

Performance Improvement of Si Engine by using Blend of Oxy-Hydrogen Gas with Gasoline Fuel

Ruturaj Bichkar¹, Rohit Jadhav², Vishal Kalyankar³

¹Department of Mechanical Engineering, Smt. Kashibai Navale College of Engineering, ruturajbichkar14@gmail.com

²Department of Mechanical Engineering, Smt. Kashibai Navale College of Engineering, rohithadhav8308@gmail.com

³Department of Mechanical Engineering, Smt. Kashibai Navale College of Engineering, vishal.kalyankar3@gmail.com

ABSTRACT

This Today the whole world is facing two major problems one is increasing pollution and rapid use of fossil fuels. So there is a need to control pollution and reduce fuel consumption. Incomplete combustion of fuel causes pollution and reduction in fuel utilization. We are looking for such source of energy which helps for complete combustion of fuel and increases fuel utilization which ultimately reduces the pollution. In order to overcome the drawbacks of the regular petroleum fuel, it is the need of time to completely or partially replace the petroleum fuel. But alternative options to petroleum fuel are having disadvantages. An electric or compressed air driven cars cannot be used where high torque is required or using hydrogen as fuel requires very costly storage equipment's. In this project work an attempt has been made to reduce the drawbacks of petroleum fuels. Electrolysis of water can give us hydrogen in form of oxy-hydrogen gas which can be used as an alternative fuel for any internal combustion engine. This project work discusses methods designed for the production of Oxy-hydrogen gas. All together it has been observed that the blend of 'oxy-hydrogen gas' and petrol instead of only conventional fuel improves the performance of the engine.

Keywords: Oxy-hydrogen gas, SI engine, Fuel cell

1. INTRODUCTION

Hydrogen powered bikes are those in which "HYDROGEN CELL" is used to produce a fraction of power for driving the bike. This results in decrease the fuel (petrol) thus increasing the mileage of the bikes. Hydrogen gas kit is latest innovation to increase mileage and power of vehicle. Combustion of fossil fuels has caused serious problems to the environment and the geopolitical climate of the world. The main negative effects on the environment by fossil fuel combustion are emissions of NO_x, CO, CO₂, and unburned hydrocarbons. The main negative effect of burning fossil fuel on the geopolitical climate is the lack in supply of these fuels and the effect of pollution on politics. Hydrogen is a clean fuel which on combustion produces water vapor as the only product. The use of hydrogen in IC engines not only helps to increase the efficiency of it but also helps to reduce pollution and reduce the poisonous gases like carbon monoxide, nitrous oxide etc. The use of hydrogen helps to reduce their use and hence prevent the depletion of the natural resources. Through a process of electrolysis water that is in a sealed container under your hood is converting to H₂ gas. This gas is then introduced to air flow in the intake manifold using your engine vacuum. This gas is then mixed with the fuel providing better mileage.

Added to this, petrol products when burned in an engine emit harmful effluents as exhaust. These effluents are responsible for acid rains, glacier melts, global warming etc. Numerous researchers around the world are involved in the field of developing alternate fuels and to reduce emission by external means like use of catalytic converters and engine modifications. However some researchers have also suggested the use of additives like brown gas, blending vegetable oils with petrol etc to reduce emissions. In this present research work an attempt to study the exhaust when hydrogen gas (additive) mixed with air and petrol as a fuel in four stroke engine was done. As we know that sources of petroleum fuels are limited and with the present state of its usage; it will one day.

The major pollutants from the conventional hydrocarbon fuels are unburned/partially burned hydrocarbon (UBHC), CO, oxides of nitrogen (NO_x), smoke and particulate matter. It is very important to reduce exhaust emissions and to improve thermal efficiency. The higher thermal efficiency of diesel engines certainly has advantages for conserving energy and also solving the greenhouse problem. How significantly the researchers aspire to compensate with an alternative fuel for our means of transport, but the outcome is that we are still lagging behind in the technical aspect compared to petroleum fuels. So not to compete with petroleum fuels but to facilitate petroleum fuels to exist longer life in turn help to survive this ever demanding automobile industry.

