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Environmental Impact Analysis of Selected Vehicle Emissions in Nigeria

Oluremilekun Ropo Oyetunji[1], Kehinde Temitope Alao[2*], Taiwo O. Alao[2], Temidayo Lekan Oladosu[3], Inerie N. Eromosele[1], Oladele John Olatoyan[4]

[1]*Department of Mechanical Engineering, Ladoke Akintola University of Technology, Ogbomoso, Nigeria*
[2]*Department of Mechanical Engineering, Universiti Teknologi Petronas, 32610, Seri Iskandar, Perak, Malaysia*
[3]*Institute of Sustainable Energy, Universiti Tenaga Nasional (UNITEN), Selangor, Malaysia*
[4]*Department of Civil Engineering, Redeemer's University, Ede, Osun, Nigeria*

Abstract

This study was conducted to examine some vehicular emissions pollution and the consequences those emissions have on the environment when they are released into the air on our highways. Every day, more secondhand cars are being brought into Nigeria, which adds to the rising pollution levels in the environment. Using the Ilorin axis as a case study, this study investigated the impact of car emissions on the ecosystem. A vehicle emission test experiment was conducted on 65 automobiles at the University of Ilorin, Faculty of Engineering, University of Ilorin Teaching Hospital, and Kpataloje Mechanic Site in Ilorin, Kwara State, to evaluate the levels of Carbon Monoxide (CO) and Nitrogen Oxide (NO_2) produced by gasoline-powered vehicles. Exhaust Gas Analyzer Monitor (Aeroqual Series 500) with sensor head mounted on monitor base was used to conduct the emission test. The Exhaust Gas Analyzer sensor inlet was placed 20 cm from the exhaust tailpipe end on stationary automobiles operating at idle speed for five (5) minutes in order to detect Carbon Monoxide (CO) and Nitrogen Oxide (NO_2). To ascertain the health impacts in the sample locations, 350 randomly chosen participants from the three research locations in Ilorin, Kwara State, were given a structured questionnaire.

The results from the sample vehicle population tested, after exhaust gas composition analysis was done with gasoline engines, show that the older the vehicle, the higher the emission level, the longer it has been in service, the older it was when it was last serviced, the higher the mileage the vehicle has travelled, and the older it was when it was manufactured/first registered. Less than half of the examined vehicles met the recommended World Health Organization requirements, according to the results of the test. The results from the sample population show that the immediate consequences of the exhaust gas pollutants are odour, eye irritations, and throw-ups. The findings also indicate that many people appear to suffer from ailments associated to exhaust gases, such as cancer, asthma, and other diseases. 94% of the people in the sample agreed that the government is doing nothing to reduce the exhaust emissions coming from our roadways, parking lots, and mechanic shops.

Keywords: Vechular emission • Health hazard • Pollution • Nitrogen dioxide • Carbon monoxide • Analyzer monitor aeroqual series 500 • Questionnaire • Effect of emissions

Introduction

The preservation of life on Earth depends on the environment, which is crucial to human civilization. Without a healthy environment, it's likely that humans cannot survive, and "the Pollution"—which is primarily brought on by road transportation—is a huge environmental problem that is creating a great deal of worry. The use of private transportation has increased significantly as a result of the country's urbanization, which has been growing slowly in most areas. Major sources of air pollution have included meteoric urbanization and heavy car use [1]. Almost all countries now rely mostly on private vehicles as the primary mode of transportation. Vehicle emissions have been steadily rising as more people use their own vehicles for a variety of activities, which might seriously harm the environment.

***Address for Correspondence:** Kehinde Temitope Alao, Department of Mechanical Engineering, Universiti Teknologi Petronas, 32610, Seri Iskandar, Perak, Malaysia; Tel: 07038874457, E-mail: kehindetemitope9@gmail.com*

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One of the main sources of the air pollutants that cause smog is the operation of motor vehicles. Fuel combustion and evaporation produce emissions in motor vehicles. Diesel and gasoline are the two most widely used types of transportation fuels. Pollutants like Carbon Monoxide (CO), Carbon Dioxide (CO_2), total Nitrogen Oxides (NOx), Sulfur Oxides (SOx), Hydrocarbons (HC), and Particulate Matter (PM) are released when gasoline in a vehicle is burnt [2]. Over 4 billion years ago, the planet naturally warmed due to the greenhouse effect. The GHGs in the atmosphere support life as we know it in their usual amounts, but when their concentrations rise, a very serious problem arises. Researchers are becoming more and more concerned that human activities, particularly in the transportation industry, are altering this natural process and bringing these gas concentrations to toxic levels, which could have serious effects on the environment and human health [1].

