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Fabrication of a Dry Cell Oxy Hydrogen Generator

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ABSTRACT

This paper discusses fabrication of oxy hydrogen generator using wet cell electrolysis method using SS304 stainless steel plates and neoprene gaskets. Using hydrogen as IC engine fuel is been an interested field of research for a long time, the interest in using hydrogen as IC engine fuel is increased recently due the shortage of fossil fuels and introduction of electric vehicles. The need for an alternative fuel to regular fossil fuels is increased as never before. In this paper a research is carried out on understanding the different methods of generation of oxy hydrogen, selection a best method based on various criteria, namely efficiency, availability of materials and cost. On the same basis mentioned, SS304 stainless was used to make the dry cell hydrogen generator. Amount of oxy hydrogen generated and method to add oxy hydrogen to engine intake and conducting engine performance and emission characteristics have to be done further.
Keywords : Oxy Hydrogen, Wet Cell, Stainless Steel

I. INTRODUCTION

Fossil fuels such as petroleum, coal and natural gas, which are used for power generation for decades are being depleted rapidly. Also, combustion byproducts are causing numerous problems, such as the ozone layer depletion, green house effect, acid rains, air pollution and environment pollution, which are dangerous for human health and our environment.
Though the research for mobility is shifted focus towards electric propulsion vehicles (electric vehicles) and majority of automotive industries have stopped funding for research on IC engines. Many engineers believe IC engines are here to stay for quite some time and are going to be a parallel technology to electric vehicles till the time electric vehicles become the prime mobility solution in the near future. One method by which the emission problems of fossil fuel IC engines can be overcome is by replacing fossil fuel by hydrogen fuel which is a clean and efficient fuel. Combustion of hydrogen does not emit ozone layer depleting chemicals and greenhouse gases.
In this paper a research on different oxy hydrogen generation methods is done to find out best method. A dry cell generator is fabricated.

II. METHODOLOGY

- Literature study of electrolysis methods for production of oxy hydrogen and using it as engine fuel
- Fabrication of oxy hydrogen generator
- Modify the engine inlet for oxy hydrogen induction

III. LITERATURE STUDY

Most early engine were designed for burning a variety of gases, including natural gas and propane.

When hydrogen was used in these engines it would backfire. Since hydrogen burns faster than other fuels, the fuel-air mixture would ignite in the intake manifold before the intake valve could close. Hydrogen gave less power than gasoline with or without the water. [1]

Hydrogen and pure oxygen were considered for submarine during world war use because the crew could get drinkable water from the exhaust. Hydrogen was also considered for powering airship engines.

Oxy-hydrogen Gas as a IC Engine Fuel

Oxy-hydrogen is a mixture of hydrogen and oxygen gases, typically in a 2:1 atomic ratio; the same proportion as water. At normal temperature and pressure, oxy-hydrogen can burn when it is between about 4% - 94% hydrogen by volume and with flame temperature around 2000 C. [5]

Automotive fuel enhancement systems inject either a hydrogen-petrol mixture, or pure hydrogen into the intake of the IC engine. A small amount of hydrogen is added to the intake air-fuel charge permits the engine to operate with leaner air-to-fuel mixture. As the air/fuel mix approaches leaner values the temperature of combustion decreases effectively reducing NOx production. A 50% reduction in gasoline consumption at idle was reported by numerically analyzing the effect of hydrogen enriched gasoline on the emission, performance and fuel consumption of a small spark-ignition engine. [5]

Under most loads near chemical correct air/fuel mixtures are still required for normal acceleration, although under idle conditions, reduced loads and moderate acceleration hydrogen addition in combination with lean burn engine conditions can result in a running of the engine with many advantages in terms of fuel consumptions and emissions levels. [4]

Comparing the properties of gasoline and hydrogen, it is possible for hydrogen engines to operate with very lean mixture, achieve good fuel economy and emissions reductions. The concept of oxy hydrogen as a combustion enhancer for internal combustion engines has a greater interest than pure hydrogen powered engines because it involves fewer modifications to the engines and their fuelling systems.

After the emission and performance analysis result are compared and considerable change were observed, Reduction in the fuel consumption of the vehicle up to 30%, increase in power and performance was observed. Once you switch to supplemental hydrogen, it will enhance power and performance in your car.

Use of oxy hydrogen in gasoline IC engines improved the combustion efficiencies reduced fuel consumption by 20%, reduction in emission of pollutants like carbon monoxide and unburnt hydrocarbons, power output increased by 5.7%. [4]

Introduction of HHO led to increased power and torque. The engine tended to run richer under higher loads. There was a significant reduction of unburned hydrocarbons as a result of the increase in HHO inclusion. Introduction of HHO led to improved combustion particularly at low loads. [5]

Hydrogen Production:

Hydrogen does not occur free in nature like conventional fossil fuel. Source of energy like nuclear, solar or hydro-electric is required to split it from original combined form. The following methods are used for production of hydrogen:

Electrolysis of H_20

In this process, electrical power is utilized to split water into H_2 and O_2. An electrolysis cell contains two electrodes, commonly carbon plates or a flat metal, immersed in an aqueous electrolyte solution.

