ISSN: 2230-9926

Available online at http://www.journalijdr.com

IJDR

International Journal of Development Research
Vol. 13, Issue, 05, pp. 62581-62585, May, 2023
https://doi.org/10.37118/ijdr.26644.05.2023

RESEARCH ARTICLE OPEN ACCESS

THE EFFECTS OF AUTOMOBILE EMISSION NITROGEN DIOXIDE (NO_2) ON THE ENVIRONMENT IN TARABA STATE, NIGERIA

***Ezekiel Usman Jabba and Engr Aminu Baba Usman**

Adamawa state Polytechnic, Dept. Mechanical Engineering, Yola

ARTICLE INFO

Article History:

Received 19th March, 2023
Received in revised form
07th April, 2023
Accepted 28th April, 2023
Published online 24th May, 2023

KeyWords:

Automobile, Nitrogen dioxide, Effects, Environment and Emission.

****Corresponding author:***
Ezekiel Usman Jabba,

ABSTRACT

This study was designed to investigate The Effects of Nitrogen Dioxide (NO_2) Emission on The Environment in Taraba State, Nigeria, The research were conducted in five (5) days and readings were taking morning, afternoon and evening at roads where there is high traffic concentration in the six study areas. Q-Rae Plus Multi-gas Monitor was used to collect data on NO_2. The average mean results of 0.063ppm revealed that the pollutants of NO_2, were above the Federal Environmental Protection Agencyof Nigeria (FEPA) minimum standard limit in Jalingo and KarimlamidoFrom this study, it could be concluded that the concentrations of NO_2, emitted in Taraba state is above the minimum set by FEPA and is dangerous The following recommendation was made based on the findings of the study. There is need for effective legislation and regulation which will guarantee these standard as well as conferment of power and duties on specific government bodies such as NESREA and state government agency with regard to air quality and there is the need for immediate and effective traffic control programmes, road network to reduce idling period for vehicles and motor cycles on highways and streets.

Citation*: *Ezekiel Usman Jabba and Engr Aminu Baba Usman. 2023. *"*The effects of automobile emission nitrogen dioxide (NO_2) on the environment in Taraba State, Nigeria". *International Journal of Development Research*, 13, (05), 62581-62585.

INTRODUCTION

Nitrogen dioxide (NO_2) is one of the groups of highly reactive gas known as oxide of nitrogen or nitrogen oxide (NOx). Other nitrogen oxide includes nitrous acid and nitric acid. NO_2 is used as the indicator for the larger group of nitrogen oxide. NO_2 primarily gets in the airfrom the burning of fuel NO_2 form emission from cars, trucks and buses, power plants and of the road equipment (EPA, 2017). Vehicle with internal combustion engines provide transportation worldwide. They can be broadly classified as road vehicle and non-road vehicles. In the beginning of the 21st century more than 600 million such vehicles are engaged in ever increasing transportation activities (Cholakov, 2018). Internal combustion engines operate by burning fossil fuel derivatives and produce exhaust emissions, which are their major contribution to environment pollution, Primary greenhouse gases, carbon dioxide, methane nitrous oxide and all criteria pollutants, carbon moNOxide, nitrogen oxide, sulfur dioxide, non-methane volatile organic compounds and particulate matter are major components. Toxic compounds emitted include benzene, butadiene, aldehydes and lately ethers, methanol etc. Noise and odor pollution is also created by internal combustion engines (Cholakov, 2018). Emission from mobile sources constitute a major negative anthropogenic influence on the environment. In 1997, they were roughly 30,4 and 67percent of the generated in the USA CO_2, CH_4, and N_2O.

Total emissions of nitrogen oxides (NOx) from mobile sources represented 49 percent of national emissions, while CO, and SO_2 emission contributed approximately 81,40 and 7 percent, respectively. Emission of particulate matter in the USA for the same year are reported as particulate matter smaller than 10 microns (PM_{10}) - 2.569Gg and total particulate matter (PT) -5.489. Automobile emission is emitted from "on-road" diesel engines (vehicle engines) or "nonroad" diesel engines (locomotives, marine vessels, heavy-duty equipment, etc.). Nationwide, data in 1998 indicated that diesel engine (DE) as measured bydieselparticulate matter (DPM) made up about 6% of the total ambientparticulate matter ($PM_{2.5}$) inventory (i.e., particles with aerodynamic diameter of 2.5 micrometers or less) and about 23% of the inventory, if natural and miscellaneous sources of $PM_{2.5}$ are excluded. Estimates of the DPM percentage of the total inventory in urban centers are higher. For example, estimates range from 10% to 36% in some urban areas in California, Colorado, and Arizona. Available data also indicate that over the years there have been significant reductions in DPM emissions from the exhaust of on-road diesel engines, whereas limited data suggest that exhaust emissions from non -road engines have increased (U.S, 2002). Human activities have begun to affect the environment through the release of pollutants (known as greenhouse gases or global warming pollutants) that exacerbate the earth's natural greenhouse effect. The environmental costs of automobile emission are hard to measure and vary according to indigenous conditions. Health cost estimates from indigenous automobile emission in the Los Angeles region of the US