Climate change is mostly brought on by air pollution, which also contributes to acid rain, global warming, ozone layer depletion, and other serious environmental dangers. The widespread climate issues, such as severe flooding, droughts, etc., are causing a lot of concern. Already impacted by these environmental catastrophes is Nigeria. Other environmental risks include water contamination that kills aquatic life and soil degradation that results in low agricultural productivity. Air pollution irritates the eyes, affects the respiratory system (cough, bronchitis, etc.), kidneys, nervous and immune system, cardiovascular, reproductive, and developmental systems, and causes birth defects, cancer, and occasionally even death. Children, the elderly, and those who have respiratory conditions like asthma are the most at risk. No country can live without vehicles notwithstanding the negative effects that vehicle emissions have on the environment and human health. Vehicles are crucial resources for a country's socioeconomic progress [2]. They act as quick and effective methods of moving people, as well as products and services, from one location to another. They make our life more convenient and simple. Tricycles, motorbikes, automobiles, buses, trucks, trains, airplanes, engine-powered boats, etc. are only a few examples of the different kinds of transportation. Vehicle emissions are becoming a global concern due to the significant benefits they provide in terms of the environment and human health. The bulks of used cars in Nigeria are second-hand ("tokunbo"), poorly maintained, and have subpar engines. These types of cars are well recognized for spewing out significant amounts of toxic air pollutants (GHGs), which have negative effects on the environment and human health. This research work is therefore aim to study the effects of vehicles emission on the environment using Ilorin axis as a case study.

Literature Review

Environmental pollution

The discharge of any material that is hazardous to the environment or human health constitutes pollution. Environmental refers to the release of dangerous pollutants into the environment that endanger the activities of living things and the natural world [3]. According to Yuksel T and Michalek JJ [4], environmental pollution is the contamination of the earth's physical and biological constituents to the point that it adversely affects the system's regular environmental processes. Large-scale environmental issues have recently arisen as a result of insufficient environmental planning and monitoring. Environmental issues, which are frequently linked to development, are complicating this scenario in many parts of certain Nigeria [2]. Air pollution, water pollution, noise pollution, soil pollution, and light pollution are among the main categories of environmental pollution. When there are enough of certain compounds in the air to threaten plant and material health and welfare, as well as human and animal comfort, air pollution develops. Environmental issues, such as air pollution in urban centers brought on by increased traffic on poorly designed roadways, are exacerbating the already substantial issues brought on by subpar, non-existent, or insufficient sanitary facilities.

Ameh, et al. state that both natural and man-made activities can contribute to air pollution. One such activity is vehicle emissions, which get their energy from the burning of fossil fuels. Vehicles release exhaust gases into the atmosphere during combustion, which poses major risks to both the environment and human health. Carbon Monoxide (CO), Sulfide Oxides (SOx), Nitrogen Oxides (NOx), Ozone (O_3), hydrocarbons, and particulate matter are all components of these emissions. Greenhouse Gases (GHGs) are the name given to some of these gases. Acute and chronic effects are two categories into which adverse effects of air pollution on people can be categorized (Ameh, et al.). Short-term exposure to high concentrations of air pollutants causes acute impacts to appear right away, whereas long-term exposure to low concentrations of air pollution results in chronic consequences that take time to appear. As a result, ground level ozone (O_3), sulphur dioxide, nitrogen dioxide, and carbon monoxide are particularly dangerous for adults, children, and those with heart and lung disorders such as asthma, bronchitis, and emphysema. As well as impairing the body's ability to fight infection and raising susceptibility to illness, it can also cause eye and noise irritation and dry up the nose and throat's protective membranes. Breathing passageways can get inflamed by bruise, which reduces the lung's functional capacity and results in shortness of breath, pain with deep inhalation, wheezing, and coughing. Environmental protection agency listed some of the following health issues caused by emissions in (Table 1) below:

Vehicular emission

Due to the delay caused by this phenomenon, emissions are concentrated in those places. Fuel gas is burned to produce energy for vehicles Diagi B, et al. [5]; during this process, exhaust gases are emitted into the atmosphere. According to research by Mmom PC and Essiet U [6], automobiles traveling through Nigeria's major urban areas are expected to produce 80% of all carbon monoxide, 50% of all hydrocarbons, and around 40% of all nitrogen oxides. According to studies Diagi B, et al. [5], Mmom PC and Essiet U [6], Oguntoke O and Yussuf AS [7], Okunola OJ, et al. [8], the morning, during break time (during the afternoon), and the evening are the times of day when vehicle emissions are at their highest in Nigeria. This is a result of the gridlock encountered during these peak times. Exposure to these pollutants can cause both immediate and long-term health problems in living things, including people.

