# "MODIFICATION OF TWO WHEELER TO RUN ON LPG FUEL"

Prof.S.H.Kondo[1], Ujjwal S. Diwane[2], Lalit S. Deore[3], Akshay A. Daund[4], Piyush R. Adhangale[5]

[1] *Assistant Professor, Department of Mechanical Engineering, Guru Gobind Singh College of Engineering and Research Center, Nashik, Maharashtra, India*
[2] *Student, Department of Mechanical Engineering, Guru Gobind Singh College of Engineering and Research Center, Nashik, Maharashtra, India*
[3] *Student, Department of Mechanical Engineering, Guru Gobind Singh College of Engineering and Research Center, Nashik, Maharashtra, India*
[4] *Student, Department of Mechanical Engineering, Guru Gobind Singh College of Engineering and Research Center, Nashik, Maharashtra, India*
[5] *Student, Department of Mechanical Engineering, Guru Gobind Singh College of Engineering and Research Center, Nashik, Maharashtra, India*

## ABSTRACT

*Day by day increasing pollution and the high cost of fossil fuels have made us think of alternative fuels. Liquefied Petroleum Gas (LPG) is one of the most popular alternative fuels for automobiles because of its various features over gasoline fuel such as high octane number, low emission rate, etc. To investigate the feasibility of LPG as an alternative fuel for automobiles, here a two-wheeler (scooter) case is studied since the usage of the scooter is more nowadays for personal transportation. The required change in the physical structure of a two-wheeler running on Petrol is discussed for LPG.*

*Scooters (two-wheelers) play a significant role in the day to day transportation. Gaseous fuels such as liquefied petroleum gas (LPG) and compressed natural gas (CNG) have been broadly used in commercial vehicles. An effort has been made to use non-conventional fuel against conventional fuel which is becoming scarce and costly these days, as nonconventional 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 installed an 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.*

**Keyword**: - *Alternative fuel, LPG, Scooter and Gas kit***.**

## 1. PROBLEM STATEMENT

Every day we are observing that the fossil fuel prices are touching higher and higher prices. For people who have to travel daily to their work, it is not feasible to suddenly buy a new vehicle which is cost effective and eco-friendly and dump their petrol vehicles. Due to the use of fossil fuels over the years the world is facing huge problem of pollution and global warming. The new electric vehicle technology is less polluting but their high initial cost compared to regular internal combustion engine vehicles makes their affordability to middle class population in India very difficult.

## 2. OBJECTIVES

- To contribute in reducing air pollution.
- To modify a vehicle such that it can run on LPG as well as Gasoline (Petrol).
- To make old vehicles reusable and less polluting.
- To keep the cost of modification as low as possible.

## 3. MODIFICATION AND ASSEMBLY OF COMPONENTS

### 3.1 Components Required

To modify the vehicle to run on LPG (Liquid Petroleum Gas) it is necessary that component we are selecting should fit the vehicle and are cost effective to match our objectives. Following are the components required for LPG conversion:

1. LPG tank: The tank has capacity of storing approximately 2.5 Kg of LPG which can be filled on LPG fuel pumps. The tank is made with same material as commercial LPG cylinder which is mild steel and thickness of this steel is 2.5 mm, below is the picture of the tank.

**Fig -1**: LPG Tank

2. Vaporizer: Its main purpose is to convert the liquid LPG into gaseous state. It also controls the flow of gas entering the engine by using the vacuum generated by engine. This component requires no extra energy from battery and works only on engine vacuum. The output from the LPG tank is given to vaporizer which then reduces the pressure of gas to 30 mbar. Vaporizer also gives safety from leakage as if any hose pipe gets disconnected it immediately stops the flow of gas to the engine. Below is the picture of Vaporizer.


**Fig -2**: LPG Vaporizer

3. Rubber Hose Pipes: The rubber hose pipes will be used to connect the input and output ports of vaporizer to tank and engine intake of vehicle.

### 3.2 Modification

After gathering all the components the vehicle needs minor alterations to take LPG as fuel and burn it efficiently. As LPG is already converted into gas and has higher calorific value than petrol that means it needs less gas to produce same amount of energy. For that the air intake from the air filter needs to be obstructed to reduce the amount of air entering the engine cylinder. The air intake in air filter of our test vehicle is blocked using a rubber bush which results in less air intake and LPG would burn efficiently in cylinder and produce the required power.

It is necessary that the air intake for the petrol should get increased so we have drilled a hole of 18 mm for sufficient air intake for burning of petrol on the front panel of air filter which can be opened or closed while switching the fuel by using rubber bush, which is easily accessible to the user. To switch between Petrol and LPG a solenoid valve is connected in series from fuel pump to carburetor which can be turned on and off by using a switch. By operating the switch user can turn on and off the flow of petrol to carburetor. These are the only modifications needed for LPG conversion.

### 3.3 Assembly

Now in the last step to assemble the components we first connected the vaporizer to the engine. The steps to connect the vaporizer to engine are as follows.

1. Firstly, we need to connect the vacuum hose of vaporizer using rubber hose pipe to the vacuum hose of engine intake.
2. The output hose of vaporizer is connected before the carburetor in air intake hose by drilling a small hole.
3. The Vaporizer itself can be now fitted inside the under seat storage using nut and bolt.
4. The intake for the Vaporizer is connected to a low pressure gas regulator.
5. The gas regulator can be connected to the tank manually and valve can be turned on and off according to need.

