HHO KIT – WATER AS A FUEL SUPPLY

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Abstract

A Water fuel engine (hydrogen Engine) is an alternative fuel vehicle that uses hydrogen as its onboard fuel for motive power. The term may refer to a personal transportation vehicle, such as an automobile, or any other vehicle that uses hydrogen in a similar fashion, such as an aircraft. The power plants of such vehicles convert the chemical energy of hydrogen to mechanical energy either by burning hydrogen in an internal combustion engine, or by reacting hydrogen with oxygen in a fuel cell to run electric motors. Widespread use of hydrogen for fueling transportation is a key element of a proposed hydrogen

Key words: hydrogen oxygen cell,hydrogen engine, fuel cell, electrolysis process.

1. Introduction:

Many companies are working to develop technologies that might efficiently exploit the potential of hydrogen energy for mobile uses. The attraction of using hydrogen as an energy currency is that, if hydrogen is prepared without using fossil fuel inputs, vehicle propulsion would not contribute to carbon dioxide emissions. The drawbacks of hydrogen use are low energy content per unit volume, high tank age weights, the storage, transportation and filling of gaseous or liquid hydrogen in vehicles, the large investment in infrastructure that would be required to fuel vehicles, and the inefficiency of production processes.

Buses, trains, PHB bicycles, canal boats, cargo bikes, golf carts, motorcycles, wheelchairs, ships, airplanes, submarines, and rockets can already run on hydrogen, in various forms. NASA uses hydrogen to launch Space Shuttles into space. There is even a working toy model car that runs on solar power, using a regenerative fuel cell to store energy in the form of hydrogen and oxygen gas. It can then convert the fuel back into water to release the solar energy. The current land speed record for a hydrogen-powered vehicle is 286.476 mph (461.038 km/h) set by Ohio State University's Buckeye Bullet 2, which achieved a "flying-mile" speed of 280.007 mph (450.628 km/h) at the Bonneville Salt Flats in August 2008. For production-style vehicles, the current record for a hydrogen-powered vehicle is 333.38 km/h (207.2 mph) set by a prototype Ford Fusion Hydrogen 999 Fuel Cell Race Car at Bonneville Salt Flats in Wend over, Utah in August 2007. It was accompanied by a large compressed oxygen tank to increase power. Honda has also created a concept called the FC Sport, which may be able to beat that record if put into production.

A fuel cell is a device that converts the chemical energy from a fuel into electricity through a chemical reaction of positively charged hydrogen ions with oxygen or another oxidizing agent. Fuel cells are different from batteries in requiring a continuous source of fuel and oxygen or air to sustain the chemical reaction, whereas in a battery the chemicals present in the battery react with each other to generate an electromotive force (emf). Fuel cells can produce electricity continuously for as long as these inputs are supplied.

The fuel cell market is growing, and in 2013 Pike Research estimated that the stationary fuel cell market will reach 50 GW by 2020.

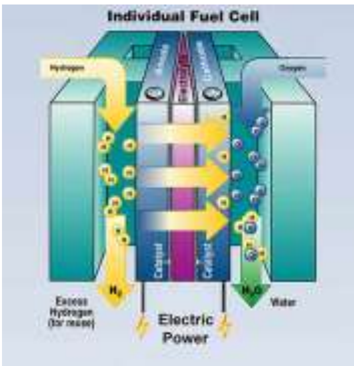

Fig 1.1 General design of fuel cell

1.21 TYPES OF FUEL CELL

Proton Exchange Membrane Fuel Cells (Pemfcs)

Proton Exchange Membrane Fuel Cell Design Issues

Phosphoric Acid Fuel Cell (Pafc)

Solid Acid Fuel Cell (Safc)

High-Temperature Fuel Cells

Hydrogen-Oxygen Fuel Cell

Molten Carbonate Fuel Cells

1.2 Hydrogen-Oxygen Fuel Cell

The hydrogen-oxygen fuel cell or alkaline fuel cell was designed and first demonstrated publicly by Francis Thomas Bacon in 1959. It was used as a primary source of electrical energy in the Apollo space program.[44] The cell consists of two porous carbon electrodes impregnated with a suitable catalyst such as Pt, Ag, CoO, etc. The space between the two electrodes is filled with a concentrated solution of KOH or NaOH which serves as an electrolyte. H_2 gas and O_2 gas are bubbled into the electrolyte through the porous carbon electrodes. Thus the overall reaction involves the combination of hydrogen gas and oxygen gas to form water. The cell runs continuously until the reactant's supply is exhausted. This type of cell operates efficiently in the temperature range 343 K to 413 K and provides a potential of about 0.9 V.