Table 1. A summary of health concerns due to different petrol pollutants.

Pollutant	Health Concern
Nitrogen dioxide	Lung irritation, respiratory illness, and premature death
Carbon Monoxide	Headaches and reduces mental alertness
Particulate matter	Increased respiratory disease, lung damage, cancer and premature death
Sulphur dioxide	Increase in existing heart disease, breathing difficulties and respiratory illness
Ozone	Breathing difficulties, respiratory infections and lung and tissue damage

According to a recent study by Chen C, et al. [9], varying average speeds, vehicle masses, and distributions of acceleration and deceleration cause vehicles to exhibit varied Vehicle Specific Power (VSP) profiles, which in turn cause various emission factors. Similar findings were made by Chandan M, et al. [10], who demonstrated that NOx emissions might vary by a factor of three when evaluated using various chassis dynamometer test regimens. The significance of planning a test cycle that accurately simulates real-world activities is further reinforced by these insights. By comparing the data, it was discovered that, depending on the operating circumstances, injection timing variations could double NOx emissions. Lim MCH, et al. [11] added to the evidence by indicating that engine operating conditions have a significant impact on the rate of pollution emission, and that higher power operation of a vehicle increases fuel consumption, which in turn increases the rate of pollution emission. According to Chen C, et al. [9], vehicle emission rates were widely dispersed and highly affected by variables including speed and acceleration. The emission rates of CO, Total Hydrocarbons (THC), and NOx were shown to be varied even under the same acceleration, but they revealed a closer association with vehicle driving cycle and fuel burning. According to their data, low-speed situations with rapid acceleration and deceleration, particularly in congested areas, were the main causes of aggravated vehicle emissions and excessive CO and THC emissions. They continued by explaining that as a vehicle accelerates, the gas combination builds up quickly and the combustion environment deteriorates, causing a high THC concentration to first peak, then a peak in the CO concentration. THC and CO concentrations gradually decline as combustion conditions improve, but NOx concentrations rise as a result of the greater exhaust gas temperature.

The history of inspections and maintenance is a crucial component that has lately been linked with car emissions. Older automobiles with poor maintenance typically produce more pollutants than newer ones, according to a few recent studies by Huang Y, et al. [12]. Due to poor engine combustion brought on by their high usage rates and minimal maintenance, Chen C, et al. [9] also noted that older vehicles had higher CO emission factors but lower NOx emission factors. To further understand the connection between vehicle emission behaviour and maintenance history, they advised conducting additional research with a larger sample size [13]. To understand the social, economic, and environmental effects of various alternative diesel fuels, much research is being done in this area. Diesel fuel characteristics, emissions composition, and their biological impacts have all been determined to have a quantitative link. The use of alternate fuels to lessen the negative effects of diesel emissions on the environment was studied by Chincholkar SP, et al. [14]. They determined that biodiesel, an ester-based fuel made from vegetable oil, should be prioritized because it is devoid of sulfur and aromatic chemicals and can be utilized in diesel engines without the need for modifications. In addition to being renewable, biodegradable, and non-polluting, biodiesel is a fuel. Turrio-Baldassarri L, et al. [15] also noted that Rape seed oil-based Methyl Esters (RME), which is popular in the US, is less widespread in Europe than soy bean esters. The researcher discovered no significant changes between diesel and biodiesel (B20) in their comparison research of pollutants such THC, CO, NOx, and PM, but they did note a 3% increase in B20's fuel consumption. The chemical and physical makeup of the particulate matter from both fuels was identical, with the majority of the particles falling between 0.06 and 0.3m. The study discovered that even though the mass emission of particulate matter from the two fuels was the same, a slight variation in the number of fine particles led to a larger variation in the number of ultra-fine particles, recommending a comparison of the particle size distribution of various fuel grades to comprehend their potential risk to people. In comparison to diesel, all of the B20 modes showed a rise in ultra-fine fractions and a decrease in fine fractions, according to the study. According to Turrio-Baldassarri L, et al. [15], Howes P and Rideout G [16] and Krahl J, et al. [17], the amount of formaldehyde significantly increased when biodiesel was blended. Nabi MN, et al. [18] found greater NOx emissions but lower CO and smoke emissions when comparing diesel-biodiesel blends to conventional diesel fuel.

