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FABRICATION AND PERFORMANCE ANALYSIS OF A DUAL FUEL 2-STROKE ENGINE

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Abstract:*Dual Fuel Engines are engines which have capable of running by taking two fuels. On internal combustion engines, one of the fuel is gasoline, and the other is an alternate fuel such as natural gas (CNG), LPG, or hydrogen etc. The two fuels are stored in separate tanks and the engine runs on one fuel at a time. Dual Fuel Engines have the capability to switch back and forth from gasoline fuel to the other fuel, manually or automatically. A dual fuel engine kit consists of Adapter, Shut off valve, gas injector, porting tool, pressure regulator, coalescing filter and Actuators. This project deals with fabrication of dual fuel engine and practical experimentation on efficiency and working operation of Dual Fuel Engine and implemented it in a 2-wheeler motorbike engine. After fabricating the engine with the kit, other accessories were fabricated. when the set up is done, we need to carry out performance test by first taking petrol as a fuel and then taking LPG as a fuel. Then, we need to compare both the results and conclude on the effectiveness of individual fuels and the advantage of using the dual fuel engine.*

Keywords: *Dual fuel Engine, Kit, Efficiency etc*

1.0 Introduction

Dual-fuel engines (Bi-fuel engines) are multi-fuel engines which have capable of running by taking two fuels. On internal combustion engines one fuel is gasoline or diesel, and the other is an alternate fuel such as natural gas (CNG), LPG, or hydrogen. The two fuels are stored in separate tanks and the engine runs on one fuel at a time in some cases, in others both fuels are used in unison. Bi-fuel vehicles have the capability to switch back and forth from gasoline or diesel to the other fuel, manually or automatically. The most common technology and alternate fuel available in the market for bi-fuel gasoline cars is Auto-gas (LPG), followed by natural gas (CNG), and it is used mainly in Europe. The Netherlands and the Baltic states have a large number of cars running with LPG. Italy currently has the largest number of CNG vehicles, followed by Sweden. They are also used in South America, where these vehicles are mainly used as taxicabs in main cities of Brazil and Argentina. Normally, standard gasoline vehicles are retrofitted in specialized shops, which involve installing the gas cylinder in the trunk and the LPG or CNG injection system and electronics.

1.1 Literature Review

Maneesh Kumar Dubey and Ravindra Randa[1] did an experiment on Experimental Performance Analysis of Single Cylinder Two Stroke Petrol Engine using Gasoline and LPG. Their work shows a comparison of performance by using petrol and LPG at no load and different load condition. The experiment also shows that LPG gives maximum Brake Thermal Efficiency (BTE) at 50% of load and 31.32% less Fuel Consumption (FC) than petrol at load, low Brake Specific Fuel Consumption (BSFC), low Brake Specific Energy Consumption (BSEC) than petrol at the loading condition of the engine..

R.R. Saraf, S.S.Thipse and P.K.Saxena[2] studied the Comparative Emission Analysis of Gasoline/LPG Automotive Bifuel Engine. This paper presents comparative emission study of newly introduced gasoline/LPG bifuel automotive engine in Indian market.

Dheeraj Kalra, Dr.Veeresh Babu A and M. Vijay Kumar[3] studied the Effects of LPG on the performance and emission characteristics of SI engine.According to them, IC engines are considered as major contributors to the deterioration of the environment, therefore there is an increasing demand to go for alternative fuels for both SI and CI engine so as to maintain the ecological balance as well as reduce dependency on petroleum and socio economic aspects. The gaseous fuel such as LPG has been widely used throughout the world in SI engines as it impacts greenhouse emissions less than any other fossil fuel.

Siddharth Shukla and Pranav Ravi [4] did an experiment on Working and Performance Analysis of Gasoline Fuelled Engine with Biogas.Their study concluded that efficient utilization of biomass is a much needed requirement.

2.0 Fabrication of Dual Fuel Engine

The dual fuel engine is fabricated with the help of a conversion kit which is attached to the 2-stroke petrol engine to convert it into a dual fuel engine. It consists of Adapter, Shut off valve, gas injector, porting tool, pressure regulator, coalescing filter and Actuators. Further the engine is connected to a LPG cylinder for the gas supply. The fabricated model is as shown in the figure given below.

