Emissions characteristics and impact on the Environment for LPG And Gasoline in Spark Ignition Engine

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Abstract – Concern on pollution continues to receive a good deal of world interest because of its adverse impacts on human health and by extension the environment. Recent studies reportable the necessary correlations between pollution and bound diseases as well as an asthma attack, breath distortion, inflammatory disease, chest pain, nausea, respiratory disorder and carcinoma, acute health effects embody eye irritation, headache. The globe Health Organization (WHO) states that two.4 million individuals die yearly from causes directly thanks to pollution. The target of this study is concentrated on the emission analysis completely different ratios of two fuels: LPG (propane) and gasoline (petrol) under different loadings. The elements employed in the analysis contains 4stroke, spark ignition LOMBARDINI LGA 226, Gas parse unit (Techno test (T156/D3)), Gas Flow Meter that measures the LPG. The fuels, gasoline in a liter (liters) and LPG in a liter (liters) also were used to assess their impacts on the exhaust gas emission released. The results are unconcealed that particle number concentration, carbon monoxide (CO) increased because the engine loading will increase in gasoline (fuel). Using LPG, the carbon monoxide (CO) concentration level was a less, significant reduction in exhaust emissions, however the high temperature in the environment than fuel (gasoline) on engine loading. The engine, powered by LPG fuel, showed improved engine performance in many aspects including overall efficiency, fuel economy and emission characteristics that are much lower than gasoline fuel.

Keywords – Environment; Spark Ignition Engine; Liquefied Petroleum Gas (LPG); Emission; Gasoline.

1. Introduction

LPG is obtained from hydrocarbons produced from refinement fossil fuel and process of natural gas, with the most parts dominated by fuel (C_3H_8) and alkane series (C_4H_{10}) [1]. LPG has an energy content of 46.23 MJ/kg and 26 MJ/l, that is slightly over gasoline that stands at 44.4 MJ/kg and 34.8 MJ/l [2]. The energy content of LPG per unit of measurement is comparatively over gasoline, though per unit volume is lower. For this reason, a similar tank size of vehicles travels by LPG, cowl a shorter distance than those run on gasoline. Over fourteen million units are potential rider vehicles to be converted to LPG by a bi-fuel or full dedicated system. LPG includes a long history as a vehicle fuel, though experiments victimization LPG began around 1910. The primary experiment was applied to vehicles in California, United States. In 1950, once the Chicago Transit Authority ordered 1000 buses with LPG fuel, with Milwaukee converting 270 fuel oil ran taxis to LPG. Afterward, LPG became one in all the foremost widespread alternative fuels for vehicles, ranging from the United States and lengthening into Europe, Asia, and different continents [3]. LPG contains more octane than gasoline, which allows the engine to run more smoothly without any negative consequences due to knock, as a result, it offers greater thermal power and fuel economy than gasoline. High heating can be obtained at a low-pressure range of 0.7 to 0.8 MPa at atmospheric pressure of LPG compared to gasoline. One of the advantages that makes LPG use more favorable is the low pollutant ratio of carbon dioxide emissions due to the low carbon content of its chemical composition and thus making it a friend of the environment [4]. In recent years, LPG has been the main alternative to gasoline, with more than four million vehicles operating worldwide. Most large and small trucks and industrial vehicles were operating on gasoline fuel but because of the multiple positive aspects and the least pollutants were converted and licensed to use LPG. Gasoline-based vehicles have been replaced with LPG, with hydro-carbons emissions of less than 40% (HC), carbon dioxide (CO) emissions of less than 60%, CO_2 also significantly reduced, In addition to a lower amount of nitrogen oxides emissions as well. Generally, SI, engines are principally powered by gasoline, it is one of the fossil fuel derivatives. Most of those engines have fuels been burnt within the combustion chamber [5]. The fuels get burnt to supply heat energy which leads to increasing the pressure within the engine. The pressure resulting from high heat combustion increases and the crankshaft rotates and thus produces mechanical energy that is later converted into mechanical movement energy. The flue gas from the combustion of fossil fuels is discharged to the air [6].

These gases contain carbon dioxide, carbon mono-oxide, nitrogen oxides, Sulphur oxides, water vapor, particulate matters and other traces of other metals. These gases contribute greatly to global warming. The emissions of pollutants rely not solely on fuel kind however additionally on the kind of engines and therefore the quality and amount of fuel consumed. However, the amount of therefore emissions-free is directly proportional to the sulfur content within the fuel, and therefore the amount of fuel consumed.CO gas may be a deadly poison made as a result of burning fuels like fuel or gas. it's one among the chemicals found in engine exhaust, shaped as a result of incomplete combustion. These gases cause the depletion of ozone layers which leads to global warming. The impact of worldwide warming is felt each by animals and Human [7,8]. Worldwide, air pollution contributes a part of 6.7% of all deaths. Carbon Monoxide may be a colorless, odorless and tasteless gas that makes it doable to have an effect on the exposed person swiftly. Exposure to carbon monoxide causes many initial symptoms, including nausea, headaches and, while prolonged exposure, causes poisoning and loss of consciousness.

