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Design & Analysis of LPG Gas Kit for a Dual Fuel Bike

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ABSTRACT: Bikes (two-wheelers) will continue to play a significant role in a human's life. Gaseous fuels such as liquefied petroleum gas (LPG) and liquefied natural gas (LNG) have been broadly used in commercial vehicles. In this, an experimental investigation of Liquefied Petroleum Gas (LPG) as an alternative fuel for a gasoline engine is evaluated. An effort has been made to use non-conventional fuel against conventional fuel which is becoming scarce and costly these days, as non-conventional fuel will lead to less polluted air than conventional fuel. It is also worthy of economic considerations and engine efficiency. In our paper, we have designed and installed LPG gas kit on a four-stroke vehicle in which we can use both gasoline and LPG as fuel. The alterations are made to install LPG in the vehicle & its effects are studied & discussed. For lower speed vehicles, LPG is appropriate, but gasoline is suitable for higher speed operation. So, their combinations are studied as fuel supply which can be suitable for city traffic conditions, in which mostly the mode of operation is low. Using this concept, we can control our expenditure in buying of fuels.

KEYWORDS: Cylinder, Dual fuel bike, Four-stroke spark ignition engine, LPG, LPG Gas Kit, Natural Gas.

I. INTRODUCTION

The use of gaseous fuels, i.e., Liquefied Petroleum Gas (LPG) for an automotive application has been undertaken in different parts of the world for varying reasons. The Committee has reviewed the global scenario, in particular, the status of the CNG and LPG vehicle commercialization programs have taken up in various countries. The Committee has taken note of the ongoing efforts for promoting the use of these alternative fuels in the country.

In India, LPG is the primary domestic fuel in urban areas. The indigenous availability of LPG is expected to fall much short of the household demand alone. As such none of those mentioned above conditions, which made LPG a competitive auto fuel in other countries, exist. For these reasons, LPG is going to be competitive as an auto fuel, in India Government support would be need by way of substantially lower taxation.

The idea behind this project generated by observing the LPG operated I.C. engine car. The same gas aspirated engine can be used to drive the two-wheeled vehicle. From LPG cylinder the gas is supplied for burning the gas inside the engine cylinder. The separate GAS KIT we are going to install on Bike to feed the metered amount of gas mixed with the air to the engine cylinder, finally, through the carburetor.

II. LITERATURE REVIEW

The concept of our research work is to Design & Analyse the LPG Gas Kit for a Dual Fuel Bike. This paper studies about dual fuel bike which is capable of running on two fuel, i.e., Petrol and LPG. In running condition, both fuels can be interchanged. It means that when the bike is running on LPG, then we can change the fuel system to petrol or vice versa. LPG gives improved mileage, and petrol gives excellent power and is eco-friendly too. So there is an advantage of using both LPG and petrol as fuel. Dual-Fuel Bike: DUAL-FUEL term itself indicates us that the using of two fuel in the system. In this dual-fuel bike, the study is done to run a bike using two fuels, i.e., LPG and

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Petrol. Usually, a bike runs on a petrol fuel but in some cases, diesel powered bikes are also available in markets, but the problem is that these fuel's resources are in the danger of scarcity and burning these fuels raises global warming which is also a significant threat to the entire world.

A running bike using LPG and Petrol is such a combination from which we can choose what we want, Power or Efficiency. Although we can run the bike entirely using LPG as we can see in the recently available BS4, pollution control BHARAT norms rated cars and busses which is capable of running using LPG, but the problem is that we can't use a bigger LPG tank as we have space limitation in the bike.

This study has the following objectives

1. Reducing the running cost of the vehicle by using cheaper fuel in the engine.
2. Avoiding emission of the engine by burning a clean fuel in the engine.
3. Increasing engine running life
4. Preventing scarcity of Non-regenerative fuels by reducing their uses.

