to human health as well as natural resources [2].

Studies [3] have revealed that more than half of the population in the world would be living in urban areas in the developing countries from 2007 to 2030 of developing countries by 2030. The fast growth of the city has an intense impact on the quality of air, which rise up as a result of increase automobiles releases of CO, especially in the developing world, mostly because of high proportion poorly maintained vehicles, old age vehicles as well as poor fuel quality [1].

Most of the researches and studies on air pollution as well as exposure to air pollutants were conducted in the world developed countries. There is no much information known on exposure to air pollution in developing countries like Nigeria particularly Maiduguri city which is the capital city of Borno State of Nigeria. The population and residents of Maiduguri city has increased rapidly in the last decade as a result of insecurity faced by the Borno State which made people to migrate to the city and the absence of a reliable public transport system. Air pollution has worsened because of an increased number of old second-hand cars, and emissions from gasoline and diesel powered engines and overpopulation.

There is presently no available data on emission and impact of air pollution in Borno state especially Maiduguri Metropolitan Council (MMC), it is anticipated that air pollution will become a major health problem if adequate not taken adequate mitigation measures. Hence, the importance of this study is to assess the CO level in a High Traffic Area (HTA) of MMC. Thereby complement the research gab present which when utilize can provide necessary data for future use in control the risk associated with the high of CO level in air.

II. MATERIAL AND METHOD

A. Study Area

Maiduguri municipal Council (MMC) is the capital of Borno state, Nigeria. Maiduguri is located between latitudes 11 42 N and 12 00 N and longitudes 12.54 and 13 14 E and has a land area of 543 km² as shown in Figure 1. The city is bounded in the north by Jere LGA, in the west, south and...
south-west by Konduga, in the north-west by Mafa LGA. Maiduguri has mean annual maximum temperature of 34.8 with mean (monthly) temperature ranging between 30 and 40 °C. The city receives rainfall from June to September. Being a nodal city, trading is the major occupation of the inhabitants with few agrarian practices. It has a population of about 521,492 people which was projected to be 746,721 for 2019 based on an annual growth of 2.8% [8].

Fig. 1. The study area MMC which is located in Borno state (Wikimedia maps).

The site chosen for this study is a very high traffic area which is located in the center of Maiduguri metropolitan council. The area is the Post Office Area, it is the epicenter and heart of MMC. It is located at the intersection of Shehu Laminu way and Ahmadu Bello way, it accommodates the main market in MMC the Maiduguri Monday market, the second largest hospital General Hospital Maiduguri, the Borno State Secretariat, Bola Motor Park, and repair services and the second largest television Borno Radio Television (BRTV) and Sanda Kyarimi Park. It even hosted the largest Phone market Jagul GSM market before been relocated as shown in Fig. 2, 3 and 4.

Fig. 2. Location of sampling station of Post Office Area Maiduguri (Source: Google Map).

Post office area is characterized by offices, retail shops, vehicular and pedestrian traffic, it serves as the main transit point for taxis, buses and tricycles (NAPEP). so, it serves as the industrial, administrative and transit center of MMC. The insecurity bedeviling Borno state has caused the influx of people into the city and corresponding increase in traffic along the post office area which provides most of the services required by citizens or acts as a transit point. Therefore, it is the wisest choice as a sample point to measure the emission of carbon monoxide that can represent the whole of MMC. Figure below shows the sample site from the map and a picture of the sample site Post Office Area, Maiduguri, Borno State.

B. Methodology

The Carbon Monoxide (EL-USB-CO Data Logger) which is calibrated as it was plugged into PC’s USB port, then easy log control software is downloaded and so many set-ups was made The EL-USB-CO Data Logger was deployed to the high traffic Post Office area for assessment. Stanley pocket tape was used to measure 3 meters above the ground and the EL-USB-CO Data Logger was mounted/placed to a surface. 12 hours CO level in Post Office area was measured from 8:00 a.m.-8:00 p.m. (the working hours) and was conducted for 2 weeks period. The daily data were transferred to the PC by plugging the module of the EL-USB-CO Data Logger straight back into the PC’s USB port, the data were imported to Microsoft Excel for subsequent data analysis and report generation.

III. RESULTS

Fig. 3. Picture of Post Office Area Maiduguri (13/04/2021 01:00 pm).

Fig. 4. Graphical representation of Week one CO levels in days within 12-hour period.
of 30 ppm, the very low reading is due to the closure of roads for sanitation as shown in Fig. 5, but there is clear correlation with Fig. 7 with only slightest drop on some days due to rainfall, and also due to closure for sanitation. It also that the device was mounted at location B: Sheyi Global Technology within the Post Office Area. The third week assessment; it is an extension week with the aim to check the effect of continuous rainfall on the levels of CO. The highest point of 38 ppm was attained and the lowest point of 8 ppm due to heavy rainfall at that particular time. There was slightly variation in the first and second week CO levels due to the rainfall as shown in Fig. 6. Therefore, rainfall cause drop in CO levels within a sampling Area because of the ceased of the CO generating activities.

Eventually, the mean of the CO level generation within the weeks as shown in Fig. 7, it is rounded to the nearest whole number for easy analysis, and it also compared with the standard values of World Health Organization (WHO) and Federal Environmental Protection Agency (FEPA) of 25 ppm and 30 ppm, respectively [4], [5]. Hence, from the chart is can be concluded that the levels are higher than the WHO recommended level and slightly higher FEPA recommended especially during the busies time during the day, when many people used the route to go to work or come back home. The levels of CO concentration in this study are mostly above the safe limit of FEPA.

V. CONCLUSION

The result obtained has shown clearly that the three weeks average Carbon Monoxide concentration were far above allowable limit as set by both International and National Standards. This indicated that people around that high traffic areas have been exposed to this pollutants of Carbon monoxide, therefore this necessitate the need to design an effective control measures such as efficient transport system, remove old vehicles that’s give out smoke, and Good road network.

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