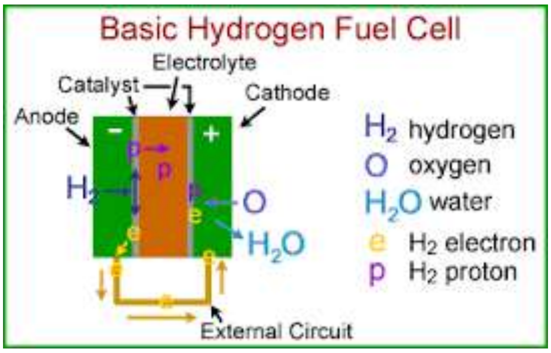

Fig 1.2 Hydrogen Oxygen Fuel cell

1.3 EFFICIENCY OF LEADING FUEL CELL TYPES

Anode: The electrode at which oxidation (a loss of electrons) takes place. For fuel cells and other galvanic cells, the anode is the negative terminal; for electrolytic cells (where electrolysis occurs), the anode is the positive terminal

Aqueous solution: **a**: of, relating to, or resembling water **b** : made from, with, or by water.

Catalyst: A chemical substance that increases the rate of a reaction without being consumed; after the reaction, it can potentially be recovered from the reaction mixture and is chemically unchanged. The catalyst lowers the activation energy required, allowing the reaction to proceed more quickly or at a lower temperature. In a fuel cell, the catalyst facilitates the reaction of oxygen and hydrogen. It is usually made of platinum powder very thinly coated onto carbon paper or cloth. The catalyst is rough and porous so the maximum surface area of the platinum can be exposed to the hydrogen or oxygen. The platinum-coated side of the catalyst faces the membrane in the fuel cell.

Cathode: The electrode at which reduction (a gain of electrons) occurs. For fuel cells and other galvanic cells, the cathode is the positive terminal; for electrolytic cells (where electrolysis occurs), the cathode is the negative terminal.

Electrolyte: A substance that conducts charged ions from one electrode to the other in a fuel cell, battery, or electrolyze.

Fuel Cell Stack: Individual fuel cells connected in a series. Fuel cells are stacked to increase voltage.

Matrix: something within or from which something else originates, develops, or takes form.

Membrane: The separating layer in a fuel cell that acts as electrolyte (an ion-exchanger) as well as a barrier film separating the gases in the anode and cathode compartments of the fuel cell.

2. EXPERMENTATION

2.1 SELECTION OF MATERIAL

In this project we introduce the various materials for fabrication of the fuel cell the galvanized iron sheet is used as an electrical conductor having cathode and anode and the rubber sheet is used as the insulator the fiber is used as the housing of this above unit power sources 12v power battery is used in this project.20kg domestic weight gauge and test fuel tank is selected for load test.

2.2 DESIGN

In this project we design a fuel cell by using the software of AutoCAD. First we design a galvanized iron sheet in 200mm x 150mm to make holes in 9mm dia and we have to design a rubber sheet to hold the galvanized iron sheet to control the flow of water from the sheet and fibre glass is used to hold the rubber sheet. The rubber sheet is as same as the dimension of the galvanized sheet. The fibre glass is also been designed to hold the rubber sheet

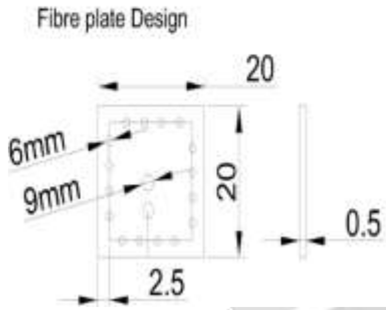

Fig 3.1 Design of fibe **Fig 3.2 Design of GI sheet** **Fig 3.3 Design of rubber sheet**

2.3 ASSEMBLY

This is a sandwich assembly process. Three materials has been used for this process two fiber glass, two galvanized iron sheet, three rubber sheet . First the rubber sheet is placed on the top of the fiber sheet. And the galvanized sheet is placed at the top of the both rubber and fiber glass. Again rubber sheet has been placed at top, and galvanized iron sheet has been placed and rubber and fiber glass has been placed then tight this process by using bold, nut. and attached to the engine air filter. The fly wheel housing has been dismantling for testing the engine load.