1.1 Theory of Hydrogen Gas

Hydrogen is a combustible gas and water on electrolysis splits into two molecules of hydrogen and one molecule of oxygen, hydrogen and oxygen though evolve separately in the electrolysis setup but combines immediately to form Oxy-hydrogen gas (Hydrogen) in the collection tube. On introduction of the Hydrogen gas and air fuel mixture through the air-inlet manifold of the carburetor into the IC engine, the highly flammable Hydrogen gas ignites a fraction of a second earlier than the fuel. No flash points, explosive points or temperatures soaring, takes place during the combustion within the cylinder. The flame speed of hydrogen is very high compared to that of gasoline. Hence there is no delay in combustion between two points in the cylinder ensuring a smoother performance, this helps in uniform and complete combustion of the additive and fuel mixture inside the cylinder of the engine. In addition to this the life and performance of the engine improves and because of the complete combustion of the fuel and Hydrogen gas mixture, it ensures that there are no unburned hydrocarbons and also oxidizes the partially oxidized carbon i.e. carbon monoxide (CO) into completely oxidized carbon dioxide (CO₂) which is less harmful compared to carbon monoxide. This results in significant decrease in hydro carbon level in the exhaust of the engine. The Hydrogen gas doesn't cause any pollution as the product after combustion is steam. The hydrogen gas is liberated using the electrolysis process, where the current is passed through the solution of distilled water and NaOH (electrolyte), this liberated volume of Hydrogen gas directly depends on:

- i. Concentration of Electrolyte.
- ii. Current sent into the solution.
- iii. Area of contact between the electrode and the solution.

2. WORKING PRINCIPLE

By the use of basic principle of Faraday's Law,

An electrical power source is connected to two electrodes, or two plates typically made from some inert metal such as titanium or stainless steel which is placed in the water. In a properly designed cell, hydrogen will appear the cathode (the negatively charged electrode, where electrons enter the water) and oxygen will appear at the anode (the positively charged electrode). Assuming ideal faradic efficiency, the amount of hydrogen generated is twice the number of moles of oxygen and both are directly proportional to the total electrical charge conducted by the solution.

Following are the reactions that normally take place at cathode and anode.

Cathode (reduction): $2 \text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{H}_2 + 2 \text{OH}^-$

Anode (Oxidation): $4 \text{OH}^- \rightarrow \text{O}_2 + 2 \text{H}_2\text{O} + 4 \text{e}^-$

Overall reaction: $2 \text{H}_2\text{O}$

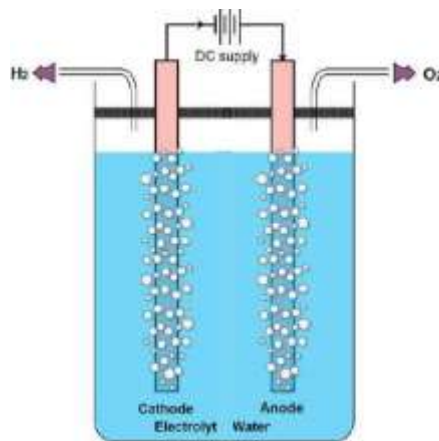


Fig-1: Electrolyte process

3. DESIGN OF HYDROLYSER KIT

The production of brown gas is done by a hydrolyser kit, designed for this purpose. The kit contains cylindrical plastic container filled with 10.50 Grams NaOH solution till the electrodes are completely immersed. The electrodes are made up of STAINLESS STEEL (140mm length × 27mm breadth × 1mm thick). The gap between two electrodes is maintained up to 1/16 inch. The electrical connections are made with the coated wires and the electrodes are held with plastic screw, nut and washers so as to resist the heat produced and to provide insulation, also the electrodes are separated using to avoid short circuiting. These containers are electrically connected to maintain constant current in the container. The evolved hydrogen gas from container is directed to flow through tube to engine inlet manifold.

