Experimental Investigation on LPG as Alternative Fuel for Two Wheelers
S. D.Meghare, N. R. Kannake, S. S. Sontakke

Abstract- An attempt has been made in this paper to use alternative fuel in four stroke Gasoline engine. Our foremost aim in selecting this paper is to use non conventional fuel against conventional fuel which is becoming scarce and costly now days. With this air is less polluted than conventional fuels. It is also good with regard to economical considerations. In our paper we have installed LPG fuel system to four stroke vehicles, where in we can use both gasoline and LPG. LPG from storage tank comes to the adjustable regulator through a primary delivery valve fitted at the mouth of the LPG cylinder.

I. INTRODUCTION

The LPG means Liquefied Petroleum Gas. It is also called as bottled gas (or) Refinery gas. It is obtained as a by product during cracking of heavy crude oils or from directly obtained natural gas. The LPG obtained either from cracking or from CNG (Compressed Natural Gas) is dehydrated, desulphurised and traces of organic sulphide (Mercaptans) are added to give warning of gas leak. It is then filled in cylinders and compressed to that extend the fuel gas in liquid state and supplied under the trade name like INDANE-BURSHANE, and many other such suppliers. The calorific value is 11,900 Kcal/kg approximately. Natural gas technology IC engines beats the current emission standards for hydro carbons (HC) and nitrous oxide (NO) by more than two thirds and level for carbon dioxide (CO) by more half. LPG consists of Hydrocarbons of such volatility that they can exist as gas under atmospheric pressure but can be readily liquefied under pressure.

II. BLOCK DIAGRAM

Fig 1. LPG System Assembly to Engine

III. COMPONENTS OF LPG SYSTEM

<table>
<thead>
<tr>
<th>No.</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Dike / Housing</td>
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<tr>
<td>2.</td>
<td>Bracket Assay</td>
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<td>3.</td>
<td>Drainer Assay</td>
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<td>4.</td>
<td>Gasified Assay</td>
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<tr>
<td>5.</td>
<td>Solenoid valve</td>
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<td>6.</td>
<td>Control Circuit &amp; Wiring</td>
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<tr>
<td>7.</td>
<td>Container / Cylinder Assay</td>
</tr>
<tr>
<td>8.</td>
<td>Regulator Assay</td>
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<tr>
<td>9.</td>
<td>Pipe Assy. / Cylinder Belt</td>
</tr>
<tr>
<td>10.</td>
<td>Nozzle / VenturyAssy</td>
</tr>
<tr>
<td>11.</td>
<td>Gas Filling Attachment Assay</td>
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<tr>
<td>12.</td>
<td>RVO Power Enhancer</td>
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<tr>
<td>13.</td>
<td>Electronic PWR 2T-Oil System</td>
</tr>
<tr>
<td>14.</td>
<td>Mechanical Oil Pump</td>
</tr>
</tbody>
</table>

IV. LOW PRESSURE GASSIFIRE

The New LPG vacuum reducer has been designed to be installed in all carburetor vehicles. As for the electronic reducer the liquid LPG arriving from the LPG solenoid through a copper pipe enters the LPG Pressure reducer, to its 1st stage vaporization-reduction chamber. In the first stage LPG is firstly vaporized and successively reduced in pressure. The second stage chamber is very sensible to the vacuum pressure. The vacuum pressure causes the flow of LPG to the engine to increase or decrease depending on the pressure difference. Any pressure difference is transferred to the second stage chamber and the membrane will allows for a greater flow of gas to enter the engine. The small coil mounted on top of the second stage cover is used for the function of choke allowing small quantities of LPG at the time of engine start.

Fig 2. Low Pressure Gassifire

A. LPG Solenoid Valve

The LPG Solenoid Valve is an electromagnetic device that stops the flow of LPG when the engine is stopped or operated with petrol.

The solenoid LPG Valve is composed of:
1. NBR seals to guarantee absolute safety
2. High thermal induction coil wire to render its working life virtually unlimited
3. Self extinguishing coil covering resin
4. Gas filter made with a fine filter paper material.
5. Vibration resistance.
6. Multiple fitting positions.