Figure: 1 Fabricated Model

3.0 Components Used For Performance Analysis

1. 2- stroke single cylinder engine
2. piping arrangement
3. dynamometer
4. switch
5. control of power supply
6. Thermocouples
7. Temperature controller
8. Emission checking instrument
9. Tachometer
10. Stopwatch

4.0 Engine Specification

Engine type	: Spark Ignition
Engine Make	: Bajaj
Engine Speed	: 3000 RPM
BHP	: 2.5 kW
Lubrication Oil	: SAE-4G
S.F.C	: 475g/kWh

Bore Diameter	: 57 mm
Stroke	: 57 mm
Orifice Diameter	: 20 mm
Method of Starting	: Manually Started
Method of Cooling	: Air Cooled

Figure: 2 Testing Setup

5.0 Experimental Procedure

- Connect the kit with different fuel with the engine setup.
- Run the engine with petrol as a fuel
- By fixing some parameter, take readings
- Vary the load on the engine, take atleast ten readings
- Now Run the engine with LPG as a fuel
- By fixing same parameter, take the readings with varying load conditions
- By varying the temperature of air at inlet to the engine, take different readings
- For each and every load calculate the brake power, specific fuel consumption, total fuel consumption, fuel power and the efficiency of the engine
- After the calculation plot the graph between the load and brake thermal efficiency, load and total fuel consumption, load and specific fuel consumption

6.0 Calculation

Different values were calculated by using different formula as follows:

$$\text{Brake power} = \frac{2*\pi*\text{RPM}*\text{load}*\text{length}*9.81}{60000}$$

$$\text{Mass of fuel consumed} = \frac{\text{cc of vfuel consumed}*\text{specific gravity}*3600}{\text{time for fuel consumption}*1000}$$

$$\text{Specific fuel consumption} = \frac{\text{mass of fuel}}{\text{brake power}}$$

$$\text{Brake thermal efficiency} = \frac{\text{brake power}*3600*100}{\text{mass of fuel consumed}*\text{calorific value}}$$

7.0 Results and Discussion

Two stroke stationary petrol engine was operated at different loading condition by keeping speed (RPM) constant and investigate the consumption of fuel when load is increased. For loading condition of engine by using relation we can determine Fuel Consumption (FC), Brake Specific Fuel Consumption (BSFC), and brake thermal efficiency. And plot graphs between load and various parameters such as thermal efficiency, total fuel consumption and specific fuel consumption.

Load vs total fuel consumption

A Graph between load vs total fuel consumption is plotted for the petrol engine. Here in the X-axis load and in the Y-axis total fuel consumption was taken. From the graph it was clear that by increasing the load the total fuel consumption increases at the same time LPG provides Lower fuel consumption at low loads but the at high loads consumption remains nearly same.

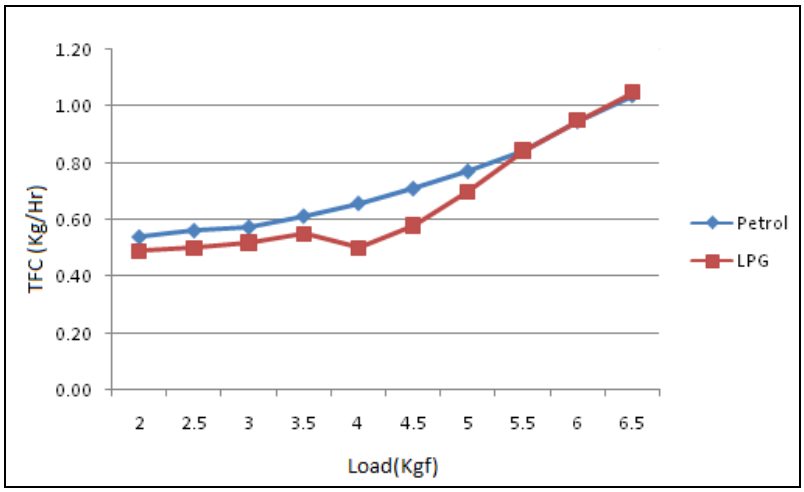

Figure: 3 Load vs total fuel consumption

Load and specific fuel consumption

A Graph between load vs specific fuel consumption is plotted for the petrol engine. Here in the X-axis load and in the Y-axis specific fuel consumption was taken. From the graph it was clear that by increasing the load the specific fuel consumption decreases at the same time LPG provides lower SFC at low loads but the petrol provides high SFC at high loads.