in 1992 was reported by Small and Kazimi (1995) to be $0.03 per vehicle-mile. McCubbin and Delucchi (1996) corroborated this fact, and stated further that health cost as a result of automobile emission could be as high as ten times that of cars and small buses. In both studies most of the health hazards are as a result of the increased mortality due to the presence of volatile organic compounds, NO2 and SO_2 in the inhaled air. The rest of the hazards are due to minorillness from ozone (O_3), formed in the atmosphere from volatile organic compounds (VOCs) and NOx. Salami (2007), noted that vehicular emission has become the most complicated environmental challenges. Automobile emission also contributes to the environmental problems of acid rain and global warming". Automobile emission affects climate directly and indirectly through mechanisms that cause both warming and cooling of climate, and the effects operate on very different timescales. For instance, Terje and Jan (2008), noted that in the year 2000 emissions, automobile emission has the largest effect on global mean temperature and this affect the climate in a variety of ways. The emissions consist of long-lived greenhouse gases mainly CO, short-lived chemically active gases (NOx, and VOCs) that indirectly lead to changes in greenhouse gases and emissions of short-lived aerosols and aerosol precursors (black carbon, organic carbon, and SO_2).

In comparing the total effects of automobile emission several issues need to be raised, some of which are scientific in nature, and some of which touch on value-related issues that go beyond what science alone can answer. The primary cause of the difficulties is the fact that the lifetimes/adjustment times of the various components span from hours to centuries, which raises two main questions, how does one compare hazard impacts that occur across different timescales? For example, how should the effects of emissions of black carbon aerosols that cause a large but relatively short-term warming be compared with the effects of CO which persists centuries after the time of emission? Short lifetimes mean indicates that the climate effects of some emissions can be very dependent on their location. This is particularly true for automobile emissions, which show large regional variations and operate in quite separate compartments of the atmosphere. Automobile emission contribute to greenhouse effect which is a natural phenomenon in which gases in the earth's atmosphere, including water vapour and carbon dioxide, trap radiation from the sun near the planet's surface. The greenhouse effect is necessary for the survival of life; without it, temperatures on earth would be too cold for humans and other life forms to survive. But human activities, particularly over the last century, have altered the composition of the atmosphere in ways that intensify the greenhouse effect. Since 1750, for example, the World Meteorological Organisation, (WMO, 2006) observed that the concentration of carbon dioxide (the leading global warming pollutant) in the atmosphere has increased by thirty five percent as a result of human activity.

The Inter-Governmental Panel on Climate Change (IPCC) (2001) also stated that the current rate of increase in carbon dioxide concentration is unprecedented in the last 20,000 years; concentrations of other environmental pollutants have increased as well. According to the 2007 Assessment Report by the IPCC, the report indicated that the absence of emissions reductions has contributed to global temperatures and are estimated to increase by about 4°C, with the potential to go as high as 7°C or higher. This level of warming will have devastating effects on human life. By mid-twenty first century, the report also indicated that more than a billion people will face water shortages and hunger, including 600 million in Africa alone. Weather extremes, food and water scarcity, and climate-related dangerous public health conditions are projected to drive the displacement of between 150 million and 1 billion people as global warming unfolds (IPCC, 2007b). The rate of economic growth in any nation is to some extent dependent on the health of the citizenry and cleaner environment, the importance of automobiles particularly in the urban area cannot be over emphasized but the danger pose by the effects of automobile emissions to the health and the environment has become a serious issue that need to be assessed. Gazali, (2014), we have grown to accept the smell of engine exhaust as a part of everyday life our nation is experience an epidemic of illness made worse by air pollution. Government understanding of the severity of air pollution depends upon what is being monitored and where the monitoring occurs. Air quality varies across space and time, and is dependent upon climatic conditions. It is poorest, but may not be monitored, where traffic is most intense, normally where highways slow near urban areas, near construction sites, and where trucks, buses, and cars tend to concentrate and idle: schools, hospitals, shopping centers, truck stops, warehouses, ports and shipping facilities, oil tank farms, rail stations, bus terminals, and where gas- and diesel-powered vehicles are used within warehouses or ships. It should be noted that perfectly operating automobile engines would produce only water (H_2O) and carbon dioxide (CO_2) in the process of fuel combustion. However, in the real world of imperfect engines, improper fuel grades, lack of regular maintenance, physical ageing of engines, intensive use of vehicles and misuse of lubricants, all these factors combine to produce a constraint on perfect fuel combustion. The ultimate effect is the emission of CO, Hydrocarbons (HCs) and NOx from the exhaust system and engine parts of Automobile vehicles, particularly those using diesel as fuel. The danger posed by automobile emission should therefore influence environmental policy directed at improving the environment. Scientific experts now believe the nation faces an epidemic of illnesses that are exacerbated by air pollution. These illnesses include cardiovascular disease, asthma, chronic obstructive pulmonary disease, lung cancer, and diabetes.