Other health effects when exposed to carbon monoxide emissions are double the elasticity of blood and the ability of chemical tissues to retain it. The blood contains a greater affinity with 210-250 times more carbon monoxide than oxygen. Therefore, the presence of Carbon Monoxide within the blood will interfere with chemical element uptake and delivery to the body. If the exposure level is unrestrained, loss of consciousness is impending. Coma or death may also occur if high exposures continue. The show of symptoms varies wide from individuals to individuals and should occur sooner in inclined people like young or aged individuals, people with pre-existing respiratory organ or cardiovascular disease, or those living at high altitudes locations [9,10,11,12].

2. Material and Method

*2.1 Experimental **Setup***

The materials needed for this research includes measuring instruments such as The Internal combustion engine and its accessories as shown in Fig. 1. The ignition motor has been modified to work with gasoline or LPG. BY using The LPG carburetor is specially designed for its performance and using CFD modeling. Simulation by The geometric model is built using ANSYS 16.0 workbench. The program ANSYS 16.0 CFD modeling has been used for analysis simulations are performed to validate the flow analysis within the produced gas carburetor.

Experimental work consists of three units represented by:
1. Test engine.
2. Injection of LPG.
3. Gas analysis.

Experiments were carried out with the LOMBARDINI LGA 226 petrol engine. It has a 4-stroke engine, single-cylinder, with maximum output capacity of 4.4 kW and 4000 rpm. Also, maximum torque was 11.1 nm at 2800 rpm. Table 1 below shows, the Characteristics of the engine listed. Although the engine was designed to run on gasoline, it absolutely was re-adapted to conjointly run on the availability of LPG. It absolutely was desired to run the engine on LPG with minimum modification whereas holding the aptitude of switch back to its gasoline refueling system simply in Table 1.

Table 1. Characteristics of the test engine

Engine characteristics	Four engine stroke
Cylinder	1
Stroke	54- mm
Bore	72- mm
weight of engine	17- Kg
Compression ratio	6.17:1
Displacement	220 - cc

For this modification within the air intake structure, it entails incorporating an external intermixture chamber that was designed. A mensuration scale was used to measure the LPG once the engine has been run on LPG, to understand the entire mass of LPG burnt. The availability cylinder was fitted with a regulator valve. A meter rule was utilized in mensuration the distance of the exhaust port to the mensuration instrumentality to allow an equal distance.

The pollutants CO, CO_2, and PM were selected based supported their degree of concern and impact on the atmosphere and public health. The concentrations of CO, CO_2, and PM released from the engine (when running on gas or LPG) were determined using, CO and PM meters, severally. The distance was kept at 1 meter throughout the experiment. The aim was to make sure sensible contact between the meters and therefore the exhaust of the engine. While measuring the concentration of the pollutants released via the exhaust pipe, readings were taken each 10 minutes for one hour. Precautions taken were to taking readings wherever potential emission interference was ascertained and therefore the use of nose mask to forestall inhalation of the exhaust whereas taking the measuring. Standard tachometer was used to know the speed of the engine. Also, the measurement of break strength resulting from the engine is to know its primary performance; an electric motor was used to rotate the engine at the beginning of experimental process. To measure brake strength, active pressure, and lost energy due to friction, a dynamic power scale device was used. K type

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thermocouples (nickel-chromium / nickel-mille) are marked to measure the temperature of exhaust gases used. The equations shown below were used to know engine performance parameters

The pilot methodology can be followed as follows

1-Several LPG and pressure valve are assembled together with each other as described in the experimental setup.