Difference Between LPG and Gasoline

PROPERTIES/FUEL	GASOLINE	LPG
Chemical structure	C7H17/C4 toC12	C3H8
Energydensity	109,000-125000 MJ/Kg	84,000 MJ/Kg
Octane number	86-94	105+
Lower heating value(MJ/Kg)	43.44	46.67
High heating value(MJ/Kg)	46.53	50.15
Stoichiometric air/fuel ratio	14.7	15.5
Densityat 15 degreeCelsius	737	1.83/505

EMISSION FROM LPG AND GASOLINE

On basis of energy, LPG has lower carbon content than gasoline or diesel fuel. When used in spark-ignition engines, LPG produces near-zero particulate emissions, minute CO and moderate HC emissions. Differences in the concentration of different hydrocarbons in LPG can affect the species composition and reactivity of HC exhaust emissions. CO₂ emissions are also a bit lower than those for gasoline because of the lower carbon-energy ratio and the higher octane quality of LPG. NOx emissions are analogous to those from gasoline vehicles and can be well controlled using three-way catalysts. The higher the Compression Ratio of an engine, the more efficient is the engine and more is the power generated for a given amount of the fuel. LPG has a high octane rating of 110+ that allows Compression Ratio to be high i.e. up to 15:1, whereas compression ratio in case of gasoline engines is in the range of 8:1 to 9.5:1.

III. DESIGN AND ASSEMBLY OF LPG GAS KIT

To use the LPG as fuel in 4 stroke bike & to get the system working, the LPG cylinder is kept inside a bag, and hanged on the rear side of a bike. The LPG converter is fixed under the fuel tank which is placed on the right side of the bike. The inlet gas pipe is connected to the inlet of the carburetor, and a vacuum pipe is connected to the inlet manifold of the cylinder. Interestingly, the methods used in this study are very systematic and involves a lot of practical application of auto technology.

The bike used in this study has the following specification-

ENGINE DISPLACEMENT	99.27 CC
ENGINE TYPE	AIR COOLED, 4 STROKE
NUMBER OF CYLINDERS	1
VALVES PER CYLINDER	2

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MAXPOWER	8.3 PS@7500 RPM
MAXTORQUE	8.1NM @5500RPM
BOREXSTROKE	54.0X 45.0MM
FUELTYPE	PETROL
STARTER	KICK

TRANSMISSION

TRANSMISSIONTYPE	MANUAL
NUMBEROFSPEED	GEARS 4
FINALDRIVE(REARWHEEL)	CHAIN

SUSPENSION

FRONTSUSPENSION	TELESCOPICFORKS SUSPENSION
REARSUSPENSION	HYDRAULIC, DOUBLEACTINGSWINGARM TYPE

BRAKES

FRONTBRAKE	110mmDRUM
REARBRAKE	110mmDRUM

DIMENSION

OVERALLLENGTH	1950 MM
OVERALLWIDTH	770 MM
OVERALLHEIGHT	1065 MM
WHEELBASE	1225MM
GROUNDCLEARANCE	150MM
KERBWEIGHT	109KG
FUELCAPACITY	9.3LIT

Major Component of the bike –

1. Engine
2. Spark plug
3. Clutch
4. Gear
5. Suspension
6. Brake
7. Wheels
8. Chain
9. Exhaust
10. Electronic devices

Major Component Used in LPG Kit-

1. GAS CYLINDER
2. VAPORIZER
3. HOSE PIPE
4. CARBURETOR

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ARRANGEMENT OF KIT IN BIKE

The arrangement of the kit in Bike is done as shown in the figures below-



Figure- 1

The figure-1 shows the Top View of the Gas cylinder positioned in the bike under study, the connection of the gas supply pipe and regulator position. There are two pipes, inlet and outlet in vaporiser. The outlet pipe is connected to the cylinder and the inlet pipe is connected to the carburettor as shown in figure 2.