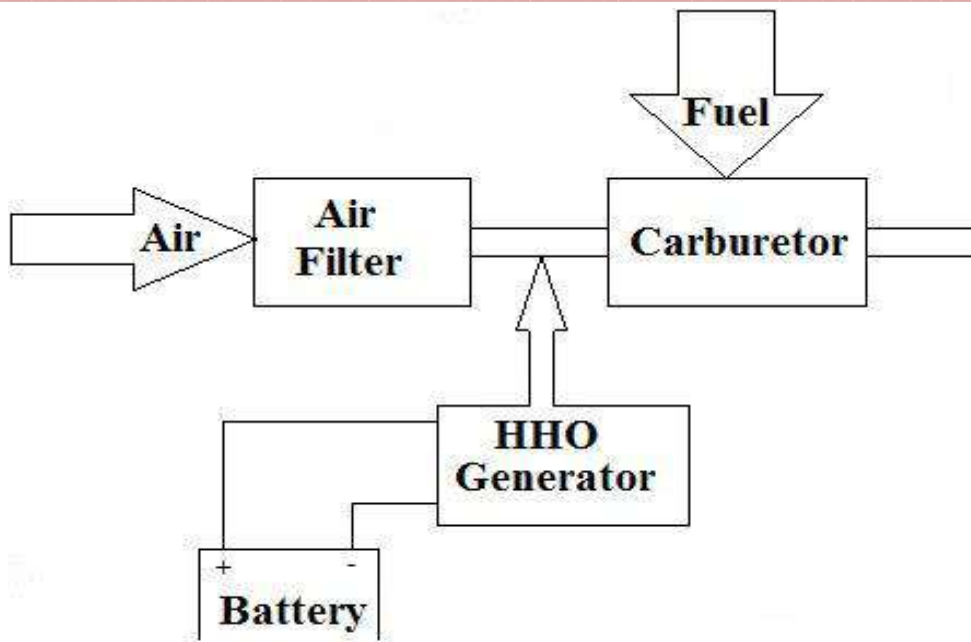


Fig-2: Line diagram of project

3.1 Components

In our experimental set up following are the main components which plays important role in it

- 1) Eliminator.
- 2) Plastic container.
- 3) Four electrode.
- 4) Electrolyser (Distilled water and NaOH).
- 5) Rubber tube.