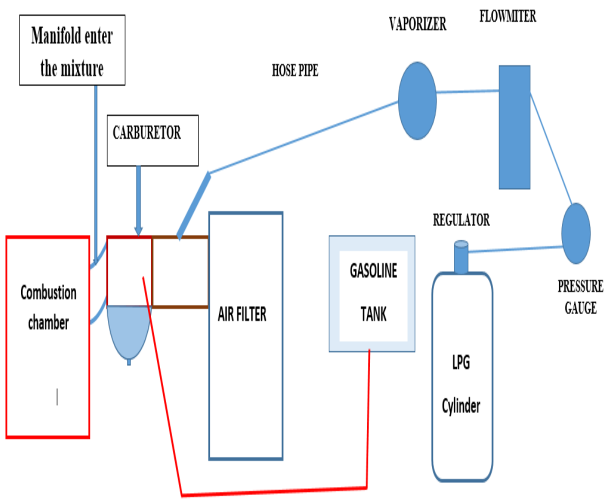

Fig1. A diagram of the engine used in experiments

2- "ON /off" the LPG cylinder regulator.
3- Before starting the engine you must check for any leaks in the setting.
4-Control of the supply of LPG is done by the regulator or evaporator, thus ensuring its conversion to vapor.
5- LPG is injected into the steam mixer, which is located close to the intake manifold, mixing with the fresh air before filtering and drawing into the combustion chamber.
6- The exhaust temperature of the T85D is recorded after the engine reaches the heat balance.
7- The dynamic scale applied to the load ranges from (0 - 11.1) Nm.
8- Reading speed at rpm under different load conditions is assisted by the tachometer, and by the fuel used for benzene, liquefied petroleum gas.
9- The torque (T), brake strength (BP) and thermal brake efficiency (Ղbth) are calculated from the apparent results.
10- Repeat steps from 3 to 6 for each load.
11- Repeat steps from 3 to 6 for each speed.

Data Processing and Analysis

The Exhaust Unit in the Techno Test (T156 / D3) collected pollution concentration and analysis measurements during the study as shown in Figure 2, suitable for gasoline engines and LPG. One of the most important uses of this device is to know the amount of concentrations of emitted gases such as carbon dioxide (CO2), carbon monoxide (CO), remaining oxygen-free (O2) hydrocarbons (HC) and nitrogen oxides. In addition, the measurement of the number of spark plugs and heat pulses gives a measure of engine speed. The measurement and resolution range of the exhaust gas analyzer has been determined in Table 2.

Table 2. Range of measurement and resolution for exhaust gas analyzer

Parameter	From	To	Concentration
CO_2	0	19.9 % vol.	0.1%
NOx	0	2000 ppm	10 ppm
CO	0	9.99 % vol.	0.01%
HC	0	9999 ppm	10 ppm

Mean concentrations of pollutants were estimated and obtained with appropriate operating parameters. Statistical analyzes were performed using Microsoft Excel 2016. In order to verify the relevant parameters, results of this pilot

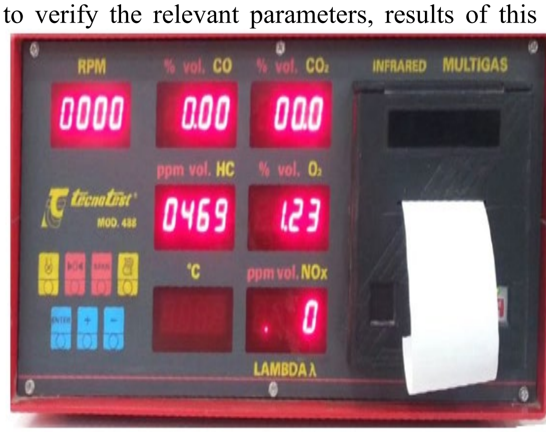

Fig 2. Gas analysis unit T156D

study were compared with air quality standards of the

American Society of Heating, Cooling and Air Conditioning Engineers [ASHRAE].

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Result and Discussion

carbon monoxide (CO) in engine LOMBARDINI LGA 226 Exhaust Gas.

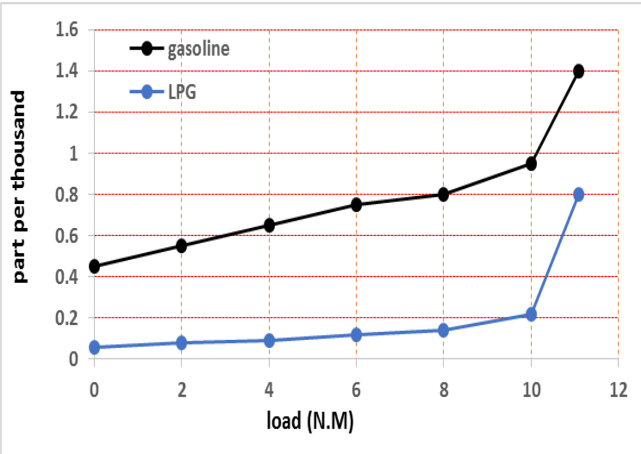

Fig 3. Mean Carbon monoxide emitted from engine Works on Gasoline and LPG

he experiments are conducted using the two type fuels: gasoline and LPG - on varying loads from zero to 11.1 N. m. to assess the level of Carbon monoxide emission released as liken to ASHRAE standards. Figure 3 Show the Carbon monoxide information collected from the study and presents the mean Carbon monoxide (CO) emission from LPG and gasoline fuel. It is Concludes in Figure 3, which Quantity of Carbon monoxide (CO) in the exhaust from gasoline and LPG diverge.

