PETROL AND HYDROGEN POWERED I.C. ENGINE

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ABSTARCT

An internal combustion engine (ICE) is an engine where the combustion of a fuel occurs with an oxidizer (usually air) in a combustion chamber that is an integral part of the working fluid flow circuit. In an internal combustion engine the expansion of the high-temperature and high-pressure gases produced by combustion apply direct force to some component of the engine. Hydrogen is an alternate source of energy; it is not directly available in nature, by using electrolysis process to produce hydrogen with water. H_2O is used to conduct electrolysis process to divide the water molecules into hydrogen and oxygen. This hydrogen gas is used as an alternate fuel. In this project hydrogen is combined with petrol and used as a fuel in I.C. engine. By using this mixture in I.C. engine it can increase the efficiency, decreases the carbon emissions and Nox emissions.

KEYWORDS: Hydrogen, electrolysis process, hydrogen, alternate fuel, efficiency, carbon emissions and Nox.

1. INTRODUCTION

Hydrogen is a simple, abundant element found in organic matter, notably in the hydrocarbons that make up many of our fuels, such as gasoline, natural gas, methanol, and propane. Hydrogen can be made by using heat to separate it from the hydrocarbons. Currently, most hydrogen is made this way from natural gas. Hydrogen can be combined with gasoline, ethanol, methanol, or natural gas to reduce nitrogen oxide emissions. Because the only byproduct of hydrogen is water, only the engine lubricants from a hydrogen-fueled vehicle emit small amounts of air pollutants. Hydrogen is already the fuel of choice for propelling space shuttles. It is also being explored for use in internal combustion engines.

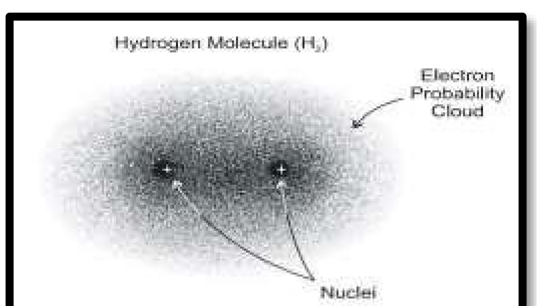

Fig. 1.1 Atomic Structure of a Hydrogen Molecule

2. HYDROGEN GENERATION PROCESS

Electrolysis of water is the decomposition of water (H_2O) into oxygen (O_2) and hydrogen gas (H_2) due to an electric current being passed through the water. This electrolytic process is used in some industrial applications when hydrogen is needed.

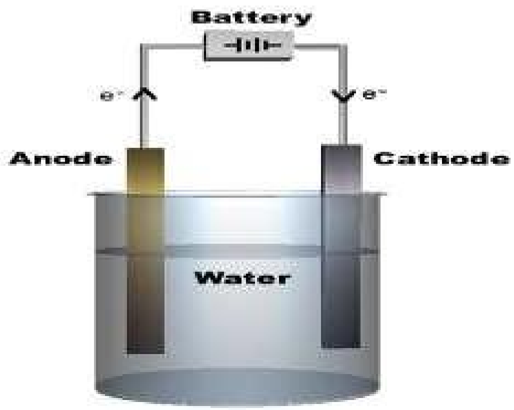

Fig. 2.1 Electrolysis of water

An electrical power source is connected to two electrodes (typically made from some inert metal such as Platinum or Stainless Steel etc.,) which are placed in water. Hydrogen will appear at the Cathode (the negatively charged electrode), and Oxygen will appear at the Anode (the positively charged electrode). The generated amount of hydrogen is twice the amount of oxygen, and both are proportional to the total electrical charge that was sent through the water.