A source of DC source is connected to the electrodes, electric current conducts through the electrolyte from anode to cathode. As a result, water in the electrolyte solution is broken into H_2 which is obtained at the cathode and oxygen at the anode. Since water is a poor conductor of electricity, an electrolyte like KOH is used to improve its conductivity.

Thermo chemical method

This method is considered potentially most promising. It depends on complex series of interactions between the primary energy, water and some specific chemicals to produce hydrogen at temperatures substantially lower than thermal decomposition. The chemicals used are recyclable. A variety of compounds of iron, iodine, lithium and cadmium are used for the purpose.

Photobialysis

In this process, action of certain catalyst to produce H2 from water by use of directs sunlight at ambient temperature. Though, it appears attractive, the present efficiency of production is only 1%.

IV. WORK DONE

Hydrogen Generator Selection:

Wet Cell:

Fig.1 Wet cell generator

A wet cell is an oxy hydrogen generation system in which the electrodes are immersed in the electrolyte aqueous liquid. And then the current is passed through. This creates an arc in the electrodes and the water is split into two gasses mainly oxygen and hydrogen.

It requires very less power and is efficient for small quantity of gas production.

Dry Cell:

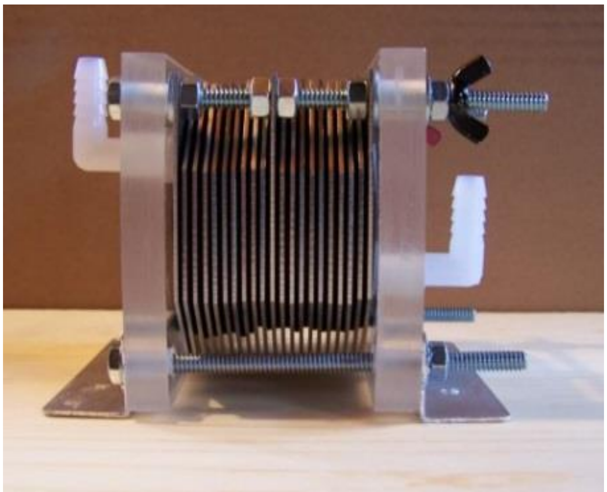

Fig. 2. Dry cell generator

A dry cell is an oxy hydrogen generation system in which the electrodes are fixed and the water is made to pass through the electrodes. It runs lesser amps and works cooler and has high gas production. Weight of dry cell is more compared to wet cell and cleaning of the electrodes should be done frequently. By taking into account all its advantages an disadvantages, and also its feasibility in the internal combustion engine, we have selected the dry cell.

V. FABRICATION

Selection of Electrolyte

KOH (Potassium Hydroxide):- Potassium hydroxide also known as 'caustic potash' is highly caustic. This needs to be handled carefully and kept away from any contact with skin, and even more importantly our eyes. 10% KOH concentration is so far reported and understood to be the optimum. KOH weighs approximately 11 grams per heaping teaspoon.

Components Required For The Dry Cell System:-

Stainless Steel Plates:

SS304:

The SS304 plate contains 18% chromium and 8% nickel whereas the SS316 plate contains 10% nickel, 16% chromium and 2% molybdenum. The molybdenum is to help resist chlorides corrosion.

Neoprene Gasket:

Neoprene is a type of synthetic rubber that are created by polymerization of chloroprene. Neoprene exhibits good chemical stability and maintains flexibility over a wide temperature range. Neoprene is sold either as solid rubber or in latex form, and is used in a wide variety of applications. Like Electrical Insulation, Membranes and fan belts.

Cover Plate:

ABS Plastic is a common thermoplastic used in high temperatures. The most important property of ABS are toughness and impact resistance. ABS polymers are resistant to aqueous acids, concentrated phosphoric and hydrochloric acids and alkalis.

Construction of Oxy-hydrogen Dry Cell

To construct the oxy hydrogen dry cell core the selected SS304 steel plate should be cut to 7" by 7" and 6 holes should be drilled on the plate for the water to pass through, 4 holes in the bottom and 2 holes on the top

Fig. 3. Stainless steel plates in required shape

The neoprene gasket of thickness 2mm is cut to the plate dimensions, this gasket is then cut on the inside of the dimension 6 by 6 inch.
The gasket creates an airtight seal between the two plates and prevents the leakage of water.

Fig. 4. Neoprene Gasket cut in shape

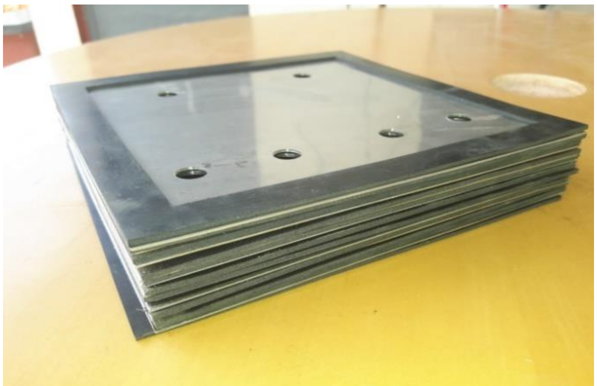

Fig. 5. Neoprene gasket and stainless steel put together

The cover plates are of 9 by 9 inch and 0.5 inch thick. With one brass fitting connected on top and two fittings on the bottom.