Fig 3. LPG Solenoid Valve
B. Petrol Solenoid Valve

The Petrol Solenoid Valve is an electromagnetic device widely used in carburetor vehicles. Its function is to stop the flow of Petrol when vehicle is running with LPG and vice versa when the vehicle is operated with Petrol. The petrol Solenoid valve is installed in the line of Petrol fuel near the engine compartment. The Petrol Solenoid valve is normally closed when electricity is switched off. It is basically composed of a shutter operated by a magnetic coil and two nipples. It is also equipped with an emergency device to manually reset the petrol flow in case of a break down in the electrical system.

C. Petrol-LPG Changeover Switch

This is a three position electronic switch, the first position is PETROL and the second is LPG. Obviously when positioning the switch on petrol the switch will close the LPG Solenoid Valve and it will open the Petrol Solenoid Valve and vice versa. The Mid position of the switch (third position) is use to maintain the LPG and the Petrol Solenoid valves in the OFF position until the carburetor uses the small Petrol reserve. With a carburetor engine gas switching is always done manually. The switch for carburetor engines also has a safety feature; it stops the gas flow to the engine when engine accidentally stops.

D. Mixers with Carburetors

The mixer with carburetor has an extremely importance. The right AIR- FUEL ration depends on the mixer and this is the reason for the existence of so many versions bearing so many shapes. The mixer for vehicles equipped with a carburetor may be manufactured with a specific Venturi or by implanting a nozzle in the proximity of the carburetor's original Venturi. The nozzle system type mixer can perform very well if executed with care and knowledge. In any way, is good to remember, that this system is not always possible to adapt to all carburetors and if not properly installed it may create irreversible damages to the carburetor.

E. Tanks:

Available in 18 different approved sizes to suit most vehicles in India. The two variant available are called

1. Cylindrical type
2. Toroidal type

The tank also has different capacity variants.

F. RVO Power Enhancer

This supersaver Reed Valve Operated device specially developed to work in tandem with the gassifire does not allow any fuel wastage by the kit and enhances the power output of the engine, for example: - if an engine has a top speed of 100 Km. /hour on petrol then on gas system with this device, ensures that the engine will give a top speed of 105 Km/hour. Emitting pollution levels also comes to near zero.

G. Mechanical Oil Pump

This is a mechanical vacuum operated 2T-Oil Pump and is a alternate, direct replacement to electronic PWR 2T oil system. Safest gas system of the world.LPG kits function on “lean burn system” and operates at extremely low pressure. Thereby maximizing fuel efficiency and overall system safety.Gassifire releases gas only when the piston of the vehicle generates a stroke, as soon as engines stops for any reason the gas supply to engine cuts of automatically.

H. Oil and Dirt Separator

LPG kits consist of a special filtration system, which enhances the performance of the total system. Protect system from all metallic impurities / rust particle in fuel. Increases the life of the gas cylinder and the total system. It prevents any fuel Line choking, Meter jamming etc. This system also separates the wax [Scent chemical: - ethyl me captor, C2H5SH] - out of gas hence increasing the life of
gassfire components manifolds [no periodic cleaning].

V. PROCESS DESCRIPTION

LPG from tank passes to the low pressure gassifire, in gassifire the diaphragm pressurizes the LPG to the pressure required inside the engine cylinder. Further this LPG passes to the LPG solenoid valve this electromagnetic device supplies LPG to the carburetor through nozzle in right amount. Operator of vehicle is capable of switching both LPG and petrol to engine by changeover switch.

VI. WHY LPG FOR TWO WHEELER?

LPG is a state of Art Technology for small engines 50 cc to 375 cc air cooled, single cylinder 2 stroke as well 4 stroke vehicles. Sole Objective to introduce this Technology, is to declare liquid fuel (Petrol) Carburetor based technology as obsolete, used presently world wide on 2 Wheelers and 3 wheelers. World’s scientific community and automobile engineers must discard this carburetor device, as it is impractical for carburetor to mix air and petrol in accurate and in metered quantity to suit the ever changing and variable engine requirements. Carburetor technology has failed to control the uneven supply of petrol with the incoming air stream to engine at various levels. It is inbuilt and inherent draw back that in some circumstances the sucking air stream sucks excess petrol at carburetor ventury, resulting in petrol wastage and pollution. Now let us replace this redundant carburetor technology with new revolutionary gas technology, which promises:

- Cent % fuel efficiency.
- With clean exhaust and Zero Pollution.