3.2 Details Drawing Of Kit

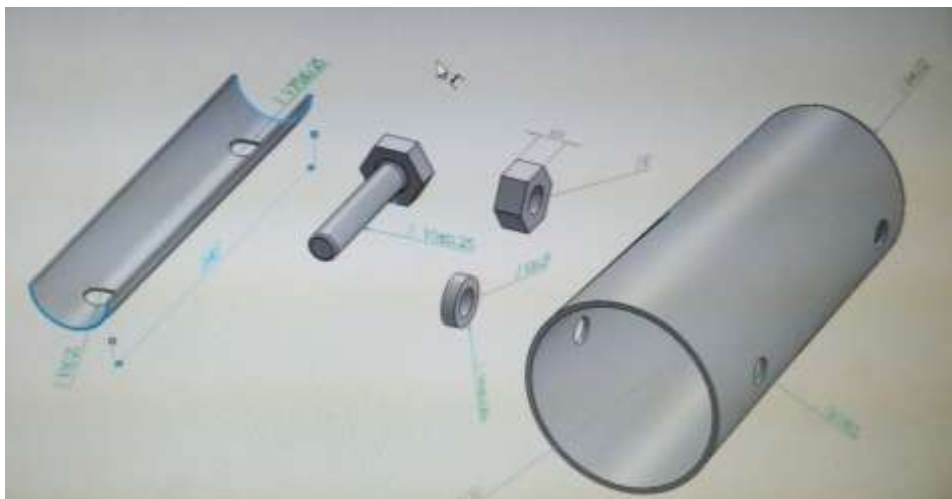


Fig-4: Details Drawing Of Kit

3.3 Assembly Drawing Of Kit

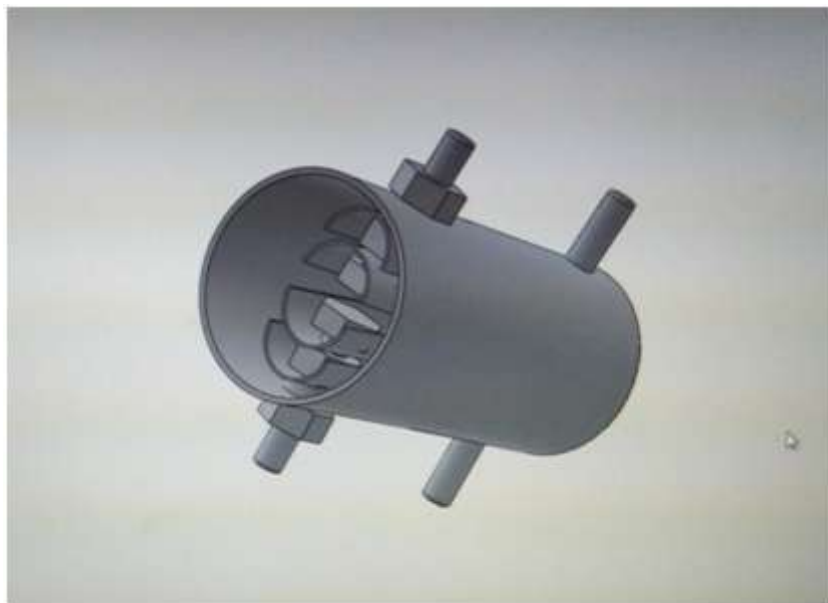


Fig-5 Assembly Drawing Of Kit

4. WORKING PROCESS

The hydrogen generated at cathode is fed to the inlet manifold that is in air hose pipe of the carburetor, then this gas mix with the coming air from the air filter when the vacuum is created by the piston movement from TDC to BDC. As the hydrogen or HO gas mixed with air then it goes to engine cylinder with gasoline during suction stroke of the engine. At the end of compression stroke the spark is generated from the cold rated spark plug the combustion of gasoline and HO gas occurs. Hydrogen itself contains 1/3oxygen by volume and 2/3 hydrogen. The hydrogen explosion is so fast that it fills the combustion cylinder at least 3 times faster than the gasoline explosion and subsequent ignites the gasoline from all directions. Hence more power is generated consequently the mileage of our bike gets increased. Some basics the burn speed of hydrogen is 0.098 to 0.197 ft/min (3 to 6 cm/min) compared gasoline’s 0.00656 to 0.0295 ft/min (0.2 to 0.9 cm/min).

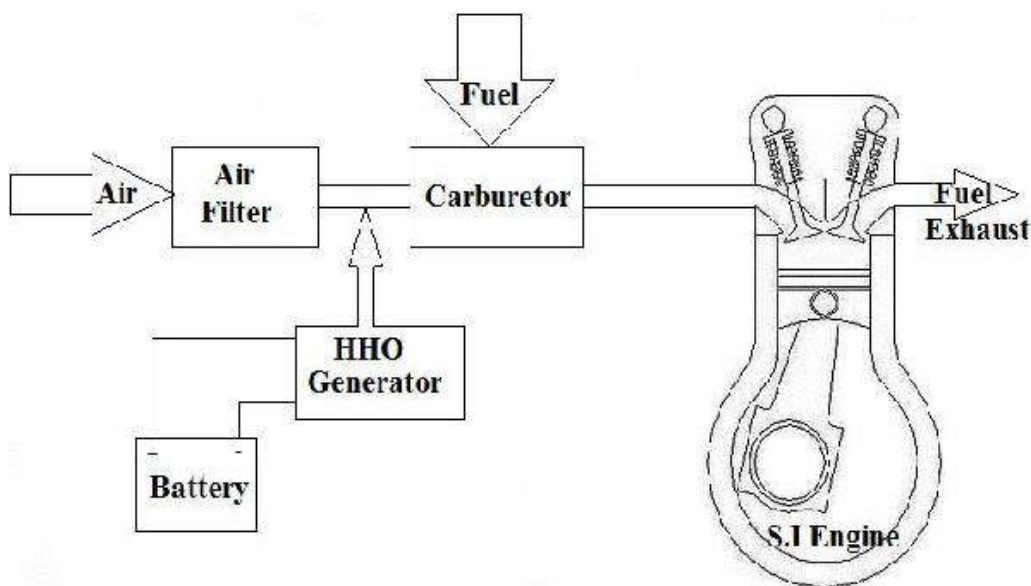


Fig-6: Complete line diagram for Experiment

5. PERFORMANCE ANALYSIS OF HHO KIT FOR PUC TESTING

The PUC testing is done by immersing the inlet pipe of gas analyzer into the engine exhaust muffler. The gas analyzer measures the amount of gases like carbon monoxide, carbon dioxide and hydrocarbons from the exhaust gases from vehicle exhaust.