The environmental costs of automobile emission are hard to measure and vary according to local conditions. Health cost estimates from local automobile emission in the Los Angeles region of the US in 1992 was reported to be $0.03 per vehicle-mile. McCubbin and Delucchi (1996) corroborated this fact, and stated further that health cost as a result of automobile emission could be as high as ten times that of cars and small buses. In both studies most of the health hazards are as a result of the increased mortality due to the presence of volatile organic compounds, NO2 and SO_2 in the inhaled air. The rest of the hazards are due to minor illness from ozone (O_3), formed in the atmosphere from volatile organic compounds (VOCs) and NOx. Salami (2007) noted that vehicular emission has become the most complicated environmental challenges.Automobile emission also contributes to the environmental problems of acid rain and global warming". Automobile emission affects climate directly and indirectly through mechanisms that cause both warming and cooling of climate, and the effects operate on very different timescales. For instance, in the year 2000 as reported by (Schwela,2000) automobile emission has the largest effect on global mean temperature and this affect the climate in a variety of ways. The emissions consist of long-lived greenhouse gases mainly CO, short-lived chemically active gases (NOx,) that indirectly lead to changes in greenhouse gases and emissions of short-lived aerosols and aerosol precursors (black carbon, organic carbon, and SO_2). In comparing the total effects of automobile emission several issues need to be raised, some of which are scientific in nature, and some of which touch on value-related issues that go beyond what science alone can answer. The primary cause of the difficulties is the fact that the lifetimes/adjustment times of the various components span from hours to centuries, which raises two main questions, how does one compare hazard impacts that occur across different timescales? For example, how should the effects of emissions of black carbon aerosols that cause a large but relatively short-term warming be compared with the effects of CO which persists centuries after the time of emission? Short lifetimes mean indicates that the climate effects of some emissions can be very dependent on their location. This is particularly true for automobile emissions, which show large regional variations and operate in quite separate compartments of the atmosphere. Automobile emission contribute to greenhouse effect which is a natural phenomenon in which gases in the earth's atmosphere, including water vapour and carbon dioxide, trap radiation from the sun near the planet's surface. The greenhouse effect is necessary for the survival of life; without it, temperatures on earth would be too cold for humans and other life forms to survive. But human activities, particularly over the last century, have altered the composition of the atmosphere in ways that intensify the greenhouse effect. Since 1750, for example, the World

Meteorological Organisation, (WMO, 2021) - The abundance of heat-trapping greenhouse gases in the atmosphere once again reached a new record last year, with the annual rate of increase above the 2011-2020 average. That trend has continued in 2021, according to the World Meteorological Organization (WMO) Greenhouse Gas Bulletin.Concentration of carbon dioxide (CO_2), the most important greenhouse gas, reached 413.2 parts per million in 2020 and is 149% of the pre-industrial level. Methane (CH_4) is 262% and nitrous oxide (N_2O) is 123% of the levels in 1750 when human activities started disrupting Earth's natural equilibrium. The economic slowdown from COVID-19 did not have any discernible impact on the atmospheric levels of greenhouse gases and their growth rates, although there was a temporary decline in new emissions. (WMO, 2006) By mid twenty first century, the report also indicated that more than a billion people will face water shortages and hunger, including 600 million in Africa alone. Weather extremes, food and water scarcity, and climate-related dangerous public health conditions are projected to drive the displacement of between 150 million and 1 billion people as global warming unfolds (IPCC, 2007b). The rate of economic growth in any nation is to some extent dependent on the health of the citizenry and cleaner environment, the importance of automobiles particularly in the urban area cannot be over emphasized but the danger pose by the effects of automobile emissions to the health and the environment has become a serious issue that need to be assessed.