Vehicular indoor air quality

This section covers the conclusions of a thorough examination of the published studies and research on the quality of the air inside moving vehicles. Lohani D, et al. [19] makes an effort to track, evaluate, and forecast the air quality within the car. A sensor drone, an off-the-shelf sensor, is connected to an Android smartphone *via* Bluetooth Low Energy in the researcher's suggested sensing system. Using Auto Regressive Integrated Moving Average (ARIMA) and Support Vector Regression (SVR), the data generated from the proposed sensor system is then used to conduct a prediction study of CO_2 build-up inside the vehicle chamber. SVR beat ARIMA in estimating the CO_2 buildup within the vehicle, with Root-Mean-Square Error for the two models being 47.91 ppm and 55.32 ppm, respectively. Saikin AM, et al. [20] describe the findings of experiments conducted to improve the method for evaluating the level of dangerous compounds in the air of the vehicle interior coming from the supply system and exhaust system of the vehicle under test, as stipulated in GOST 33554-2015. On the basis of the research findings, proposals were made for the "Vehicle Interior Air Quality" working group, which is a part of the World Forum for Harmonization of Vehicle Regulations (WP.29) of the United Nations Economic Commission for Europe. Driving along the routes on the FSUE "NAMI" testing ground and parking in specifically chosen locations with the whole vehicle was used to determine the amount of air pollutants in the vehicle compartment under various engine and ventilation system operating conditions.

According to research by Solomon GM, et al. [21], the black carbon level at the back of a school bus with closed windows may be up to four times higher than in a passenger automobile in front of the bus. Black carbon and PM2.5 concentrations inside commuter school buses were reported to be 5–10 times higher than rural background values by Wargo J, et al. [22] in a related investigation. In a study conducted by Rodes, et al. the researchers looked at a number of variables that affected indoor concentrations and came to the conclusion that driving lane (e.g., carpool lane *vs.* right lane), roadway type, congestion level, and time of day had a significant impact. They also found that ventilation settings and vehicle type had little effect on pollutant concentrations. The research findings revealed that, compared to driving buses, idling vehicles with open windows had higher mean concentrations of particles and black carbon, although there was no discernible difference in concentration between the front and back of the bus. Both Solomon GM, et al. [21] and Wargo J, et al. [22] proposed various measures, such as banning bus idling, retrofitting buses with particle traps and catalytic converters, using ultra-low sulfur fuels, allocating the cleanest buses to the longest route, limiting ride duration, buying alternative fuel school buses, and keeping windows open on school buses, to successfully reduce children's exposure to DPM [23]. They also recommended allocating the cleanest buses to the longest routes.

Materials and Methods

The following items were utilized in the research:

- Designed Questionnaire
- Aeroqual series 500 gas analyzer monitors
- Heads of sensors (CO) and (NO_2)
- A variety of gasoline-powered automobile brands

The following are the ways of approach employed in this work:

- Creation and Administration of Questionnaire (Survey)
- Carbon Monoxide (CO) and Nitrogen Oxide (NO_2) emission measurements using an experimental design

Experimental procedures

In this investigation, the emissions that were particularly measured at the tailpipe of the vehicle exhaust were Carbon Monoxide (CO) and Nitrogen Dioxide (NO_2). After properly attaching the sensor head (CO) to the gas analyzer monitor's base, the device is powered on and typically allowed to warm up for three minutes. The Gas Analyzer sensor should be placed 20 cm from the exhaust pipe. To prevent damage to the sensor head, it should be positioned perpendicular to the gas stream from the exhaust. Finally, the car engine should be started and allowed to run at idle speed for 5 minutes. Next, measure the level of Carbon Monoxide (CO) and Nitrogen Oxide (NO_2) by following the same procedure. (Figures 1and 2)

Figure 1. Experiment of vehicle gas emission of Carbon monoxide (co) using gas analyzer monitor aeroqual series 500 with carbon monoxide sensor head.

Figure 2. Experiment of vehicle gas emission of Nitrogen Oxide (NO_2) using gas analyzer monitor aeroqual series 500 with nitrogen oxide sensor head.

Data collected from motor vehicles: The following information was gathered using an Exhaust Gas Analyzer model Aeroqual series 500 from the automobiles that arrive at the University of Ilorin Faculty of Engineering parking lot, University of Ilorin Teaching Hospital, and Kpataloje Mechanic site. It examined the carbon monoxide and nitrogen oxide exhaust gas content by percent volume in automobiles with gasoline engines.

Experimental locations: The University of Ilorin Faculty of Engineering parking lot, University of Ilorin Teaching Hospital parking lot, and Kpataloje Mechanic site Ilorin are among the locations in Ilorin, Kwara State, where the study was conducted. Measurements of the background were made from each of these places. Information was gathered throughout the course of one season. The experiment was carried out in January 2019, during the Harmatan season. The experiment was carried out daily throughout the season. The quantity of individuals and vehicles at the experiment site during a specific time period were counted.

