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A project on

HHO DRY CELL GENERATOR

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ISSN No: - 2456 – 2165

ABSTRACT

Today, the availability of fuel oil is increasingly limited and combustion results have impact on pollution of the environment. Then, all efforts to save fuel consumption and the green energy utilization of should be continued. One example of energy savings is utilizing HHO Gas (Brown's Gas) in Internal Combustion Engine (ICE).

HHO generator is an efficient approach that used to increase the fuel efficiency in a combustion engine by increasing the energy produced per mole of fuel during the ignition process. Although people use HHO generators in practice a very little research has been carried out in implementing an efficient system.

An efficient/optimal system is supposed to produce a large volume of Hydroxy gas using a very little power. Therefore, such a system will be able to increase the power of a spark ignition engine while reducing the air pollution.

The rapid depletion of fossil fuels and rising of oil prices has led to the search for Secondary fuels. The Secondary fuels that we are using should have the same efficiency or greater efficiency of the engine that uses ordinary fuel. In this project the secondary fuel used is HHO gas. HHO otherwise known as hydroxyl or Browns Gas is the gas produced from splitting water into hydrogen and oxygen from electrolysis and allowing the gas to stay in a premixed state for use on-demand without the need for storage. This reduces the exhaust gas emitted during the working of engine, and the temperature of the engine is also reduced which is produced by the burning of ordinary fuels. The HHO gas is injected into the inlet manifold of the combustion chamber through the air filter of the engine. From this design the fuel utility is reduced from 10% to 30% which minimizes the carbon deposition in the cylinder thereby increasing the changing period of engine oil, it also improves the efficiency of the engine and the life span.

ISSN No: - 2456 – 2165

CHAPTER 1
INTRODUCTION

1.1. BACKGROUND

Faced with the ever increasing cost of conventional fossil fuels, researches worldwide are working overtime to cost effectively improve internal combustion engine (ICE) fuel economy and emission characteristics. In recent years, many researchers have focused on the study of alternative fuels which benefit enhancing the engine economic and emissions.

Hydrogen is seen as one of energy vector of the next century. Hydrogen, as an renewable energy source provide a potential form sustainable development particularly in transportation sectors. The Hydrogen driven engine reduces both local as well as global emission.

A HHO Generator is a device that uses **electrolysis** to convert water into **two moles Hydrogen and one mole Oxygen** (HHO). This gas, also known as Brown's Gas, is a very clean burning, powerful fuel. Efficient HHO Generators are capable of using Distilled Water only, but most HHO Generator uses an electrolyte, or catalyst in addition to the distilled water. The most popular is regular old baking soda. That's right folks.

Distilled water + Electrolyte + Electricity = cheap, clean fuel.
One important use of electrolysis of water is to produce hydrogen.

$$\mathbf{2H_2O(1) = 2H_2\ (g) + O_2\ (g);}$$

$$\mathbf{E_o = +1.229\ V[1]}$$

1.2. WORKING PRINCIPAL OF HHO

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.
By placing two pieces of metal in distilled water, and applying electricity, the water (H20) can instantly be separated into Hydrogen and Oxygen. The separated gas molecules surface and regroup to form HHO Gas, which is an unbounded mixture of Hydrogen and Oxygen.

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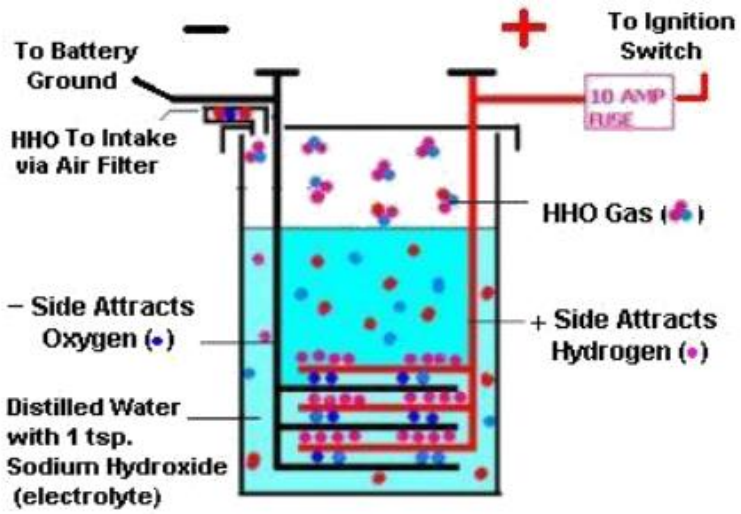