An infrared gas analyzer measures traces gases by determining the absorption of an emitted infrared light source through a certain air sample.

Traces gases found in the Earth's atmosphere get excited under specific wavelength found in the infrared range.

Infrared gas analyzer usually have two chambers ,one is a reference chamber while the other chamber is a measurement chamber. Infrared light is emitted from some type of source on one end of the chambers, passes through a series of that contains given quantities of the various gases

For instance , if the analyzer is to measure carbon monoxide and dioxide ,the chambers must contain a certain amount of these gases.

6. RESULT

6.1 No Load Condition

PARAMETERS	WITHOUT HHO KIT	WITH HHO KIT
CO	2.38	1.79
CO ₂	2.30	1.90
HC	666	404
LAMBDA	0	0

Table -1: No Load Condition

The carbon monoxide percentage decreases from **2.38 to 1.79**. The carbon dioxide percentage decreases from **2.30 to 1.90**. The hydrocarbon ppm decreases from **666 to 404**.

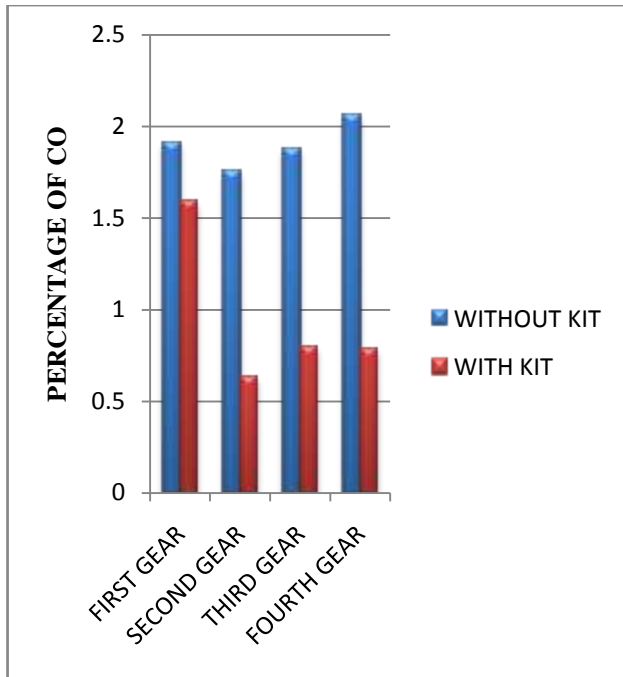
6.2 Mileage Testing Of Bike With Kit And Without Kit

The on-road mileage test was carried out on the vehicle with use of HHO kit. The mileage testing kit was filled with 50 ml of petrol and the supply of petrol pipe of mileage kit was directly given to the carburetor of the bike, At the same time the supply from fuel tank of bike was deducted. This is the experimental setup for HHO kit on road mileage test. The battery wires are connected to electrodes of HHO kit.

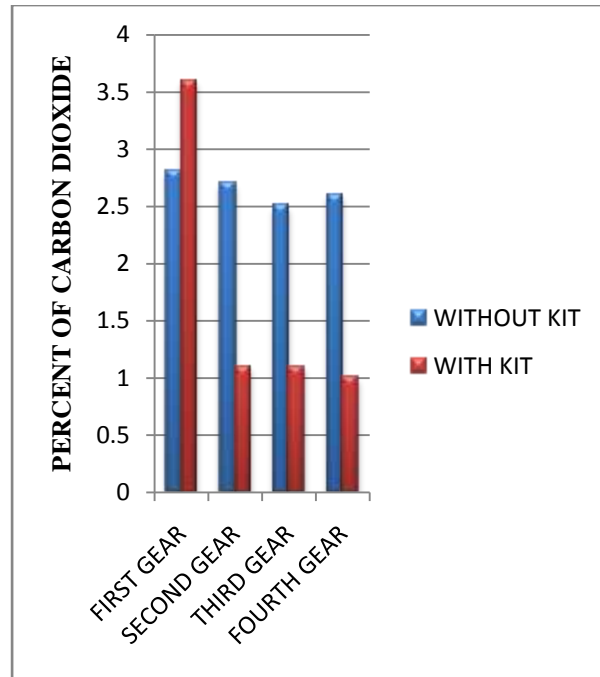
The outlet pipe of kit is attached to the air inlet hose of the bike. The kit is filled with electrolyte of distilled water and NaOH solution.

