FABRICATION OF WATER FUEL ENGINE WITH POWER GENERATION

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Abstract *:* In internal combustion engines, water injection, also known as anti-detonat injection, is spraying water into the cylinder or incoming fuel-air mixture to cool the combustion chambers of the engine, allowing for greater compression ratios and largely eliminating the problem of engine knocking (detonation). This effectively reduces the air intake temperature in the combustion chamber, meaning that performance gains can be obtained when used in conjunction with a supercharger, turbocharger, altered spark ignition timing, and other modifications. The reduction of the air intake temperature allows for a more aggressive ignition timing to be employed, which increases the power output of the engine. Depending on the engine, improvements in power and fuel efficiency can also be obtained solely by injecting water. Water injection may also be used to reduce NOx or carbon monoxide emissions. Finally the load test is carried out in order to find the efficiency of the engine and they are compared with that of the conventional engines.

***IndexTerms* – I.c Engine, carbon monoxide**

I. 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, golfcarts, 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 aprototype 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.

LITERATURE SURVEY

- Vinoth Kanna and A. Vasudevan and K. Subramani in the journal international research for ambient energy in the year 2017 has explained that they decided to try using hydrogen as a means of alternative power for the car. With a hydrogen generator, the idea is to replace some of the gasoline with hydrogen. Gaseous hydrogen burns readily and produces loads of power. The idea is that the extra boost (not replacement) in gasoline power from the hydrogen would cause a gasoline-burning engine to back off on using so much gasoline. This in turn should result in less gas being burned.

This paper brings about hydrogen fuel generator, whose fuel generated can be used as alternate source of fuel.

- M. Falahat and M.A.Hamdan and J.A.Yamin in the journal of International journal of automotive technology in the year 2014 has wrote that the performance of an SI engine powered with both gasoline and HHO as supplement fuel was studied and compared with pure gasoline-fuelled engine. The amount of HHO gas quantities added was 1, 1.5, and 2 LPM. The engine speed was varied from 1350 to 2250 rpm. The performance was found by measuring the engine torque, the brake power, the brake specific fuel consumption and the thermal efficiency, while gas analyzer was used to measure the amounts of nitrogen oxides and carbon dioxide that are emitted from the engine during operation. It was found that the engine performance was best when 2 LPM HHO gas was used with pure gasoline fuel. Further, it was found that, at high amount of HHO gas addition, the nitrogen oxide decreases. Further, the CO level increased when using HHO gas as supplement fuel.
- CHOONGSIK BAE AND JAEHEUN KIM IN THE JOURNAL ALTERNATIVE FUELS FOR INTERNAL COMBUSTION ENGINES IN THE YEAR 2017 WROTE THAT THE REPRESENTATIVE ALTERNATIVE FUELS FOR SI ENGINES INCLUDE COMPRESSED NATURAL GAS (CNG), HYDROGEN (H_2) LIQUEFIED PETROLEUM GAS (LPG), AND ALCOHOL FUELS (METHANOL AND ETHANOL); WHILE FOR CI ENGINES, THEY INCLUDE BIODIESEL, DI-METHYL ETHER (DME), AND JET PROPELLENT-8 (JP-8). NAPHTHA IS INTRODUCED AS AN ALTERNATIVE FUEL FOR ADVANCED COMBUSTION IN PREMIXED CHARGE COMPRESSION IGNITION. THE CONTENTS OF ENGINE COMBUSTION BASICALLY CONSIST OF THE COMBUSTION PROCESS FROM SPRAY DEVELOPMENT, AIR–FUEL MIXING CHARACTERISTICS, TO THE FINAL COMBUSTION PRODUCT FORMATION PROCESS, WHICH IS ANALYZED FOR EACH ALTERNATIVE FUEL.
- P.Balashanmugam and G.Balasubramanian in the journal Global journal of advanced research in the year 2015 ha explained that hydrogen vehicle 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. The widespread use of hydrogen for fueling transportation is a key element of a proposed economy. Hydrogen fuel does not occur naturally on Earth, and thus is not an energy source, but is an energy carrier. Currently it is most frequently made from methane or other fossil fuels. However, it can be produced from a wide range of sources (such as wind, solar, or nuclear) that are intermittent, too diffuse or too cumbersome to directly propel vehicles. Integrated wind-to-hydrogen plants, using electrolysis of water, are exploring technologies to deliver cost low enough, and quantities great enough, to compete with traditional energy sources.
- Akhileshpati tiwari, Manoj kumar yadav, Surender kumar ,Ramnaresh yadav in the journal International Journal of Engineering Trends and Technology (IJETT) in the year 2017 has explained

that Hydrogen is an environmentally friendly alternative to fossil fuels, and they can be used to power just about any machine needing energy. The fuel cell, which is the energy conversion device that can capture and use the power of hydrogen effectively, is the key to making this happen. Compared to diesel or gas, hydrogen is much more fuel efficient as it can produce more energy per pound of fuel. This means that if a car is fueled by hydrogen, it can go farther than a vehicle loaded with the same amount of fuel but using a more traditional source of energy. Hydrogen-powered fuel cells have two or three times the efficiency of traditional combustion technologies.