How to determine the sample size for the test: The sample size was determined using the formula below. Where N is the population size, n is the sample size, and e is the level of precision, n=N/1+N(e)2. The number of individuals and vehicles that visit the University of Ilorin Faculty of Engineering parking lot, the University of Ilorin Teaching Hospital, and the Kpataloje Mechanic site between the hours of 10 a.m. and 2 p.m. for three days was physically counted. The outcome is displayed as follows.

University of Ilorin faculty of engineering car park

Number of persons=700

Numbers of vehicles=400

Sample size n=N/1+N(e)2

e=level of precision = 0.05

n=700/1+700(0.05)2

n=701.75

University of Ilorin Teaching Hospital (UITH) car park

Number of Persons=600

Number of Vehicles=400

Sample size n=N/1+N(e)2

n=600/1+600(0.05)2

n=601.5

Kpataloje mechanic site ilorin

Number of Persons=800

Number of Vehicles=700

n=N/1+N(e)2

n=800/1+800(0.05)2

n=802

350 randomly chosen people who live or work in the research areas were given questionnaires to complete in order to ascertain the health consequences in the sample locations.

Questionnaire

The University of Ilorin Faculty of Engineering parking lot, the University of Ilorin Teaching Hospital parking lot, and the Kpataloje Mechanic site in Ilorin all received questionnaires. To ascertain the impact of emissions on health, surveys were given to a total of 350 respondents. Office workers, market vendors, street vendors, truckers, conductors, traders, and residents are among the respondents who were chosen.

The crew members helped those who needed help filling out the surveys. The analysis of the questionnaires will be done in light of the elements and symptoms that make up health issues. Experimental and survey analysis are the methods used to accomplish the researches goals.

Procedure related to questionaire administration and analysis

1. To estimate the sample size, a pre-survey is conducted by visiting the field to learn more about the types of respondents who will be included, having them complete the questionnaire, and perhaps estimating the population.
2. Based on (1), questionnaires are created, and a test survey is conducted to improve the instrument's questions and assess its suitability.
3. The questionnaire is created and given to the respondents based on the desired number of respondents. Since the questions are straightforward enough to not take up much of the respondent's time and for financial reasons, a response rate of 100% is the goal.
4. An examination of the items in the returned surveys is then conducted.

Items in the questionnaires

How frequently they show up at the location: How frequently do you visit the University of Ilorin Teaching Hospital, Kpataloje Mechanic Site, and the Faculty of Engineering parking lots during the day?

Awareness of the effect of the emission: Are you aware that certain automobiles' exhaust emissions can have a negative impact on your health?

Human health effects of emissions: Do you display the aforementioned behaviors while strolling through the University of Ilorin Teaching Hospital, Kpataloje Mechanic site, and the Faculty of Engineering parking lot? (a) Eye irritation, (b) Cough, (c) Throw-up, (d) Obnoxious smell

A response to the pollution effect: Have you ever voiced your concerns about air pollution to a "Environmental Authority"?

Passers-by awareness of victims of exhaust gases emission: Do you know anyone who has undergone a brief period of treatment after breathing exhaust fumes?

Specific ailment cause by emission: Do you know what condition a person was suffering from when they inhaled car exhaust gases?

Expected government action: What do you think of the government's efforts to reduce the contaminants in car exhaust?

Results and Discussion

Experimental Results from the Sixty-Five Petrol Fueled Vehicles Tested for Carbon Monoxide (CO) and Nitrogen Oxide (NO_2) Emission

As indicated in (Table 2), these are the findings from the measurements of Nitrogen Oxide (NO_2) and Carbon Monoxide (CO) from 65 gasoline-powered vehicles in Ilorin, Kwara State. Thirty of the 65 gasoline-powered vehicles that were tested passed with an average CO of 1.6% by volume, while 35 of them failed with an average CO of 6.25% by volume. The maximum amount of CO that could be released at the exhaust was 3.5% by volume, according to the World Health Organization (WHO, 2005).

Effects of year of vehicle manufacture on the emission of CO

Carbon monoxide emissions with the manufacturing year: When a car gets older, it typically develops hazardous deposits in the engine, which decreases performance and raises emissions. The research of (Table 3) revealed that the older the vehicle, the higher the carbon monoxide emissions above the 3.5% by volume (W.H.O., 2005) norm.

Table 2. Values of measured CO and NO_2 for sixty-five petrol vehicles. Maximum CO (% Volume) 3.5 (W.H.O., 2005).