2.4 HYDROGEN PRODUCTION

Hydrogen Gas is a volatile gas at room temperature, but when chilled to -253C and compressed, it makes the perfect fuel. Hydrogen's greatest feature, as a fuel, is that it causes no pollution.A hydrogen fuel cell works by combing hydrogen gas with atmospheric oxygen. The resulting chemical reaction generates electric power, and the only by-product it produces is clean water. At a time when there is real concern about global warming due to carbon emissions, this makes hydrogen fuel a desirable technology and perhaps the most feasible alternative to petrol and gasoline.

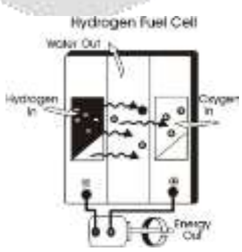

Fig 3.4 Hydrogen fuel cell

Many scientists and researchers are working towards a vision of the hydrogen economy. Hydrogen based fuel could potentially be used to run our cars or even drive larger scale power plants, generating the electricity we need to light our buildings, run our kettles and fridges, and power our computers. But hydrogen does not occur naturally and it has to be processed. The big challenge is the large scale production of hydrogen in sustainable way. There are a number of challenges to be overcome before hydrogen gas is common place as a fuel.

Hydrogen fuel is used to generate electricity, but conversely, electricity is required to generate the hydrogen fuel. Electrolysis uses electricity to break water into hydrogen and oxygen, with the two gases forming at opposite electrodes. Electricity is also required to power the compression of the hydrogen and the refrigeration to chill it to less than -200 degrees. However, this initial requirement of electricity could be generated sustainably through wind power, biomass, tidal, hydropower, or even nuclear. Hydrogen can also be generated by extracting it from natural gas, but this process generates carbon dioxide and negates the main motivation for moving to hydrogen fuel-cell vehicles: ending dependence on fossil fuels. Further exciting alternative technology at an early stage in development is Solar Powered Hydrogen Generation utilizing water-splitting solar panels.

3. CALCULATION

3.1 Engine Design Calculations-

Design and analysis on temperature distribution for two-stroke engine component using finite element method:

Specification of four stroke petrol engine:

Type	:	four strokes
Cooling System	:	Air Cooled
Bore/Stroke	:	50 x 50 mm
Piston Displacement	:	98.2 cc
Compression Ratio	:	6.6: 1
Maximum Torque	:	0.98 kg-m at 5,500RPM

Compression ratio = (Swept Volume + Clearance Volume)/ Clearance Volume

Here, Compression ratio = 6.6:1

$\therefore 6.6 = (98.2 + V_c)/V_c$

$V_c = 19.64$

3.2 Calculation of air fuel ratio:

Carbon = 86%

Hydrogen = 14%

We know that,

1Kg of carbon requires 8/3 Kg of oxygen for the complete combustion.

1Kg of carbon Sulphur requires 1 Kg of Oxygen for its complete combustion.

(From Heat Power Engineering-Balasundrrum)Therefore,

The total oxygen requires for complete combustion of 1 Kg of fuel =[(8/3c) + ($3H_2$) + S] Kg

Little of oxygen may already present in the fuel, then the total oxygen required for complete combustion of Kg of fuel = { [(8/3c) + ($8H_2$) + S] - O_2} Kg

As air contains 23% by weight of Oxygen for obtain of oxygen amount of air required= 100/23 Kg

∴Minimum air required for complete combustion of 1 Kg of fuel= (100/23) { [(8/3c) + H_2 + S] - O_2} Kg

So for petrol 1Kg of fuel requires=(100/23) { [(8/3c) x 0.86 + (8 x 0.14)] }=14.84 Kg of air

∴Air fuel ratio =m_1/m_2 =14.84/1= 14.84

∴ m_1 = 14.84 m_2-------------------------- (2)

Substitute (2) in (1)

1.01325 x 100 = 3.81134 (14.84 m_2) + 555.02 m_2

∴m_2 = 1.791×10^{-5} Kg/Cycle

Mass of fuel flow per cycle = 1.791×10^{-5} Kg cycle

Therefore,

Mass flow rate of the fuel for 2500 RPM

$[(1.791 \times 10^{-5})/3600] \times (2500/2) \times 60$

$=3.731 \times 10^{-4}$ Kg/sec

Heat supplied details

POINT POSITION	PRESSURE (bar)	TEMPERATURE	
POINT-1	1.01325	30 ºC	303 K
POINT-2	13.698	347.68 ºC	620.68 K
POINT-3	94.27	3999.45 ºC	4272.45 K
POINT-4	6.973	1813.15 ºC	2086.15 K