Figure 1: electrolysis of water

The brown gas generation rate depends on the various factors in the electrolysis process

- Electrolyte quality - A 25% to 30% KOH aqueous solution is reported to have a wide use in electrolyzes . On the other hand, the electro catalytic performance of water electrolysis cell is known to be limited.[2]
- Temperature
- Pressure
- Electrical resistance of the electrolyte
- Space between the electrodes
- Size and alignment of the electrodes
- cdForcing the bubbles to leave
- Electrode material
- Separator material

1.3. AIM OF THE STUDY

- To generate HHO gas or brown gas by electrolysis process in such amount that it can be used in combustion process along with the conventional fuels.

ISSN No: - 2456 – 2165

1.4. OBJECTIVE OF THE STUDY

- To reduce the fuel economy in the combustion.
- To increase the burning efficiency of the combustion process.
- To reduce the pollutants emitted from the combustion of fossil fuels.

ISSN No: - 2456 – 2165

CHAPTER 2

LITERATURE REVIEW

2.1. HHO GAS

Water (H2O) is a compound that is most important in life, which consists of a compound of hydrogen (H2) and oxygen (O2). While gas HHO gas is a result of the decomposition of pure water (H2O) through electrolysis process [3],

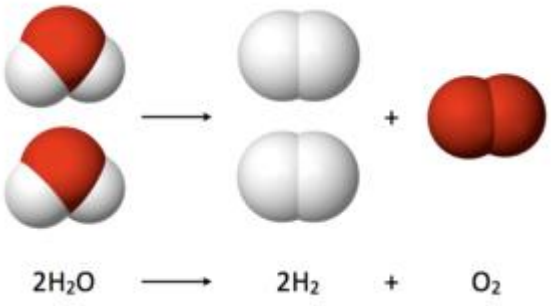

Figure 2: splitting of water into Hydrogen and Oxygen

The electrolysis of water is basically done by passing an electric current through the water to the two electrodes (cathode and anode). In order for the electrolysis process can happen quickly, the water is mixed with a liquid electrolyte as a catalyst. Electrode is useful as a conductor of electric current from the power supply voltage source to the water to be electrolyzed. At electrolysis using DC current, the electrodes are divided into two poles: positive as the anode and negative as the cathode. Electrode material influence on HHO gas production from water electrolysis process so that the electrode material must be selected from a material which has electrical conductivity and good corrosion resistance. Electrodes used in this research using 316 L type of stainless steel plate.

2.2. HHO GAS GENERATOR PERFORMANCE

The performance parameters of the HHO gas generators are as follows:

A. Generator Power Input

To produce HHO gas using the process of electrolysis of water is needed electric energy. Therefore, it should be known a magnitude of generator input power. Formulation to find the input power is: P = V x I

ISSN No: - 2456 – 2165

where: P = Power input of HHO gas generator (watts) V = voltage (volts) and I = electrical current (Ampere).

B. HHO Gas Production

The amount of production of HHO gas produced by the HHO gas generator is measured using gas flow mater.

C. Specific Energy Input

Specific energy input is defined as the amount of energy required to process the electrolysis of water in kJ to produce 1 kg of HHO gas.

D. Generator Efficiency

Generator efficiency is the ratio of useful energy to the energy supplied on system. At the HHO generator, useful energy is the product of the electrolysis of water in the form of HHO gas which is obtained in the reaction of decomposition of water.

$$(H_2O)\text{: } 2\ H_2O\ (l) \rightarrow 2\ H_2\ (g) + O_2\ (g) \qquad -285.84$$

This reaction is an endothermic reaction that requires energy enthalpy of 285.85 kJ / mol. The amount of HHO gas mole obtained from the ideal gas equation on STP conditions [4]. While the amount of energy supplied calculated based on the input voltage and current to the electrolysis process.