When the ignition is made ON the current passes from battery to the electrodes, And as the electrodes are dipped in the electrolyte due to current decomposition takes place. Here the electrolysis process starts and HHO gas generation takes place. The generated gas is passed through the outlet pipe of kit.

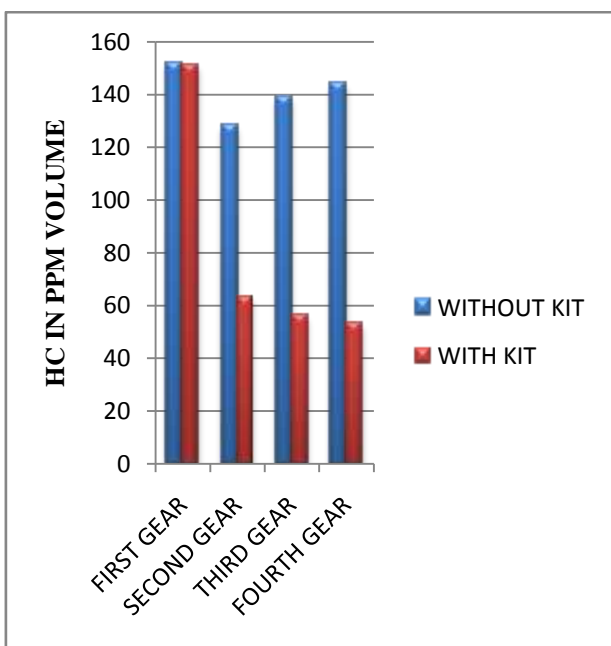
6.3 Graphs



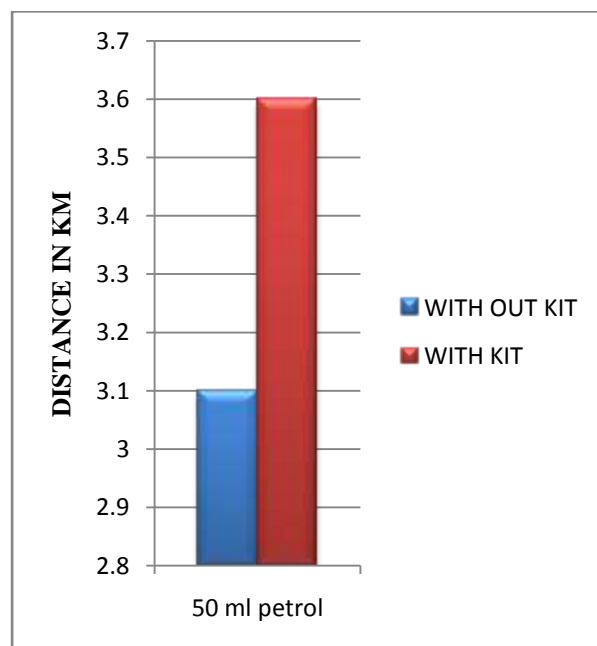
Percentage of CO and load on vehicle



Percentage of CO2 and load on vehicle



Percentage of HC and load on vehicle



Distance Travelled By Vehicle

7. CONCLUSION

From the testing and analysis we can conclude that-

- I. The percentage of carbon monoxide is decreases up to 59%.
- II. The percentage of carbon dioxide is decreased up to 40%.
- III. The percentage of hydrocarbon decreased up to 54%.
- IV. The percentage of mileage increase up to 14%

It will make India free from pollution that is going to be a major problem of the world. Hydrogen gas and fuel completely burns in the IC engine, hence giving no scope for the incomplete combustion With the introduction of hydrogen gas a 99% decrease in the unburned hydrocarbons and Carbon monoxide has been observed when compared to exhaust because of air fuel mixture alone (without hydrogen gas).

Also helps in

- Increase in life of engine oil more than 2 to 3 times
- Increase in pick-up of vehicle
- Better smoother running engine
- Reduced knocking of engine
- Reduce the operating temperature of the engine
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