S/N	Mileage Covered (MC)	Frequency Of Service (FOS)	Last Date Vehicle Was Service (DVS)	Value of CO	Value of NO_2	Comment (Pass or Fail)
1	208133	4 Months	Sept. 11	6.91	0.081	Fail
2	77508	1 Month	Dec.22	3.3	0.104	Pass
3	64743	1 Month	Dec. 23	3.2	0.101	Pass
4	34212	1 Month	Dec. 23	2.9	0.3	Pass
5	84333	1 Month	Dec. 21	3.3	0.114	Pass
6	330462	5 Months	Aug. 5	7	0.101	Fail
7	321211	5 Months	Aug. 3	7.2	0.142	Fail
8	54384	1 Month	Dec.28	2.89	0.111	Pass
9	87152	1 Month	Dec. 21	3.21	0.142	Pass
10	32313	1 Month	Dec. 23	2.5	0.109	Pass
11	30421	1 Month	Dec. 25	2.2	0.128	Pass
12	157222	3 Months	Oct. 13	5.2	0.118	Fail
13	11231	1 Month	Dec. 24	0.6	0.111	Pass
14	28342	1 Month	Dec. 25	2.79	0.121	Pass
15	32191	5 Months	Aug. 10	7.04	0.13	Fail
16	321100	5 Months	Aug. 7	7.07	0.127	Fail

17	23111	1 Month	Dec. 27	2.51	0.143	Fail
18	321212	5 Months	Aug. 9	7.23	0.133	Fail
19	429139	5 Months	Aug. 10	8.68	0.111	Fail
20	321200	5 Months	Aug. 22	7.15	0.146	Fail
21	21478	1 Month	Dec. 21	2.47	0.124	Pass
22	32195	5 Months	Aug. 11	7.06	0.114	Fail
23	160212	3 Months	Oct.10	5.02	0.154	Fail
24	161222	3 Months	Oct. 7	5.07	0.112	Fail
25	100121	2 Months	Nov.14	4.9	0.115	Fail
26	111212	2 Months	Nov.11	4.6	0.134	Fail
27	278121	5 Months	Aug.10	6.6	0.134	Fail
28	38677	1 Month	Dec. 26	2.5	0.113	Pass
29	38673	1 Month	Dec. 28	2.59	0.082	Pass
30	90564	1 Month	Dec.29	2.6	0.062	Pass
31	171213	3 Month	Oct. 3	5.03	0.167	Fail
32	298654	4 Months	Sept. 9	6.52	0.136	Fail
33	321333	5 Months	Aug. 2	7.24	0.132	Fail
34	20345	1 Month	Dec. 22	2.64	0.3	Pass
35	18432	1 Month	Dec.23	2.7	0.137	Pass
36	49232	1 Month	Dec.24	2.64	0.31	Pass
37	44333	1 Month	Dec. 26	2.79	0.121	Pass
38	342156	5 Months	Aug. 4	7.12	0.123	Fail
39	279333	4 Months	Sept. 4	6.63	0.123	Fail
40	172130	3 Months	Oct. 9	5.07	0.061	Fail
41	278999	4 Months	Sept. 10	6.94	0.124	Fail
42	180011	3 Months	Oct. 10	5.03	0.116	Fail
43	161201	3 Months	Oct. 7	5.01	0.111	Fail
44	288421	5 Months	Aug. 6	6.02	0.311	Fail
45	288566	4 Months	Sept. 2	6.34	0.065	Fail
46	47423	2 Months	Nov. 5	2.79	0.082	Pass
47	322001	5 Months	Aug.3	7.02	0.115	Fail
48	311222	5 Months	Aug.11	7.08	0.321	Fail
49	30421	1 Month	Dec. 28	2.79	0.082	Pass
50	30333	1 Month	Dec.28	2.68	0.167	Pass
51	48421	1 Month	Dec.27	2.53	0.126	Pass
52	38222	1 Month	Dec. 26	2.66	0.111	Pass
53	39111	1 Month	Dec. 25	2.74	0.112	Pass
54	41231	1 Month	Dec.22	2.75	0.133	Pass
55	47212	1 Month	Dec.21	2.72	0.111	Pass
56	264121	4 Months	Sept.3	6.6	0.043	Fail
57	121010	4 Months	Sept. 2	4.1	0.043	Fail
58	44121	2 Months	Nov.9	2.7	0.13	Pass
59	231010	4 Months	Sept.10	6.08	0.321	Fail
60	213421	4 Months	Sept. 6	6.92	0.133	Fail
61	42348	2 Months	Nov. 4	2.21	0.114	Pass
62	23467	2 Months	Nov.8	1.81	0.135	Pass
63	299445	4 Months	Sept. 2	6.64	0.121	Fail
64	300501	5 Months	Aug. 8	7.19	0.134	Fail
65	256773	4 Months	Sept. 5	6.61	0.121	Fail

Effects of frequency of vehicle service on the emission of CO

Effects of service frequency on carbon monoxide emissions: The fluid that lubricates, cleans, cools, and prevents wear is the engine oil, which is the lifeblood of the car. To maintain the car's peak performance and lower emissions, it must be changed on a regular basis. According to the analysis of (Table 4), a frequent oil change in a vehicle lowers carbon monoxide emissions, and the longer the service interval, the greater the emissions of carbon monoxide above the 3.5% by volume (W.H.O., 2005) level.