E. Generator HHO Temperaturee

The process of electrolysis of water into HHO gas on HHO Gas Generator influenced by the input electric current to the electrodes and the fluid in the generator. As time goes on generator continues to work to produce HHO gas, electric current flows through a conductor is the greater, causing fluid temperature rise in the HHO generator. This is caused by the amount of electric current from the input power source is not controlled, so most current and voltage is not used for the electrolysis process, but only generates heat continues to rise. So that needs to be considered to keep the quality of HHO gas by controlling the fluid temperature below 60 °C so as not to produce water vapor.

ISSN No: - 2456 – 2165

2.3. SELECTION OF DESIRED ELECTRODES

The selection of electrodes is very important in the electrolysis process, since different metals have different rates at which the electrolysis takes place. The best metal for the process is platinum. The other metals in the platinum family (**ruthenium**, **rhodium**, **palladium**, osmium, **iridium**, and platinum) are also good electrodes since there are all least reactive metals. But these metals are all very expensive and are not economically viable for the lab scale production of brown gas.

So, there are other cheap and easily available are stainless steel, iron, and aluminum etc and amongst non metals we have graphite which is also a good electrode and it does not create any toxin like stainless steel. The electrodes that we are going to use in our project are stainless steel and graphite electrodes and observing the result after carrying out various experiments.

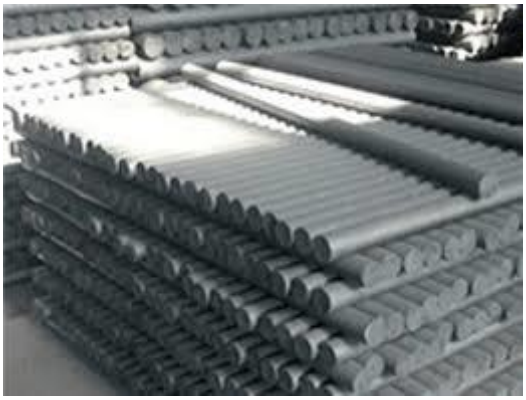

Figure 3: Graphite electrodes

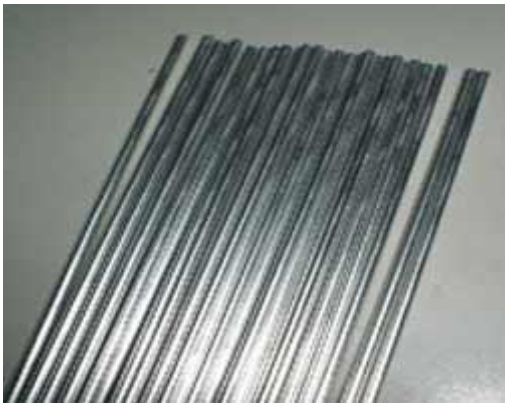

Figure 4: Stainless steel electrodes

Our objective is to test out various electrodes present in the market and select the best electrode according to our requirement.

We are considering graphite plate electrodes or some grades of stainless steel like 304 and 316L for our HHO dry cell. Depending upon which ever gives the most desired output.

2.4. SELECTION OF ELECTROLYTE

Since we are going to use distilled water for our HHO dry cell we have to use a electrolyte to make the water conductive. We use distilled water because it is free from impurities and does not form toxin during electrolysis, unlike taped water which contains lots of unknown impurities. We have come to this conclusion by carrying out a small experiment in two beakers, one containing distilled water with electrolyte and the other containing simple tap water.