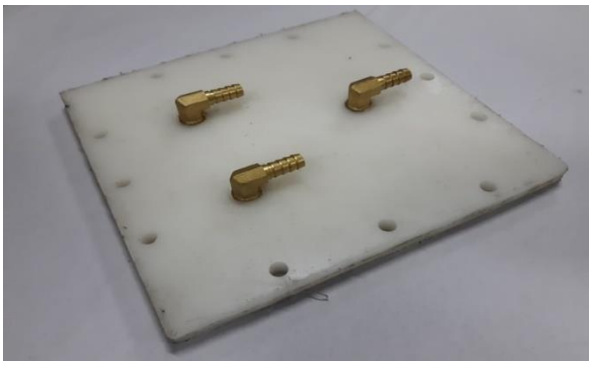

Fig. 6. Cover plate with brass fittings

All these components are connected together to form the core of the oxy-hydrogen generator. The effective plate configurations are 11plate cell in which 3 plates are the electrodes and the other 8 are the neutral plates.

The plate configuration is given by:-

+ N N N N – N N N N + =11 plates in total with 3 electrodes and 8 neutral plates

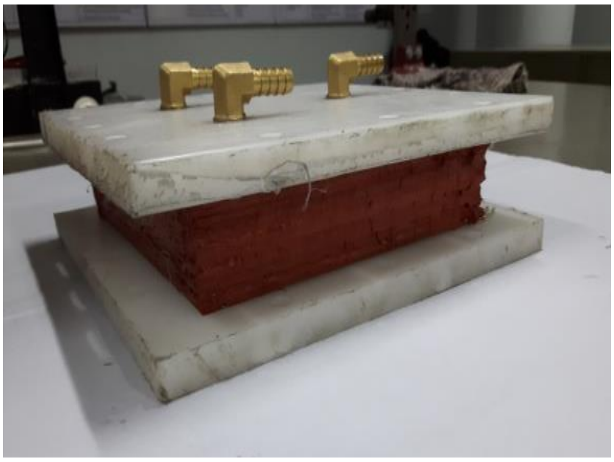

Fig. 7. Oxy hydrogen generator core

The construction of the reservoir is simple as it requires a 5 liter jerry can. The reservoir is used to hold the water solution . The holes are drilled at the bottom and top of the can for the connection of inlet and outlet of the core there is another hole drilled on top of the can which connects to the bubbler. The jerry-can is plastic or metal. The reservoir contains 4 liters of water and KOH solution.

The construction of the bubbler is done with the help of an acrylic tube which is cut up to 5 inches in length and is 3 inches in diameter. The bubbler is then closed with 2 end caps which have brass fittings on both of them.

The final assembly of this system is done on a wooden board for easy transportation and a 12 volt battery is used for the working of the generator system.

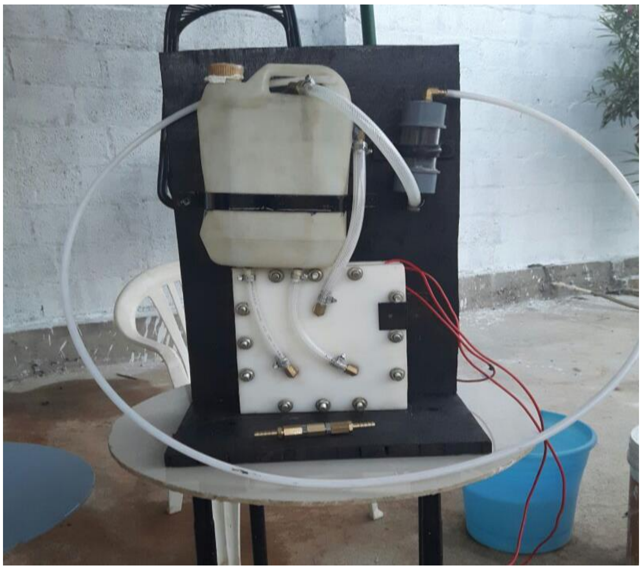

Fig.8. Oxy-hydrogen generator system

The oxy-hydrogen gas generator shown above is a dry cell system with 11 plate configurations; it consists of 3 electrodes in which 2 are connected to the positive and the other one to the negative. These are connected to the 12 volt battery. The other 8 plates are neutral plates which are used to reduce the voltage by 1.2 volts, which is the optimum voltage for the plate to break down the water solution into hydrogen and oxygen.

VI. CONCLUSION

In this paper a dry cell oxy hydrogen generator was fabricated using SS304 stainless steel plates and neoprene gasket. SS304 was used because of its availability and cost. The constructed oxy hydrogen generator is generating oxy hydrogen at a steady rate, which is evident by seeing the bubbler. Quantity of oxy hydrogen generator should be measured accurately and provision to add oxy hydrogen to the engine intake has to be made in future to study the engine performance and emission characteristics.

VII. REFERENCES

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