Effects of last date vehicle was serviced on the emission of CO

Carbon monoxide emissions are affected by the last date of service in (Table 5). The analysis revealed that the older the last date of service, the higher the emissions of carbon monoxide above the 3.5% by volume (W.H.O., 2005) level.

Effects of mileage covered by vehicle on the emission of CO

Effects of miles traveled on carbon monoxide emissions: According to the analysis in (Table 6), the higher the mileage traveled by the vehicle, the higher the carbon monoxide emissions over the 3.5% by volume (W.H.O., 2005) norm.

Effects of year of vehicle manufacture/year of first registration on the emission of CO

Effects of vehicle manufacture year and initial registration year on carbon monoxide emission: The examination of (Table 7) revealed that the carbon monoxide emission increased with the vehicle's manufacturing year and first

Table 3. Analysis of the effects of year of manufacture on emission of Carbon Monoxide (CO).

S/N	Year of Manufacture(YM)	Value of CO	Comment (Pass or Fail)
1	1990	8.68	Fail
2	1994	7.23	Fail
3	1995	7.15	Fail
4	1996	7.04	Fail
5	1997	7.02	Fail
6	1998	6.94	Fail
7	1999	6.02	Fail
8	2000	2.79	Pass
9	2001	2.72	Pass
10	2002	2.64	Pass
11	2003	2.53	Pass
12	2004	2.47	Pass
13	2006	2.21	Pass
14	2008	1.81	Pass
15	2014	0.6	Pass

Table 4. Analysis of frequency of vehicle service on emission of Carbon Monoxide.

S/N	Frequency of Service (FOS)	Value of CO	Comment (Pass or Fail)
1	5 Months	8.68	Fail
2	4 Months	6.91	Fail
3	3 Months	5.07	Fail
4	2 Months	4.9	Fail
5	1 Month	2.5	Pass

Table 5. Analysis of last date vehicle was service on emission of Carbon Monoxide.

S/N	Last Date Vehicle Was Serviced (DVS)	Value of CO	Comment (Pass or Fail)
1	Aug.10	8.68	Fail
2	Sept. 11	6.91	Fail
3	Oct. 13	5.2	Fail
4	Nov.14	4.9	Fail
5	Dec. 20	2.9	Pass

Table 6. Analysis of mileage covered by vehicles on emission of Carbon Monoxide.

S/N	Mileage Covered by Vehicle (MC)	Value of CO	Comment (Pass or Fail)
1	429139	8.68	Fail
2	321333	7.24	Fail
3	278121	6.6	Fail
4	161222	5.07	Fail
5	111212	4.9	Fail
6	84333	3.3	Pass
7	34212	2.9	Pass
8	11231	0.6	Pass

Table 7. Analysis of year of vehicle manufacture/year of first registration on emission of Carbon Monoxide.

S/N	Year of Maufacture (Ym)/Year of First Registration (YFR)	Value of CO	Comment (Pass or Fail)
1	1998/2005	3.3	Pass
2	1999/2008	3.2	Pass
3	2000/2004	2.9	Pass
4	2001/2005	2.72	Pass
5	2002/2005	2.64	Pass

registration year. Nitrogen oxide and carbon monoxide are measured in mg/m^3 units. The following are parts per million related: Concentration (ppm) equals 24.45* Concentration (mg/m^3) divided by Molecular weight. Nitrogen oxide has a molecular weight of 46.006 and carbon monoxide has a molecular weight of 28.

Survey results from administered questionnaire

The information in table 8 about the effects of exhaust pollutants on human health in Ilorin, Kwara State, is the findings of the responses from 350 people who were given questionnaires. Their regularity of attendance there: Overall, 8% of visitors to the University of Ilorin Faculty of Engineering, University of Ilorin Teaching Hospital, and Kpataloje mechanic site in Ilorin come only once, 60% come more than twice, and 36% come several times or more. The vehicle parks and the mechanic facility are visited by 96% of the sample populations at least twice per day. This finding indicates that many people visit survey sites at least twice daily. It demonstrates that as the population at the survey site grows, so does the population that is impacted by car emissions.

Awareness of the effect of the emission: 41% of interviewees said they were aware of the impact of the pollution, while 59% said they were not. According to the study results for each responder, there is minimal knowledge of how emissions affect the environment.