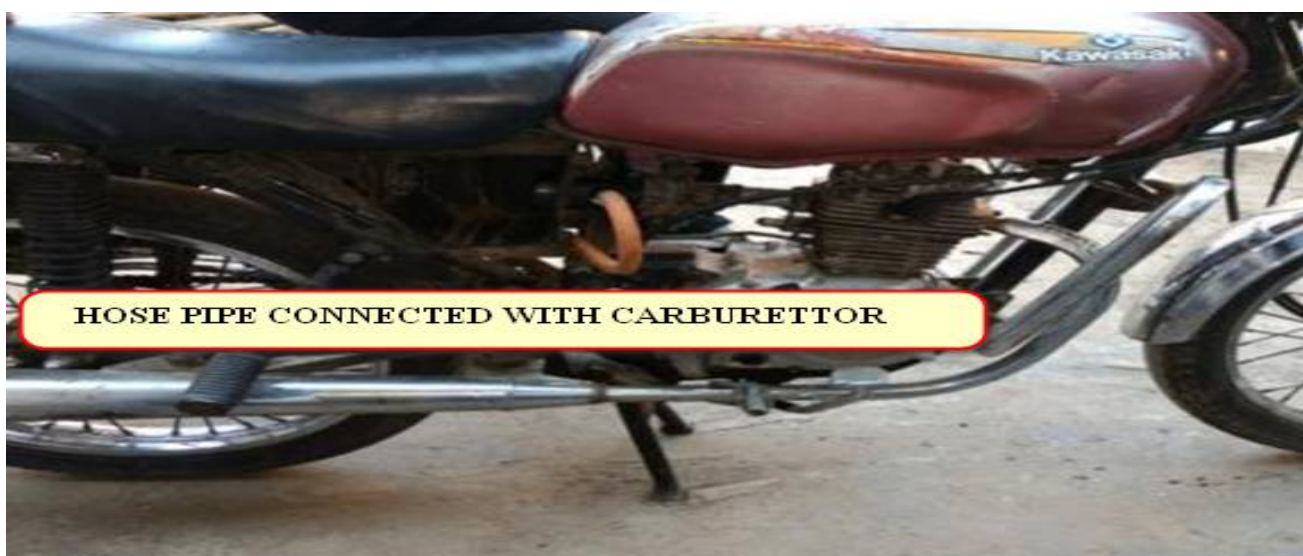


Figure-2 - Hose pipe connected with a carburetor.

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Difference Between Combustion of Petrol and Combustion of LPG Gas –

PETROL	LPG
CALORIFIC VALUE 43000 KJ/KG	CALORIFIC VALUE 46100 KJ/KG
FLAME SPEED 52-58 M/S	FLAME SPEED 48 M/S
UPPER FLAMMABILITY IN AIR 7.6 %	UPPER FLAMMABILITY IN AIR 74.5 %
LOWER FLAMMABILITY IN AIR 1.3	LOWER FLAMMABILITY IN AIR 4.1
OCTANE NUMBER 85-98	OCTANE NUMBER 105+
SOMETIMES MORE THAN 1 SPARK PLUGS ARE USED FOR EFFICIENT BURNING OF FUEL	NO NEED OF MORE SPARK PLUGS IN CYLINDER.
KNOCKING OCCURS	KNOCKING RESISTANCE
POSSIBILITY OF DETONATION	LESS POSSIBILITY OF DETONATION
PETROL ENGINES ARE NOT SO SMOOTH AT A TIME OF COMBUSTION	LPG ENGINES ARE SMOOTH AT A TIME OF COMBUSTION
PETROL PROVIDE MORE POWER AFTER COMBUSTION	LPG PROVIDE LESS POWER AFTER COMBUSTION OF FUEL
PETROL HAS ODOUR OR ITS SMELL BADLY	LPG IS ODOURLESS OR IT HAS NO SMELL. BUT DUE TO IDENTIFIED LEAKAGE ETHYL MERCAPTAN IS ADDED IN IT WHICH ALSO SMELLS BADLY.

Changes Made for Combustion of LPG Gas –

In this study, one simple thing that is added is an additional small metallic leak-proof box which is fixed with the carburettor. The key purpose of this box is to provide LPG gas into the carburetor so that it goes to the combustion chamber.

The hose pipe is connected with the vaporizer at one end and another end is connected with metallic box, this box is very small in size and cannot produce any kind of bad effect on the combustion process. No variations are encountered in actual bike engine & the combustion process is similar to that of combustion of petrol. For using LPG gas to run the bike, firstly petrol fuel supply is switched off and with the help of regulator, the flow of LPG gas is started inside the cylinder. One additional vaporizer is used to convert the LPG gas into vapour form. The vaporizer is fixed outside the engine and placed above the footrest as shown in the figure.