ISSN No: - 2456 – 2165

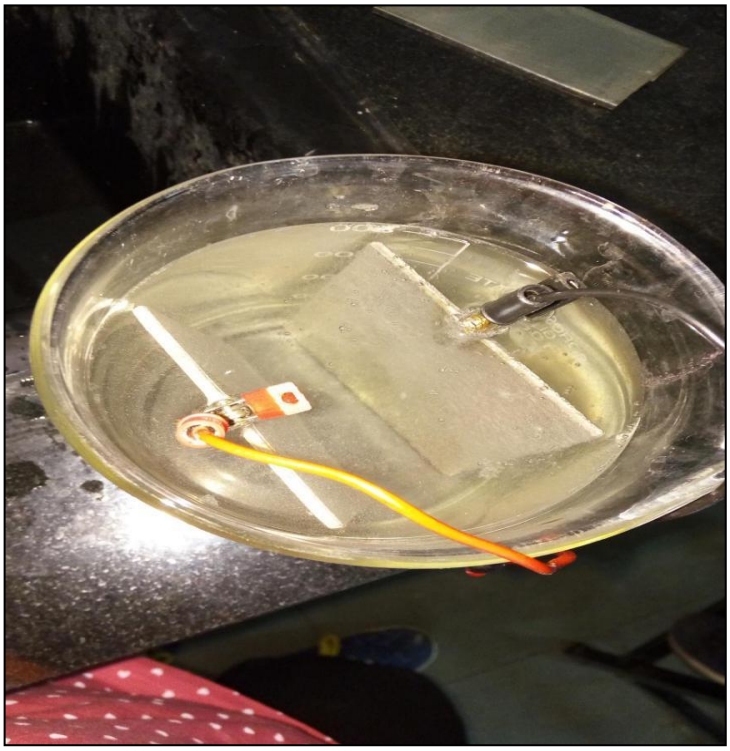

Figure 17: Beaker 1 with clear water(distilled water)

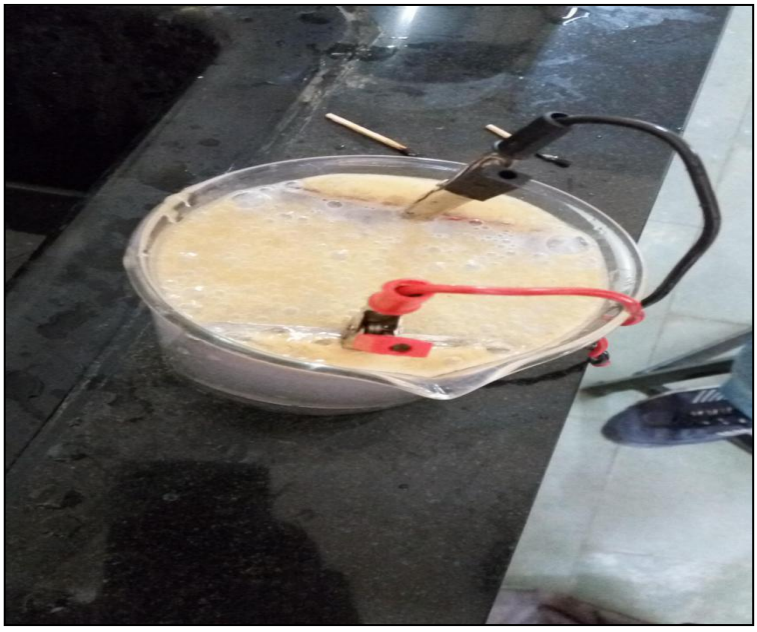

Figure 18: Beaker 2 with coloured water(tap water)

As you can see in the figure that in the beaker 1 the water is clear and the water in other beaker is colored. This indicates that tap water generates toxins during electrolysis of water.

ISSN No: - 2456 – 2165

CHAPTER-3

WORKING

- The system is contend with electric supply and is generating bubble of HHO gas.
- The water filled in the tank goes into the dry cell with the tubing connected at the bottom of the tank.
- The water gets distributed in the voids of the dry cell electrode plates.
- As the current is passed to the electrode plates bubbles of hydrogen and oxygen are formed on the surface. The small bubbles join and form big bubbles and escape the dry cell through the outlet and back into the tank where the un reacted water and pure HHO gas is separated.
- That gas is then goes through the outlet to the connected bubbler.
- The bubbler bubbles the gas in water and dissolves any water vapor mixed with the gas Clean and vapor free HHO gas is obtained on the other end of the bubbler.