Effect of emission on the people: 70% of respondents reported eye irritation, 65% coughing, 60% throwing up, and 55% describing the scent as repulsive. Only 4% appeared to be completely unaffected. According to the study results, a higher percentage of onlookers reported having eye irritations, coughing, throwing up, and offensive odours. The immediate impacts of exhaust gas pollution on people include eye irritation, coughing, throw ups, and unpleasant odour in descending order of severity.

Action taken on pollution effect: Only 6% of the population had been able to report to government authorities, while 94% had not bothered. According to the survey results for each responder, few persons were able to report to government authorities, while a larger proportion of people chose not to. It demonstrates how little knowledge there is about how the pollution affects the environment.

Passers-by awareness of the victims of vehicle emission: 60% appeared to know no one who had been harmed by the exhaust emissions, compared to 40% who claimed to have. The survey results per respondent revealed that despite a bigger percentage of people did not appear to know of anyone harmed by the exhaust gases, a smaller percentage of people are aware of the victims of car emissions. The reason why so many individuals appear to be unaware of anyone being harmed by exhaust gases is a lack of knowledge.

Specific ailment cause by emission: Of these, 50% had what would be considered cancer, 58% had asthma, and 13.45 others had other illnesses. 38.5% of the sample who were tested were at a loss for words. As a result of inhaling automobile emissions, the survey's findings indicated that a greater proportion of persons suffered from cancer and asthma, while a lesser proportion suffered from a variety of other disorders. Additionally, the survey's findings indicate that 38.5% of the population examined was unable to name anyone.

Expected government effort: 35% of respondents thought nothing was being done to reduce exhaust emissions from our automobiles, while 54% thought the government was taking action to do so. 11% were undecided. The survey's findings indicated that a greater proportion of respondents thought the government was doing action to reduce exhaust pollution. The survey's findings also revealed that fewer respondents thought the government was not taking any action to reduce the exhaust emissions from vehicles, and very few respondents had no opinion on the topic (Table 8).

Conclusion

The experiment's findings indicated that Carbon Monoxide (CO) and Nitrogen Oxide (NO_2) were the main pollutants found in car exhaust.

1. The amount of carbon monoxide emissions exceeding the limit of 3.5% by volume increases with the age of the vehicle (year of production).
2. The amount of carbon monoxide emissions exceeding the legal limit of 3.5% by volume increases as the vehicle's service life increases.
3. The amount of carbon monoxide emissions exceeding the legal limit of 3.5% by volume increases with the age of the vehicle.
4. The amount of carbon monoxide emissions exceeding the legal limit of 3.5% by volume increases as the vehicle's mileage increases.
5. The survey's findings revealed that a sizable portion of people are unaware of how emissions affect humans. The survey's findings

Table 8. Table survey results of administered questionnaires.

Responses Type No. of % of total	Responses Type No. of % of total	Responses Type No. of % of total	Responses Type No. of % of total
Frequency of their presence at the location	Only once	28	8
	more than twice	210	60
	several times or more	126	36
	At least twice	336	96
Awareness of the effect of the emission	Yes	144	41
	No	207	59
Effect of the emission on the people	Eye irritation	245	70
	Cough	228	65
	Throw-up	210	60
	Obnoxious smell	193	55
	Not affected	14	4
Action taken on pollution effect	Yes	21	6
	No	329	94
Passers-by awareness of victims of exhaust	Yes	140	40
	No	210	60
Specific ailment cause by emission	Cancer	175	50
	Asthma	203	58
	Various other diseases	47	13.45
	Those that could not think of anything	135	38.5
Expected Govt. effort	Yes	189	54
	No	123	35
	No Response	39	11

revealed that a large portion of the population is unaware of the consequences of the emission. More people were suffering from cancer, asthma, and eye irritations.

Recommendations

On the basis of the research findings, the following suggestions are made:

1. The government should establish emission control standards for the minimal amounts of exhaust pollutants, conduct sporadic inspections on all road vehicles and motor parks, and impose severe fines on cars that don't pass the emission test. The age of imported automobiles should be lowered from eight to three years after the date of manufacturing.
2. Engine oil should be changed on a regular basis to maintain the car operating as efficiently as possible and lowering emissions. Engine oil is the fluid that lubricates, cleans, cools, and prevents wear in the engine. To lower the level of emissions, vehicles' engines should be maintained at least once every two months.
3. To lower the mileage the car travels, unnecessary trips should be avoided. Because the exhaust emissions are dangerous, using a nose mask is strongly advised when performing this experiment.
4. There should be more study done to find solutions to lessen the harm that automobile exhaust gas emissions cause to people and the environment.

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None.

Conflict of Interest

None.

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