Table 2.1 Variation in the generation of hydrogen on the basis of change in voltage:

S.No	Volts (V)	Amps (A)	Watts (W)	Volume (ml)	Time (min)	Flow Rate (ml/min)	MMW (ml/min/w)	Temp (C)
1	12	4.8	57.60	1000	3.43	291.26	5.06	84
2	12.3	5.8	71.34	1000	2.48	402.68	5.64	83
3	12.7	8.5	107.95	1000	1.48	674.16	6.25	81
4	13	10.9	141.70	1000	1.12	895.52	6.32	80
5	13.3	13.9	184.87	1000	0.85	1176.47	6.36	80
6	14.3	27.6	394.68	1000	0.40	2500.00	6.33	79
7	14.7	32.5	477.75	1000	0.35	2857.14	5.98	80
8	15	36.5	547.50	1000	0.32	3157.89	5.77	81
9	15.7	46	722.20	1000	0.25	4000.00	5.54	84
10	16.3	51.4	837.82	1000	0.20	5000.00	5.97	88

2.1. H_2O GENERATOR

The H_2O Generator is really an electrolysis device, based on an invention from the late 19th century. It uses electricity to separate water into hydrogen and oxygen. A water molecule is made of two hydrogen atoms and one oxygen atom. In electrolysis two water molecules can be separated to produce two hydrogen molecules, each made of two hydrogen atoms, and one oxygen molecule made of two oxygen atoms.

Fig 2.2 H_2O GENERATOR

2.2. ELECTRODE DESIGN:

Stainless steel tubes of 3mm thick and 1”, ¾”, ½” inch long stainless steel (304 Grades).The electrodes are welded with small copper wireat the end position for electrical contact. After the electrical connection the tubes are arranged in a very close manner such that the gap between the anode and cathode is 2-3mm. The gap between the electrodes is as small as possible, to increase the active surface area of the tubes and seems necessary for ultra high efficiency. The electrical connections are sealed with Teflon tape for minimizing the electrical losses.

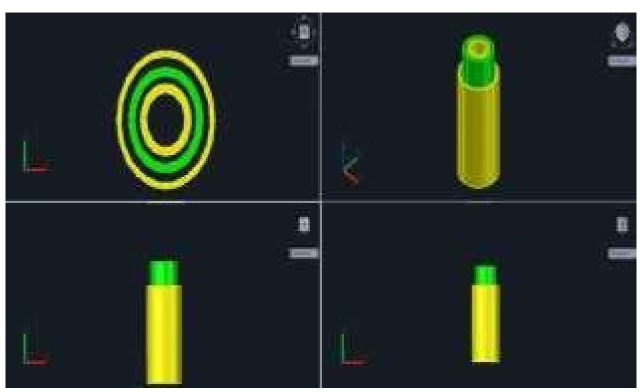

Fig 2.3 DESIGN OF ELECTRODES

2.3. H_2O SUPPLY TO ENGINE

The H_2Ogas which is generated from the electrolyzer is supplied to the engine in between the air filter and carburetor, for efficient mixing of H_2O gas with atmospheric air. It is supplied to the engine through the bubbler for reducing the risk of explosion. H_2O gas is supplying through the PVC hose pipe of 8 mm diameter, and a nozzle is arranged at the exit of the tube for increasing the velocity of the outgoing H_2O gas into the carburetor, where it is efficiently mixed with atmospheric air and is sucked in to the cylinder.

Fig 2.3 Assembly of H_2O generator to bike

According to the properties of the H_2O gas nearly 30% volume of H_2O gas has to be supplied for complete combustion inside the cylinder. Since hydrogen has high flammability nature the combustion takes place very quickly compared to the general petrol or diesel engines, such that more amount of thrust (power) is generated.

3. CALCULATIONS

3.1. AIR/FUEL RATIO:

The theoretical or stoichiometric combustion of hydrogen and oxygen is given as:

$$2H_2 + O_2 = 2H_2O$$

Moles of H2 for complete combustion = 2 moles

Moles of O2 for complete combustion = 1 mole

Because air is used as the oxidizer instead oxygen, the nitrogen in the air needs to be included in the calculation:

Moles of N_2 in air = Moles of O_2 x (79% N_2 in air / 21% O_2 in air)
= 1 mole of O_2 x (79% N_2 in air / 21% O_2 in air)
= 3.762 moles N_2

Number of moles of air = Moles of O_2 + moles of N_2 = 1 + 3.762 = 4.762 moles of air