3.1 EXPERIMENT SETUP

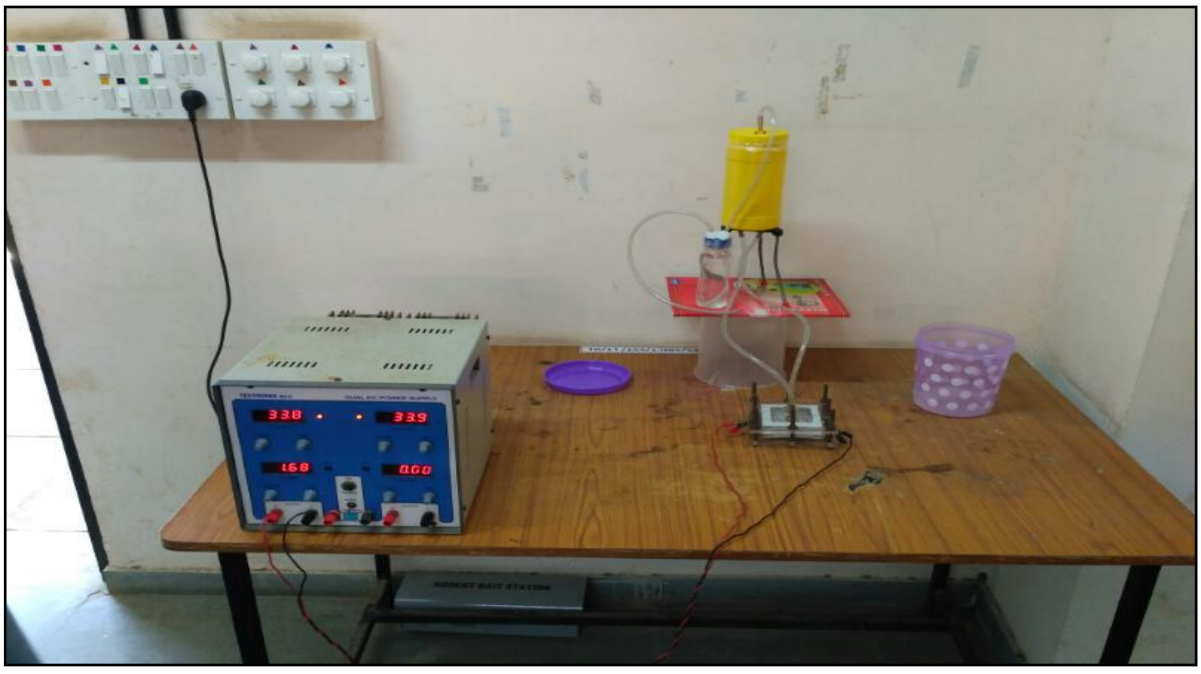

Figure 19 : Experiment setup of HHO Generator

ISSN No: - 2456 – 2165

CHAPTER- 4

RESULT TABLE

Volt	Baking Soda	KCl	KOH
34 V	0.054 l/min	0.075 l/min	0.19 l/min
28 V	0.033 l/min	0.033 l/min	0.085 l/min
24 V	0.024 l/min	0.026 l/min	0.046 l/min
18 V	0.010 l/min	0.011 l/min	0.019 l/min
13 V	-	-	-

Table 1 : Result table of Volatge and different electrolytes

4.1 .CONCLUSION

From the experiment of HHO Generator , the following results were concluded :

1. Using dry cell, we have observed that generation of HHO Gas is more compared to wet cell.
2. As we increased the voltage in dry cell the generation of gas also increases, but as we increase the voltage after the certain time the cell starts heating.

ISSN No: - 2456 – 2165

3. We have used different electrolytes with distilled water and observed that potassium hydroxide(KOH) gives a considerable amount of gas.

ISSN No: - 2456 – 2165

CHAPTER 5

SCOPE AND APPLICATIONS

- The HHO gas can be used in various combustion process to increase the fuel economy.
- It has a major application in automobile industry.
- Can be used in under water welding and cutting.
- Can help in decreasing the air pollution.

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