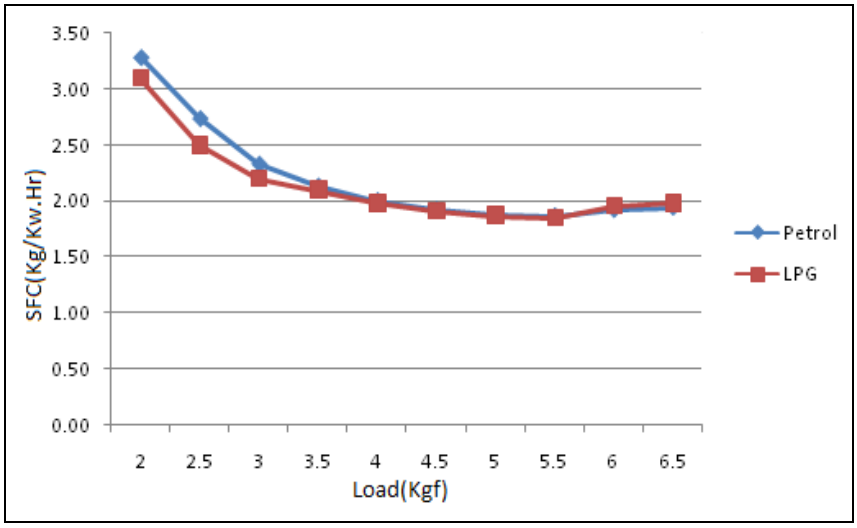

Figure: 4 Load and specific fuel consumption

Load vs brake thermal efficiency

A Graph between load vs Brake Thermal efficiency is plotted for by taking the readings. Here in the X-axis load and in the Y-axis brake thermal efficiency was taken. From the graph it was clear that by increasing the temperature of the

inlet air the brake thermal efficiency increases at the same time LPG provides higher efficiency at low loads but the petrol provides high efficiency at high loads.

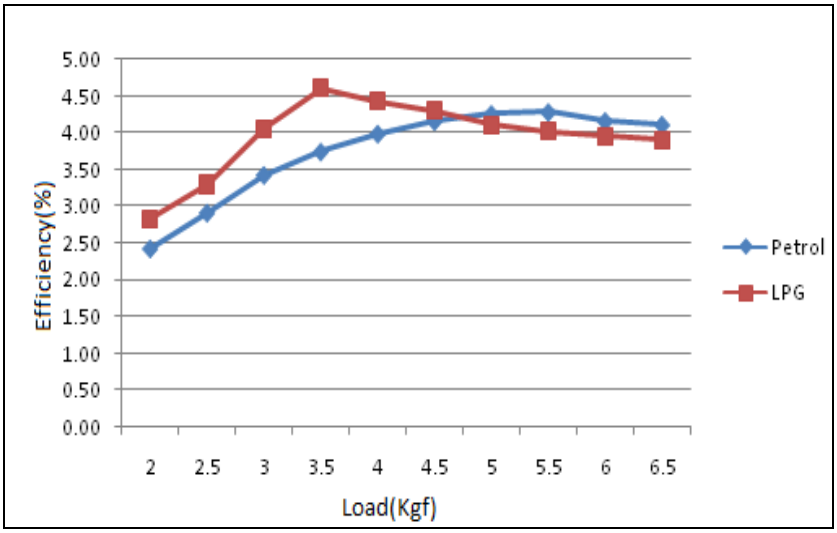

Figure: 5 Load vs brake thermal efficiency

8.0 Conclusion

From the above calculation and analysis it is clear that we can use LPG as a fuel for a petrol engine. From the analysis the following observations were made

- LPG provides higher efficiency at low loads but the petrol provides high efficiency at high loads
- CO content in the exhaust gas of LPG is lower than Petrol.
- NOx content in the exhaust gas of LPG is lower than Petrol
- LPG provides lower SFC at low loads but the petrol provides high SFC at high loads.
- LPG provides Lower fuel consumption at low loads but the at high loads consumption remains nearly same.

Hence the analysis shows that we are getting more advantages if we will use LPG as a fuel but it has some disadvantages as the weight of the engine increases and size of the engine increases. The most important disadvantages is the LPG is used as a fuel for cooking in home so that we cannot use LPG as a fuel for commercial applications

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