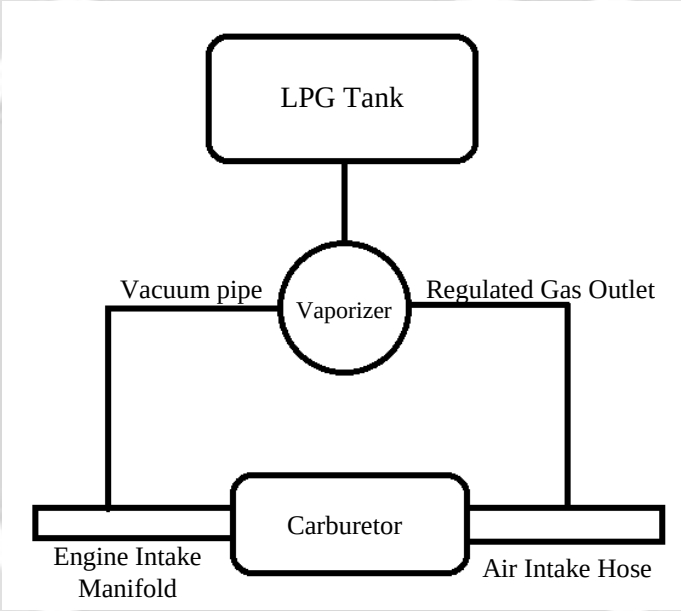


**Fig -3**: Connections of LPG Vaporizer

## 4. PERFORMANCE ANALYSIS

The scooter was tested on road and in real world conditions and following results were obtained:

### 4.1 Pollutant Emission

Pollution analysis of the vehicle was done in the RTO authorized PUC (Pollution Under Control) test center. The PUC test on vehicle was done on the vehicle using both Petrol and LPG alternatively. The PUC report is shown below:

Vehicle Photo with Registration plate
60 mm x 30 mm

| Sr. No. | Pollutant (as applicable) | Units (as applicable) | Emission limits | Measured Value (upto 2 decimal places) |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| Idling Emissions | Carbon Monoxide (CO) | percentage (%) | 3.0 | 1.4 |
| | Hydrocarbon, (THC/HC) | ppm | 3000.0 | 174.0 |

**Fig -4**: PUC Test Report on Petrol

Vehicle Photo with Registration plate
60 mm x 30 mm

| Sr. No. | Pollutant (as applicable) | Units (as applicable) | Emission limits | Measured Value (upto 2 decimal places) |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| Idling Emissions | Carbon Monoxide (CO) | percentage (%) | 3.0 | 1.08 |
| | Hydrocarbon, (THC/HC) | ppm | 3000.0 | 94.0 |

**Fig -5**: PUC Test Report on LPG

It can be observed from the PUC test that the emission of pollutants is more in Petrol compared to LPG. The HC emissions from the Petrol are 174 mg/L (parts per million) and HC emissions from LPG are just 94 mg/L which is 46% less than Petrol. And CO emission for the Petrol was 1.4 % out of 3.0 % as per BS-IV norms. And same for the LPG was 1.08% out of 3 % as per BS-IV norms.
Both the emissions are well under the limits of BS-IV norms but comparing the emissions of LPG to Petrol there is 30-40% decrease in emissions which is very beneficial for reducing pollution.

### 4.2 Economy

The average mileage from LPG scooter we got is about 30km/L from both the fuels (LPG and Petrol) in the same real world operation conditions. In this case the per kilometer cost of LPG running case is much lower than that of petrol running case. That means to cover the same distance the LPG costs 37.30 Rs/Kg compared to Petrol which costs 110 Rs/L. In short terms, LPG costs only one third of the petrol for the same amount of distance covered. Due to which the running cost of vehicle gets drastically reduced and is very affordable for daily commute.

### 4.3 Engine Longevity and Power

The power of the engine while running on LPG may be reduced 10% in comparison with original petrol engine because of the reduction of volume efficiency due to gaseous state fuel. Since the octane number of LPG fuel is higher than that of gasoline, the compression ratio of LPG engine can be chosen higher. In this case, the engine power can be preserved. The durability of LPG scooter is better than that of petrol one since the gas in not condensed on the cylinder surface so that the piston and cylinder are not worn rapidly.

## 5. ADVANTAGES AND DISADVANTAGES

### 5.1 Advantages

1) It contains less carbon than petrol. LPG powered scooter produces less than 30-40% carbon monoxide per Km and 46% less hydro carbons. Therefore emission is much reduced by the use of LPG.

2) LPG mixed with air at all temperatures. There is no dilution, because the fuel is in the form of vapor.
3) It has high antiknock characteristics.
4) Its heat energy is about 80% of gasoline, but its high-octane value compensates the thermal efficiency of the engine.
5) Running on LPG translate in to cost saving of about 50%
6) The engine may have 50%longer life.

**5.2 Disadvantages**

1) Engines are normally designed to take in a fixed volume of the mixture of fuel and air. Therefore LPG will produce 10% less horsepower for a given engine, at full throttle.
2) A special fuel feed system is required for LPG.
3) The under seat storage of vehicle cannot be used as LPG tank and vaporizer consumed that space.

## 6. CONCLUSION

Application LPG on scooter is appropriate solution for reducing of air pollution. A carburetor system combining a Vaporizer and LPG tank allows the use of LPG in these kinds of vehicles. The system allows the engines to work with the optimal mixture composition of air and fuel in the operating conditions. The whole system can be domestically manufactured, which can cut the cost of production and increase the rate of domesticated parts in our vehicle industry. Also the cost of modifying the two-wheeler is also very low i.e. 5000-6000 Rupees compared to other alternative fuel options.
At the current fuel prices, using LPG instead of petrol can help save 50% of fuel costs. Using LPG driven vehicles will contribute to reducing air pollution 60 to 80% in comparison with petrol-driven one.

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