If this new technology is implemented with right spirit in India alone, on in-use vehicles [Existing Vehicles] plus new vehicles added during the year. New gas technology will save fuel worth Rs.200 crores per dayOr73000 Crore rupees [Seven KharabThirty Arab Rupees] annually in foreign exchange only. Even more importantly this will prevent entry of 1.5 crore tons of carbon and NOx pollutant from Air per day in India alone. Project will drastically improve Air quality, crores of urban people suffering from Air Born dieses will breathe in Fresh Air. [Which will help our urban citizens to breathe in fresh Air], even lot more saving will be on account of engine life and maintenance.

VII. MARKET POTENTIAL

To date No Proven Gas Technology available world wide to run two wheelers & single cylinder small engine on LPG.LPG kit provides complete solution and 110% performance of petrol engine on Auto LPG Fuel. In India alone we have an existing population of 90 million 2 wheelers and every year another 9 Million new 2 wheelers are added to this existing population.LPG kits can be supplied as OEM to 2 wheeler giants [After all types of Govt. Approval and certification].Tremendous export potential, as there is a growing demand of LPG based products in ASIAN countries like Philippine, Indonesia, Malaysia etc.LPG as Auto fuel is gaining popularity day by day. LPG dispensing Units/ Pumps are opening up in all major cities of the country in another 2 years time another additional 20new cities will be having LPG Pumps. Major car manufacturers like Maruti Suzuki, GM etc., are already offering cars on only LPG Fuel. As a low polluting.

VIII. EFFICIENCY AND PERFORMANCE

<table>
<thead>
<tr>
<th>Petrol K.m./Ltr</th>
<th>Rs. K.m.</th>
<th>LPG K.m./Ltr</th>
<th>Rs. K.m.</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 cc to 125 cc M/Cycles [TVS scooty pep+]</td>
<td>60 K.m./Ltr</td>
<td>Rs.1.16 /Km</td>
<td>72 K.m./Ltr</td>
<td>Rs.0.97 /Km</td>
</tr>
<tr>
<td>350 cc M/Cycle [Bullet ]</td>
<td>40 K.m./Ltr</td>
<td>Rs.1.75 /Km</td>
<td>50 K.m./Ltr</td>
<td>Rs.1.40 /Km</td>
</tr>
</tbody>
</table>

Fuel Saved 50% to 75%.

LPG Cost

All calculated on domestic LPG Rates]LPG is a clean burning fuel and reduces clogging of spark plug as well as carburetor and piston block, whereby you save on maintenance cost.

IX. SPECIAL FEATURES OF LPG SYSTEM

1. LPG is cheaper than gasoline in cost as well availability.
Due to LPG there is no adverse effect on engine operation.

It is highly knock resistant.

Residue and oil contamination is small as it burns early.
Crank case dilution is small thereby resulting in increased engine life.
Due to uniform distribution thermal efficiency is higher.
Higher octane rating making it useful in engines having compression ratio above 10:1.
It leaves little or no carbon deposits in the cylinder when it burns. It is a clean gas.
Easy cold starting is possible due to thermal motion.
It has a low strain on lubricants.
Lesser exhaust emission and hence lesser air pollution.
High durability of exhaust system.
Spark plug and upper cylinder.
Since it enters as a gas it cannot wash down the cylinder walls. Thus not remove lubricant and so cylinder wall wear, piston rings wear is decreased.
Increased engine life

The Benefits of LPG compared to other fuels:

<table>
<thead>
<tr>
<th>LPG compared to oil</th>
<th>LPG compared to Electricity</th>
<th>LPG compared to Solid Fuel</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Burns cleanly Without soot</td>
<td>1. Heat is instantly available and readily controlled</td>
<td>1. Heat is instantly available and readily controlled</td>
</tr>
<tr>
<td>2. Appliances require less maintenance</td>
<td>2. More responsive for direct-heating systems</td>
<td>2. Cleaner and more convenient to deliver, store and use</td>
</tr>
<tr>
<td>3. Flame temperature easily controlled</td>
<td>3. Reduced carbon</td>
<td>3. More reliable in continuous use</td>
</tr>
<tr>
<td>4. Combustion is virtually odourless</td>
<td>4. emissions mean that</td>
<td>4. Lower maintenance costs</td>
</tr>
<tr>
<td>5. Appliances operate quietly</td>
<td>5. LPG is environmentally cleaner for a given energy output</td>
<td>5. Burns cleanly without soot</td>
</tr>
<tr>
<td>6. No containment area generally required around tank</td>
<td>6. Computer telemetry can be used to ensure continuity of supply</td>
<td>6. Computer telemetry can be used to ensure continuity of supply</td>
</tr>
<tr>
<td>7. LPG produces very low sulphur emissions</td>
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</table>