In 2005, the World LP Gas Association conducted research to identify the health effects of automobile emission and reported that cancers and bronchial illnesses, stemming from inhalation of fine particles in automobile emission, have been identified as being a health risk of great concern. Automobile emissions are also key constituents of photochemical smog, which has debilitating respiratory effects on the residents of many large urban areas. Some transport fuels also contribute to a long list of highly toxic air contaminants which, although present in very low concentrations, include known carcinogens and are now suspected to have links with many "20th Century" illnesses, including higher incidence of asthma and allergies.

In 2000 the World Bank summarized the airborne particle problem as follows:

"High concentrations of suspended particulates adversely affect human health, provoking a wide range of respiratory diseases and exacerbating heart disease and other conditions. Worldwide, in 1995 the ill health caused by such pollution resulted in at least 500,000 premature deaths and 4-5 million new cases of chronic bronchitis." The European Union, (EU) in its wide-ranging Extern-E study to quantify the economic effects of automobile emissions, concluded that the total social cost to EU member states was equivalent to between one and two per cent of GDP (85 to 170 billion Euros) No single strategy will provide a solution to this pervasive problem, but policies and strategies that lead to a significantly increased uptake of cleaner fuels can greatly reduce levels of those pollutants that do most harm to humans. In conclusion, automobile emission has severe adverse health impacts on the community, especially for people living in urban areas or in locations close to busy roads.

The resultant health care and lost productivity costs are very high, especially where there are large numbers of vehicles. For many countries, the net health costs of vehicle emission have been estimated to exceed percent of national GDP. The early adoption of rigorously implemented transport fuel policies, which lead to a strong uptake of cleaner gaseous fuels, can play a very significant role in reducing automobile emission and its consequential harm to the community and the national economy. Environmental protection agency national greenhouse gas (GHG) emission standards for passenger cars and light track for model 2023 -2026, the final standard would achieve significant GHG emissions reduction along with reductions in other criteria pollutant. The rule would result in substantial public health and welfare benefit. While provide consumers with saving fromlower fuel cost

Statement of the Problem

Despite the support from the governmentand Environmental protection agency there are still poor emission control.Petrol and diesel fuel possess a lot ofhealth hazard. However, petrol and diesel fuel persist as the major source of energy for our transportation system with higher pollutant and Green House Gas (GHG) emissions particularly CO, NO_2 and SO_2. Emission from automobile is growing at an alarmingrate due to per capital vehicle ownership, thus resulting to high congestion and increase in the concentration of automobile emissions, thereby increasing health risk on human population. The environmental problems in terms of health effects of automobile emissions are high. Though, these automobiles also offer significant benefits related to personal freedom, mobility, and consumer affordability. The health effects of automobile emissions can be reduced and one approach to achieving this goal is to substitute alternative fuels for petrol and diesel, but Heather, Lester, Rebecca and Satish (2000) noted that continuing low fuel prices and the recent rapid improvement in performance of petrol and diesel fueled automobiles make it ever more difficult for the alternative fuels to compete and safe the health of the citizens. Ndoke and Jimoh, (2000) carried out a similar study in Minna and the maximum value for CO emission obtained was 15ppm still lower than the 8 hourly value of 20ppm stipulated by Federal Environmental Protection Agency of Nigeria (FEPA). The number of motor vehicles, motor cycles and filling stations in the state is on the increase, all these use petrol and diesel for energy with great negative heath impact, hence the need for the assessment of quantities of automobile emissions, the health effects and government measures necessary to reduce its effects in Niger State.

Purpose of the Study: The purpose of this research was to assess the effects of Nitrogen dioxide on the on-People's Health in Taraba state, Nigeria. Specifically, the study intended to assessed:

1. The quantity of nitrogen dioxide (NO2) contributed by automobile emission to the environment in Taraba State, Nigeria.