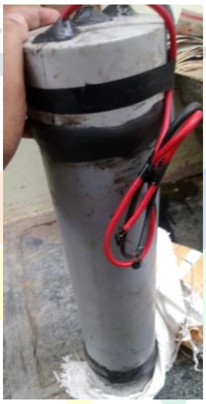
DESIGN AND FABRICATION

ENGINE SPECIFICATION

Type of fuel used	:	Petrol/Hydrogen with LPG
Cooling system	:	Air cooled
Number of cylinder	:	Single
Number of stroke	:	Four Stroke
Arrangement	:	Vertical
Cubic capacity	:	100 cc

Hydrogen Gas

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.



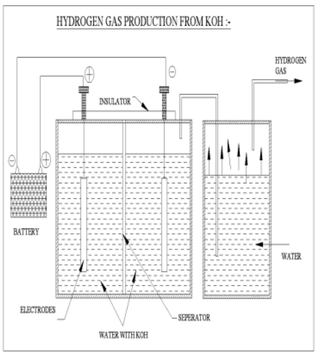
HYDROGEN GAS FROM WATER MIXED WITH KOH:-

The chemical reaction we are interested in occurs with water in the following equation.

KOH + H2O = KOOH + H2

The balanced equation is

2KOH + 2H2O = 2KOOH + 2H2



hydrogen gas production

DESIGN,DRAWING AND CALCULATIONS

Bearing No. 6202

Outer Diameter of Bearing (D)	=	35 mm
Thickness of Bearing (B)	=	12 mm
Inner Diameter of the Bearing (d)	=	15 mm

r_1 = Corner radii on shaft and housing

r_1 = 1(From design data book)

Maximum Speed = 14,000 rpm (From design data book)

Mean Diameter (d_m) = (D + d) / 2

= (35 + 15) / 2

d_m = 25 mm

ENGINE DESIGN CALCULATIONS:-

DESIGN AND ANYLSIS 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 5,500 RPM

CALCULATION:

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

Here,

Compression ratio = 6.6:1

∴ 6.6 = (98.2 + Vc)/Vc

Vc = 19.64

Assumption:

1. The component gases and the mixture behave like ideal gases.
2. Mixture obeys the Gibbs-Dalton law

Pressure exerted on the walls of the cylinder by air is P_1

$P_1 = (M_1RT)/V$

Here,

M_1 = m/M=(Mass of the gas or air)/(Molecular Weight)

R = Universal gas constant = 8.314 KJ/Kg mole K.

T_1 = 303 ºK

V_1 = V = 253.28×10^{-6} m³

Molecular weight of air = Density of air x V mole

Here,

Density of air at 303ºK = 1.165 kg/m³

V mole = 22.4 m³/Kg-mole for all gases.

∴Molecular weight of air = 1.165 x 22.4

$\therefore P_1 = \{[(m_1/(1.165 \times 22.4)] \times 8.314 \times 303\}/253.28 \times 10^{-6}$

$P_1 = 381134.1\ m_1$

Let Pressure exerted by the fuel is P_2

$P_2 = (N_2\ R\ T)/V$

Density of petrol = 800 Kg/m³

$\therefore P_2 = \{[(M_2)/(800 \times 22.4)] \times 8.314 \times 303\}/(253.28 \times 10^{-6}$

$P_2 = 555.02\ m_2$

Therefore Total pressure inside the cylinder

$P_T = P_1 + P_2$

= 1.01325 x 100 KN/m²

$\therefore 381134.1\ m_1 + 555.02\ m_2 = 1.01325 \times 100$ ------------------------- (1)

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 Oxigen 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 $=(100/23) \{ [(8/3c) \times 0.86 + (8 \times 0.14)] \}$

=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)

$1.01325 \times 100 = 3.81134 (14.84\ m_2) + 555.02\ m_2$

$\therefore m_2 = 1.791 \times 10^{-5}$ 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

Calculation of calorific value:

By Delong's formula,

Higher Calorific Value $= 33800\ C + 144000\ H_2 + 9270\ S$

$= (33800 \times 0.86) + (144000 \times 0.14) + 0$

HCV = 49228 KJ/Kg

Lower Calorific Value $=HCV – (9H_2 \times 2442)$

$= 49228 – [(9 \times 0.14) \times 2442]$

= 46151.08 KJ/Kg

LCV = 46.151 MJ/Kg

Finding Cp and Cv for the mixture:

We know that,

Air contains 77% N_2 and 23% O_2 by weight

But total mass inside the cylinder $= m_1 + m_2$

$= 2.65 \times 10^{-4} + 1.791 \times 10^{-5}$ Kg

$= 2.8291 \times 10^{-4}$ Kg

(1) Weight of nitrogen present = 77% = 0.77 Kg in 1 Kg of air

∴In 2.65×10^{-4} Kg of air contains,

$= 0.77 \times 2.65 \times 10^{-4}$ Kg of N_2

$= 2.0405 \times 10^{-4}$ Kg

Percent of N_2 present in the total mass

$= (2.0405 \times 10^{-4}/2.8291 \times 10^{-4})$

= 72.125 %

(1) Percentage of oxygen present in 1 Kg of air is 23%

Percentage of oxygen present in total mass

= $(0.23 \times 2.65 \times 10^{-4})/(2.8291 \times 10^{-4})$

= 21.54 %

(2) Percentage of carbon present in 1 Kg of fuel 86%

Percentage of carbon present in total mass

= $(0.866 \times 1.791 \times 10^{-5})/(2.8291 \times 10^{-4})$

= 5.444%

(3) Percentage of Hydrogen present in 1 Kg of fuel 14%

Percentage of Hydrogen present in total mass

= $(0.14 \times 1.791 \times 10^{-5})/(2.8291 \times 10^{-4})$

= 0.886 %

Total Cp of the mixture is = $\sum msi\ Cpi$

Cp = $(0.72125 \times 1.043) + (0.2154 \times 0.913) + (0.54444 \times 0.7) + (8.86 \times 10^{-3} \times 14.257)$

Cp = 1.1138 KJ/Kg.K

Cv = $\sum msi\ Cvi$

= $(0.72125 \times 0.745) + (0.2154 \times 0.653) + (0.05444 \times 0.5486) + (8.86 \times 10^{-3} \times 10.1333)$

= 0.8 KJ/Kg.K

(All Cvi, Cpi values of corresponding components are taken from clerks table)

n For the mixture = (Cp/Cv)

= 1.11/0.8

n = 1.38

Pressure and temperature at various PH:

P_1 = 1.01325 x 100 bar

= 1.01325 bar

T_1 = 30ºC = 303 K

P_2/P_1 = $(r)^{n-1}$

Where,

P_1 = 1.01325 bar

r = 6.6

n = 1.38

$\therefore P_2$ = 13.698 bar

T_2 = $(r)^{n-1} \times T_1$

Where,

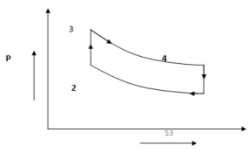
T_1 = 303 K

$\therefore T_2$ = 620.68 K

Where,

T_1 = 303 K

$\therefore T_2$ = 620.68 K



Heat Supplied by the fuel per cycle

Q = MCv

= $1.79 \times 10^{-5} \times 46151.08$

Q = 0.8265 KJ/Cycle

$0.8265 = MC_v (T_3 - T_2)$

$T_3 = 4272.45$ K

$(P_2 V_2) / T_2 = (P_3 V_3) / T_3$

Where,

$V_2 = V_3$

$\therefore P_3 = (T_3 \times P_2)/T_2$

Where,

$P_3 = 94.27$ bar

$P_4 = P_3 / (r)^n$

$\therefore P_4 = 6.973$ bar

$T_4 = T_3 / (r)^{n-1}$

$= 2086.15$ K

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

Table 10.1

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 aluminium alloy.

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

$= 12$ 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

Other parameter:

Centre of piston pin above the centre of the skirt = 0.02 x D

= 65 mm

The distance from the bottom of the piston to the Centre of the piston pin = ½ x 65 + 1

= 33.5 mm

Thickness of the piston walls at open ends = ½ x 12

= 6 mm

The bearing area provided by piston skirt = 65 x 50

= 3250 mm²

LIST OF MATERIALS

Sl. No.	PARTS	Qty.	Material
i.	Frame Stand	1	Mild Steel
ii.	LPG Tank	1	M.S
iii.	Hydrogen Gas Tank	1	-
iv.	Bearing with Bearing Cap	1	M.S
v.	Engine	1	75 Cc
vi	Chain with Sprocket	1	M.S
viii.	Connecting Tube	1 meter	Plastic
ix.	Bolt and Nut	-	M.S
x	Wheel Arrangement	1	-
Xi	Battery	1	Lead Acid
Xi	Electrode	2	Steel

CONCLUSION

The project adventured by us is the one that can be used for both Petrol and water , we have entered to this project. We have done the project to simple in construction by low expenses.

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.

We are proud that we are able to increase efficiency and complete the work successfully. The **WATER FUEL ENGINE WITH POWER GENERATION** is working with satisfactory conditions. We are able to understand the difficulties in maintaining the tolerances and also quality. We have done to our ability and skill making maximum use of available facilities. In conclusion remarks of our project work, let us add a few more lines about our impression project work. Thus we have developed an "**WATER FUEL ENGINE WITH POWER GENERATION**" which helps to know how to achieve low fuel cost to run the vehicle.

PHOTOGRAPHY OF THE MODEL

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