CO₂ Emissions for Common Expensive Heating Fuels in Buildings:

<table>
<thead>
<tr>
<th>Fuels</th>
<th>CO₂ Emissions (kg CO₂/KWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPG</td>
<td>0.234</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>0.194</td>
</tr>
<tr>
<td>Oil</td>
<td>0.265</td>
</tr>
<tr>
<td>Solid fuel</td>
<td>0.293</td>
</tr>
<tr>
<td>Electricity</td>
<td>0.422</td>
</tr>
</tbody>
</table>

A. Safety

In terms of combustion, LPG is similar to petrol. The vehicle’s LPG tank is in fact much stronger than a conventional fuel tank as the gas is stored inside it under moderate pressure. All tanks are fitted with electric shut off valve, fill point, pressure relief valve.

B. Perceived Advantages

1) Kit costs as low as Rs.6000/- to Rs.7000/- (CNG kits cost upwards of Rs.30, 000/-)
2) Cost per kilometer of running approx. 80 paise (petrol being nearly Rs.2 per km)
3) Household subsidized cooking gas cylinders available easily.

C. Realities

1) LPG is hazardous

It is worth pointing out that natural gas (CNG) is lighter than air and in the unlikely event of a leak from piping or container the gas will dissipate upwards quite quickly. In the case of petrol and LPG the vapour given off is heavier than air and will tend to pool near the ground; this is where there is a strong risk of some ignition source. It is generally accepted that the various automotive fuels range in safety from diesel (safest) to LPG as the most hazardous, with alcohol fuels, methane and gasoline lying in the middle of the range.

2) Illegal dealers

Dealers are illegally converting at least 2-3 cars per day. They do not even bother to fit imported LPG Commercial cylinders (since manufacturing is not authorized by the government as yet) but just go in to fit household, subsidized cooking gas cylinders. "Cylinders for vehicles have to be thicker, these have a meter and two safety valves," says P. S. Sethi of Malcha petrol pump at PulaniMarg, New Delhi. This is the first petrol pump in the country to have an LPG station and is waiting for the real government nod.

3) Ministry speaks

"These (illegal household LPG fitted vehicles) are moving bombs, highly dangerous and should be stopped immediately," says Himmat Singh, director, Ministry of Surface Transport. As far as regulating the illegal dealers are concerned, the transport department has been caught winking. "We are not aware of any of these dealers. They should be immediately stopped," says Parvez Hashmi, Minister of Transport. Similar view was eco's by M.P.Tyagi, special commissioner, Delhi Traffic Police “We have never said that it is legal.”

4) Law speaks

For LPG kits and special cylinders to be available off the shelf, the Motor Vehicles Act has to be modified, and safety norms set up. And even before that, it has to be cleared by Parliament in the next session. “In fact, we are yet to get a formal note from the Cabinet,” says an official from the Ministry of Surface Transport.

5) Out of breath

If you're driving is to get over a mountain quickly it might be better to stick to petrol - although if you convert to gas you can still switch back to petrol when hitting the high mountain passes.

D. Actual Advantages

Friendly Environment

Propane, or liquefied petroleum gas, is paraffin: although a
petroleum product (it can also be produced from natural gas), it contains none of the olefins or aromatics that produce smog. Propane mixes very well with air, and, like compressed gas, is already vaporous when mixing in the injection ports of carburetors, reducing the pollutants ordinarily released when an engine turns over. Propane has significantly lower carbon monoxide and hydrocarbon emissions, and causes nitrogen oxide emissions that, while no lower than gasoline, are not significantly higher, either.

CNG (Compressed natural gas) or LPG (Liquid petroleum gas) has been recognized the world over as an efficient, safe, reliable, environment friendly and economical alternate fuel for automobiles. Both CNG and LPG are being used in many developing and developed countries and many people are opting for them.

X. CONCLUSION

- Low fuel consumption based on best vaporization.
- Perfect system for bio-fuel (gasoline, LPG, and CNG) and Monofuel (LPG or CNG only).
- Due to combustion very low effect on environment.
- Easy and convenient work by small size and light weight
- More efficiency as compared to other fuels.
- Due to LPG there is no effect on engine operation
- Save fuel save money

REFERENCES