Table 1. Nigerian Ambient Air Quality Standard

Pollutants	Time of Average	Limit
Particulates	Daily average of daily values 1 hour.	250 ug/m^3 *600 ug/m^3
Sulphur oxides (Sulphur dioxide)	Daily average of hourly values 1 hour	0.01 ppm (26 ug/m^3) 0.1 ppm (26 ug/m^3
Non-methane Hydrocarbon	Daily average of 3-hourly values	160 ug/m^3
Carbon moNOxide	Daily average of hourly values 8-hourly average	10 ppm (11.4 ug/m^3) 20 ppm (22.8 ug/m^3)
Nitrogen oxides (Nitrogen dioxide)	Daily average of hourly values (range)	0.04 ppm-0.06 ppm (75.0 ug/m^3-113 ug/m^3)
Photochemical oxidant	Hourly values	0.06 ppm

Federal Environmental Protection Agency (1991)

The United State Environmental Protection Agency (EPA) has set a national ambient air quality standard of 0.12 ppm (240ug/m^3) for ozone on a 1-hour average basis and standard of 0.08ppm (160ug/m^3) for total photochemical oxidant (expressed as ozone) on a 1-hour average basis to be exceed not more than one year, (Revi and Diana, 2012). This research assessed the quantity and effects of Nitrogen oxide to People's Health in Taraba state, Nigeria with specific assessment on the quantity ofNO2 contributed by automobile emissions.

Instruments for Data Collection: Q-Rae Plus Multi-Gas Monitor, PGM-2000/2020, was used to measure and record NO2 were measured by electrochemical sensors with a range of 0 to 20ppm and a 0.1ppm resolution. The sensor response time is20 - 25 seconds for NO2. Its operating temperature is between -20^{0}C to 45^{0}C (-4^0 F to 113^{0}F) and its operating humidity is between 0% and 95%.

Table 2. Mean Concentrations of NO_2 Emitted in the Study Area of Taraba State

Location	Day 1	Day 2	Day3	Day 4	Day 5	Avarage meam (PPM)
Jalingo	0.07	0.07	0.06	0.07	0.06	0.07
Karin lamido	0.06	0.07	0.07	0.06	0.07	0.07
Genbu	0.05	0.05	0.05	0.05	0.05	0.05
Bali	0.06	0.07	0.07	0.06	0.07	0.07
Takum	0.06	0.05	0.06	0.05	0.06	0.06
Zing	0.07	0.05	0.06	0.05	0.06	0.06

Method of Data Analysis: The data collected for NO, with the use of computer analyser for research was analysed using mean and statistics, with excel computer software.

DISCUSSION

The finding of the study revealed quantity of NO_2 measured in Jalingo, Karimlamido,and Bali out of the six research areas is high than the 0.04 -0.06ppm minimum standard stipulated by the Federal Environmental Protection Agency, Gembu is within the range, while Takum and Zingread almost exactly as the standard. WHO, (2000) stated that road traffic is responsible for half the total NO_2 emissions. Goyal (2006) also supported the fact that automobile emissions contribute about 50-80% of NO_2 concentration in developing countries. This situation is alarming and it is due to the poor economic development of the developing countries. Poor vehicle maintenance culture and importation of used vehicles which culminate to an automobile fleet dominated by a class of vehicles known as ''super emitters'' with high rate of harmful emissions. Long term effects from NO_2 exposure from automobile emission reacts with hydrocarbons to produce ozone and result to respiratory irritant which is known to exacerbate asthma.

CONCLUSION AND RECOMMENDATION

From the research, the concentrations of NO_2 emitted in Taraba state is 0.063ppm above the minimum set by FEPA and is dangerous. NO_2 has normally been the gas which has been the indicator for traffic pollution. It is toxic in low and highly concentration leading to a wide range of health effects. NO_2 consist of nitric oxide and nitrogen dioxide formed by the reaction of oxygen and nitrogen within an engine's combustion chamber. While at a low level it affects the ozone which is directly harmful to human health by causing respiratory problems and reducing lung function. Although this study is limited, it does appear that residence of Taraba state has a high risk of health problems related to automobile emissions.

Recommendations: The following recommendation was made based on the findings of the study.

1. There is need for operational legislation and regulation which will security these standard as well as conferment of power and duties on specific government bodies such as NESREA and state government agency with regard to air quality.
2. There should be consistent and efficient mass transport system to reduce the numberof vehicles and motor cycles on our roads and therefore reduce the emissions of NO_2
3. Standard Inspection and maintenance test for vehicle and motor cycle should be made compulsory
4. There should be good education, mass awareness and establishment of numerical air quality standard and limit values for individuals' pollutant with the potential to the settlement of differences public health programs on the health effects of automobile emissions in Taraba State.

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