The up mean value of Carbon monoxide (CO) is 80.3 ppm and 140 ppm for LPG and gasoline respectively, while the lesser value is 15 ppm and 45.4 ppm for LPG and gasoline respectively. It's of a reminder that the evaluated mean concentration of Carbon monoxide (CO) obtained in this work for both LPG and gasoline higher than 9 ppm adopted by ASHRAE (IAQ, 2013) and 10 ppm as stipulated by WHO (2014). The concentration of carbon monoxide from LPG is much less concentrated than in gasoline. This is because petroleum gas is well mixed with air so it has a good mix with air intake and combustion is more complete with gasoline comparison. Also, the relatively low carbon content in LPG has also identified a decrease in carbon monoxide (CO) released when LPG is burned.

3. Matter (PM) in engine Lombardini LGA 226 Exhaust Gas.

The experiments are conducted using the two type fuels: gasoline and LPG - on varying loads from zero to 11.1 N. m. to assess the level of PM emission released as liken to ASHRAE standards. Figure 4 Show the Particulate Matter information collected from the study and presents the mean Particulate Matter emission from LPG and gasoline fuel. It is

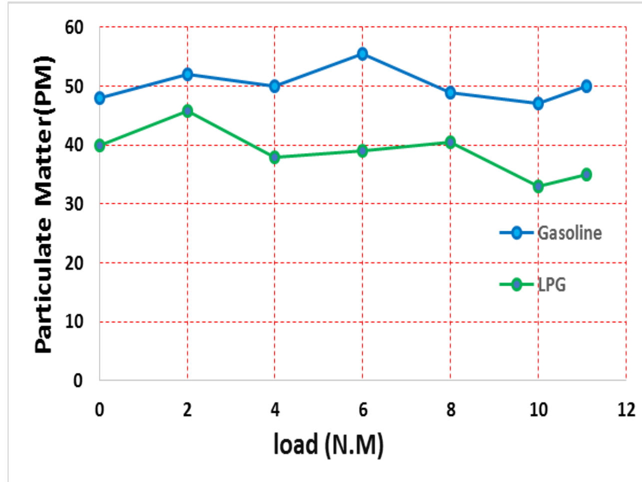

Fig 4. Mean Particulate Matter (PM) emitted from Gasoline and LPG.

Concludes in Figure 4, which the Quantity of Particulate Matter in the exhaust from gasoline and LPG diverge. The up-mean value of Particulate Matter is 45.8 µg/m and 55 µg/m for LPG and gasoline respectively, while the lesser value is 33 µg/m and 47.4 µg/m for LPG and gasoline respectively. This amount of PM particles is significantly higher than the amount of 25 µg/m by WHO for 24 hours of direct exposure (WHO, 2014).

The effect of this is that direct exposure to smoke emitted from the engine when running on both fuels is unsafe for human life as the PM can penetrate deeply into the lungs from the inside as well as the bloodstreams, resulting in the destruction of the entire body system (UNEP, 2014). PM for LPG is few when compared with gasoline, due to low carbon content in LPG.

4. Conclusion

The four-stroke Spark Ignition engine was successfully tested and emissions emitted using various advanced technical measuring instruments. The use of a modified engine to work on LPG proved to be an important and positive advantage. LPG has proven to be an excellent alternative to traditional gasoline fuel with low emissions and exhaust characteristics. The reading of the results and information obtained from the experiments conducted on a load of 0 to 11.1 shows a significant and significant reduction in the emission levels of LNG fuel, where the combustion of gaseous fuels occurs in relatively full and semi-regular fuel-air, resulting in a significant reduction in precipitation Incomplete combustion such as soot on the wall of the combustion chamber. In addition, there is a decrease in fuel consumption. Because the price of LPG is reduced by the increase in fuel production, this will save imports in terms of the cost of fuel and the cost of engine maintenance will decrease because it requires less maintenance. The LPG engine showed good performance and improved performance, especially in fuel economy, engine

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efficiency, and the characteristics of harmful emissions and significantly better emissions compared to gasoline. Given the economic, environmental and health benefits of using LPG on gasoline, we recommend using this revised engine as a short-term strategy to achieve the goal of reducing emissions in Iraq.

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