Weight of O_2 = Mole of O_2 x 32 g/mole = 32 g

Weight of N_2	=	3.762 moles of N_2 x 28 g/mole	=	105.33 g
Weight of air	=	weight of O_2 + weight of N	=	32g + 105.33 g = 137.33 g
Weight of H_2	=	2 moles of H_2 x 2 g/mole	=	4 g

3.2. STOICHIOMETRIC AIR/FUEL (A/F) RATIO FOR HYDROGEN AND AIR:

A/F based on mass = mass of air/mass of fuel = 137.33 g / 4 g
= 34.33:1

A/F based on volume = volume (moles) of air/volume (moles) of fuel
= 4.762 / 2 = 2.4:1

The percent of the combustion chamber occupied by hydrogen for a stoichiometric mixture:

% H_2 = Volume (moles) of H_2/total volume
= Volume H_2/(volume air + volume of H_2)
= 2 / (4.762 + 2) = 29.6%

3.3. ENGINE SPECIFICATION CALCULATIONS

1. BRAKE POWER = 6941.03 W or 6.94 KW.
2. INDICATED POWER = 15.73 KW
3. FRICTIONAL POWER = 8.79 KW
4. THERMAL EFFICIENCY = 74.65%
5. MECHANICAL EFFICIENCY = 44.11%
6. OVERALL EFFICIENCY = 43.52%
7. RELATIVE EFFICIENCY = 1.69 (efficiency ratio)
8. AIR-STANDARD EFFICIENCY = 60.18%
9. SPECIFIC FUEL CONSUMPTION PER I.P HOUR = 0.13 Kg/hr
10. SPECIFIC FUEL CONSUMPTION PER B.P. HOUR = 0.28 Kg/hr

4. RESULT

As these calculations show, the stoichiometric or chemically correct A/F ratio for the complete combustion of hydrogen in air is about 34:1 by mass. This means that for complete combustion, 34 pounds of air are required for every pound of hydrogen. This is much higher than the 14.7:1 A/F ratio required for gasoline. Since hydrogen is a gaseous fuel at ambient conditions it displaces more of the combustion chamber than a liquid fuel. Consequently less of the combustion chamber can be occupied by air. At stoichiometric conditions, hydrogen displaces about 30% of the combustion chamber, compared to about 1 to 2% for gasoline

After conducting test drive by using millage tester it shows the variation of the fuel consumption, the millage increased about 5 km per liter, by adding this equipment to an IC engine Mechanical properties of an engine is also changed by increasing the efficiency, decreasing the carbon emissions and Nox emissions.

CONCLUSION

In this a normal petrol bike used to test by using H_2O gas as a fuel, by simply placing the H_2O generator, it is successfully working and it reduces the emissions. So many researches are undergoing on Green engines in Automobile industry. By adding some additional equipment to this setup, it will work efficiently. By using this technology in automobile, it will drastically reduce the emissions and be helpful in rapid development of the mankind on the whole. This technology has great promises and will help in creating a clean & green world for our future generations.

REFERENCES

1. Kreith,F. and R. West. (2004). Fallacies of a hydrogen economy: A critical analysis of hydrogen production and ultilization. *Journal of Energy Resources Technologies*
2. Aiche-Hamane, L., Belhamel, M., Benyoucef, B., &Hamane, M. (2009). Feasibility study of hydrogen production from wind power in the region of Ghardaia. *International Journal of Hydrogen Energy*
3. Cardinali, L., Santomassimo, S., &Stefanoni, M. (2002). Design and realization of a 300 W fuel cell generator on an electric bicycle. *Journal of Power Sources*
4. Bergen, A., Pitt, L., Rowe, A., Wild, P., &Djilali, N. (2009). Transient electrolyser response in a renewable-regenerative energy system. International Journal of Hydrogen Energy
5. Zeng, K., & Zhang, D. (2010). Recent progress in alkaline water electrolysis for hydrogen production and applications. *Progress in Energy and Combustion Science*
6. Veziroglu TN. 1987, International Journal of Hydrogen Energy
7. King RO, Rand M. 1955, “The hydrogen engine” Canadian Journal Technology
8. Furuhama, S., 1989, “Hydrogen engine systems for land vehicles” International Journalof Hydrogen Energy