3.3 Design Of Engine Piston:

We know diameter of the piston which is equal to 50 mm

Thickness of piston:

The thickness of the piston head is calculated from flat-plate theory

Where,

$$t = D\,(3/16 \times P/f)^{½}$$

Here,

P -Maximum combustion pressure = 100 bar

f -Permissible stress in tension = 34.66 N/mm²

Piston material is aluminum alloy.

$$\therefore t = 0.050\,(3/16 \times 100/34.66 \times 10^6/10^5)^{½} \times 1000$$

$$t = 12 \text{ mm}$$

Number of piston rings:

No. of piston rings = $2 \times D^{½}$

Here, D - Should be in Inches = 1.968 inches

∴No. of rings=2.805

We adopt 3 compression rings and 1 oil rings

Thickness Of The Ring:

Thickness of the ring = D/32

= 50/32

= 1.5625 mm

Width of the ring:

Width of the ring = D/20

= 2.5 mm

The distance of the first ring from top of the piston equals

= 0.1 x D

= 5 mm

Width of the piston lands between rings

= 0.75 x width of ring

= 1.875 mm

Length of the piston:

Length of the piston = 1.625 x D

Length of the piston = 81.25 mm

Length of the piston skirt = Total length – Distance of first ring from top of The first ring (No. of landing between rings x Width of land) – (No. of compression ring x Width of ring) =81.25 – 5 – 2 x 1.875 – 3 x 2.5=65 mm

4. TESTING

This work presents the cold-start exhaust gas emission levels and also performance test on a petrol engine by using the fuel cell. The vehicle, powered by fuel cell engine, was used in the experiments. The fuel for the engine is supplied using the conventional carburetor system. Cold-start emission levels are measured for with fuel cell and without fuel cell at different proportion. Emission values are recorded for E5 to E20 in steps of 5% and for isobutanol, it is from IB10 to IB50 insteps of 10% increase. The cold start emission test results show that hydrocarbon and carbon monoxide content is lowest for IB 30. And IB30 showed the highest increase of brake thermal efficiency of 8.7%

The project study focuses on the cold-start emission control and also performance test by fuel modification in a conventional two-wheeler Spark Ignition engine.

Engine Specification

Engine	Splendor, Air cooled
Cubic Capacity	100 cc
Stroke	4 Stroke
Brake Power	7.37 HP (5.4KW) @ 8000 RPM
Speed	1500 RPM
No of Cylinder	Single
Radius of the Brake Drum	0.083m

No changes in the engine were made. The schematic diagram of the project setup is shown in figure 1. The air would be naturally aspirated through the air filter. Then it would mix with the fuel vapor from the fuel tank in the carburetor and sent to the engine for combustion. The exhaust gas would leave the engine and it escapes to the environment through the muffler. Initially, the carburetor of the engine was cleaned to remove the residues present and the engine was checked for sustained running. The speed of the engine was monitored from the spark-plug pulses to the engine by using an electronic tachometer.

4.1 Testing and analysis:

Load Test Without hydrogen

Trial No	Amount Of Petrol Consumption	Distance Covered (Winter)	Distance Covered (Summer)
1	100 ml	4.8 km	5 km
2	150 ml	6.7 km	7 km
3	200 ml	9.6 km	10 km

Load Test With Hydrogen

Trial no	Amount of petrol consumption	Distance covered (winter)	Distance covered (summer)
1	100 ml	7.2 ml	8.5 km
2	150 ml	12 ml	13.3 km
3	200 ml	17 ml	18 km

CONCLUSION

HHO gas technology is still considered experimental but it is a supplemental fuel additive of sorts that could help you increase mileage, increase horse power , reduce emission while providing a quieter and cleaner engine . Energy must be conserved in one way or the other , so we are trying to implement This is one of the advantageous project conserving the cost and low fuel cost. This project work has provided us an excellent opportunity and experience, to use our limited knowledge. We gained a lot of practical knowledge regarding, planning, purchasing, assembling and machining while doing this project work. We feel that the project work is a good solution to bridge the gates between institution and industries.

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