Fig-2 Vaporiser

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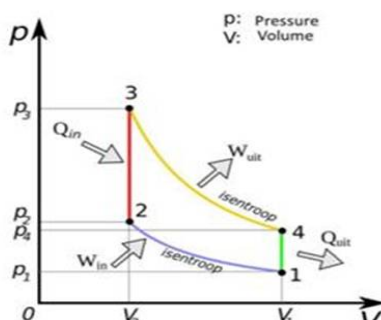
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FUEL COMBUSTION DETAIL

FUEL	Price	Avg/litre	Distance travel in Rs 1
PETROL	70	35-40	0.571km
LPG	41	60-65	1.585km

IV. EXPERIMENTAL RESULTS

EFFICIENCY OF THE ENGINE



Here, $T_1=35^\circ\text{C}$, $P_1=0.1\text{ MPA} = 100\text{ KPA}$, $T_3=1100^\circ\text{C} = 1373\text{ K}$, $r = V_1/V_2 = 9$

Process 1-2 is Isentropic –

$$P_1/P_2 = (V_1/V_2)^\gamma = (9)^{1.4} = 21.67$$

Hence, $[P_2 = 2167\text{ K Pa}]$

$$T_2/T_1 = (V_1/V_2)^{\gamma-1} = (9)^{1.4-1} = (9)^{0.4}$$

$$T_2 = 2.408 * 308$$

$$T_2 = 741.7\text{ K}$$

For process 2-3 –

$$P_2V_2/T_2 = P_3V_3/T_3$$

$$P_3 = T_3 P_2/T_2$$

$$P_3 = 2167 * 1373 / 741.7$$

$$P_3 = 4011.4\text{ KPa}$$

Process 3-4 is again Isentropic-

$$T_3/T_4 = (V_4/V_3)^{\gamma-1}$$

$$= (9)^{0.4} = 2.408$$

$$T_4 = 1373/2.408 = 570.18\text{ K}$$

Heat input –

$$Q_{in} = CV (T_3 - T_2) = 0.718(570.18-308)$$

$$Q_{out} = CV (T_4 - T_1) = 0.718(570.18-308)$$

$$Q_{out} = 188.24\text{ KJ/KG}$$

$$\text{Net Work output} - W_{net} = Q_{in} - Q_{out} = 453.2 - 188.24$$

$$W_{net} = 264.96\text{ KJ/KG}$$

$$\text{Thermal efficiency } \eta_{th,otto} = W_{net} / Q_{in} = 264.96/453.2$$

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$$= 0.58 = 58\% = 0.58 = 58\% \text{ Otto cycle thermal efficiency } - \eta = 1 - 1/r^{r-1} = 1 - 1/(9)^{0.4} = 58\%$$

AMOUNT OF SAVING DONE

Petrol	LPG
In RS 100 of petrol, we travel 57 Km	In RS 100 of LPG, we travel 158 km

V. CONCLUSION

The conclusion of this study is done by comparing & analysing working of a four-cylinder car engine kit with a kit on a bike & it was possible with this study to work on the present bike by changing carburetor inlet with the mixer of LPG or fuel injected engine. It is a complex task to reconfigure the kit, but this study has effectively reconfigured the kit and hence, made it possible to successfully run a single cylinder S.I engine bike.

The study suggests manufacturing LPG tank which can be easily fitted in the Bike & it must store enough LPG so that average travel can be done on the bike in one refill. Limitations-

The study found some of the limitations such as:

Limitations-

The study found some of the limitations such as:

1. Less LPG refueling stations.
2. Rural areas don't have Natural gas filling stations.
3. Small LPG tank.
4. Cost for conversion of the bike is high.

Although it has some limitations, these limitations can be avoided by implying a company fitted LPG kit bike. This will reduce the cost of the LPG conversion and company can fit a bigger LPG tank in a better position rather installing it in the bag. If a company fitted LPG kit bike will be available in the future, it will demand more natural gas stations for refueling them, which force government to increase the number of the natural gas fueling station.

The scope of this study is to minimize the overall running cost of the Bike and making it useful for daily use by reducing its cost & also to reduce the Harmful Emissions and decrease the danger of ozone depletion by utilizing a clean fuel in our bike engine.

There are also some other features of this study on LPG bike, which are:

1. Low running Cost.
2. Decrease in maintenance
3. Low Emissions.
4. Increase in a total run of the bike in one refill.
5. Increase in engine life.
6. Less wear and tear in the piston cylinder.
7. Cold starting Improves.

Daly Usage of Bike Gives the Following Results:

1. For daily usage, a normal person rides a bike for 50km.
2. Recent price of Petrol= 77 Rs/ltr and LPG=50 Rs/ltr.
3. Normal mileage of 150cc, for Petrol- 55 km/ ltr, LPG-50 km/ltr (Theoretically)
4. Calculating monthly running cost (for daily 50 km)
5. LPG & Petrol – Rs 1785

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