THE EFFECTIVENESS OF SEPARATION HYDROGEN BY ELECTROMAGNETIC FORCES TO EFFICIENCY ELECTROLYSIS OF WATER COMBUSTION OF HYDROGEN

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Abstract. Hydrogen become one of the alternative energy are constantly being developed to get optimal production. One way of obtaining hydrogen is through the process of electrolysis of water. Related research electrolysis of water is constantly evolving to obtain energy consumption to a minimum, and generally gaseous hydrogen and oxygen are produced are still in mixed conditions. Needs to be done to the separation process due to the combustion process can be release of energy quickly or explosion if hydrogen concentrations of more than 18.3% by air. To avoid it then we do research to separate the hydrogen and oxygen using electromagnetic force. So that hydrogen is separated not in a state of excess oxygen and can be burned directly in free air. Electric current for direct current (DC) voltage regulation varied premises for 11-15 Volt and supplied to the anode and cathode in the form of stainless steel pipe which leads to a potential difference ionizes water molecules into H + and O- ions. Through electromagnetic induction, written after the ionization step, hydrogen ionic compounds that are positively charged and negatively charged ionic oxygen flow can be maintained to remain separate in a different formation zones. The production of pure hydrogen gas is the maximum generated at a voltage 15 V (2 A) that is equal to 1:10 ml / sec using a solution concentration of potassium hydroxide 1 M.

Keywords : Pure Hydrogen, Electromagnetic, Electrolysis

I. INTRODUCTION

The depletion of fossil energy reserves makes man trying to find new substitute energy for a safe clean environment. In many respects, hydrogen is the perfect fuel. Amounted abundant, highly efficient, and produces no emissions when used in fuel cells. Many studies have noted that hydrogen may be the only alternative fuel that can reduce dependence on fossil fuels and reduce greenhouse gases significantly.

In many respects, hydrogen is the perfect fuel. Hydrogen combustion produces the cleanest and most efficient. Hydrogen can generate electricity, and electricity can produce hydrogen, creating a cycle of renewable energy and environmentally safe. On vehicles, the hydrogen can be used as fuel in two ways: to produce electricity in a fuel cell; or burned directly in internal combustion engines. Car with hydrogen fuel has been designed by Stanley Meyer [1].

One method for producing hydrogen gas is through water electrolysis. Electrolysis is a chemical process that converts electrical energy into chemical energy. The process of electrolysis to separate water molecules into hydrogen and oxygen gas is by means of an electric current to the electrodes. Classified electrolysis reaction redox reaction is not spontaneous, the reaction can take place due to the influence of electrical energy. Water molecules break down into ions H + and OH- ions to form hydrogen molecules by means of an electric current (DC) to the cell electrodes in water that has been mixed with an electrolyte solution as a catalyst. Half reactions that occur in the electrolysis of water:

Oxy (anode) $2H_2O_{(l)} \rightarrow O_{2(g)} + 4H^+_{(aq)} + 4e^-$
$E^o_{red} = 1.23$ V .. (1)

Red (cathode) $2H_2O_{(l)} + 2e^- \rightarrow H_{2(g)} + 2OH^-_{(aq)}$
$E^o_{red} = 0.0$ V .. (2)

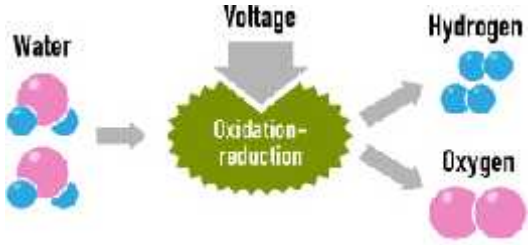


Fig. 1 The process of electrolysis / decomposition of water molecules

One of the natural resources are abundant and can be utilized on this earth is water. Water can be used as an alternative fuel. The water can be converted into one of the alternative fuels that are environmentally friendly by converting it into a

gaseous form through the process of electrolysis. Electrolysis is a chemical process that converts electrical energy into chemical energy. The process of electrolysis to separate water molecules into hydrogen and oxygen gases one of which is by way of an electric current to the electrodes. Classified electrolysis reaction redox reaction is not spontaneous, the reaction can take place due to the influence of electrical energy with a standard potential difference of 1.23 V. The water molecules break down into ions H + and OH- ions to form molecular hydrogen by passing direct current (DC) to electrodes in the cells water that has been mixed with an electrolyte solution as a catalyst. The energy required in the process of electrolysis of water is affected by the conditions of the temperature, the higher the water temperature will be parsed, energy consumption will fall [2].

Salt compounds, bases and acids can be added to change the nature of the conductivity of pure water. These compounds have the effect of reducing the overvoltage value that must be provided in breaking down water molecules in the unit elektroliser. That is because there has been increased ionic conductivity of aqueous solutions containing some electrolytes. However, the level of concentration of the solution of acid or alkali solution to be used is limited in practice, the concentration is too high will cause corrosion on the metal electrode used. Concentration of 25% to 30% KOH solution is the most widely used in the electrolysis process water [3].

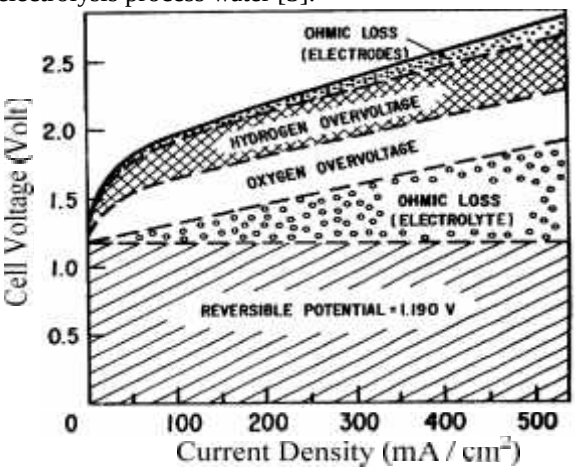


Fig 2. Components of voltage between electrodes [4]

Ideally, the voltage required in the process of decomposition of water is 1:23 V as in the equation 1 and 2. But in order to get a continuous reaction, the voltage should be given excessive, overvoltage or over potential. The term "overvoltage" here refers to the minimum required polarization for each electrode at a level sufficient for the electrolysis process [5].

Hydrogen is explosive if burned directly on the concentration of 18.3% - 59% with air [6]. To avoid this, many studies have been carried out by burning hydrogen in engines. Research by combining hydrogen with liquid fuel (fuel mix) [7], or using hydrogen in the EGR (exhaust gas recirculation) [8]. Other studies have also gained influence on the hydrogen injection supercharged diesel engines to gas-gas emissions produced [9].

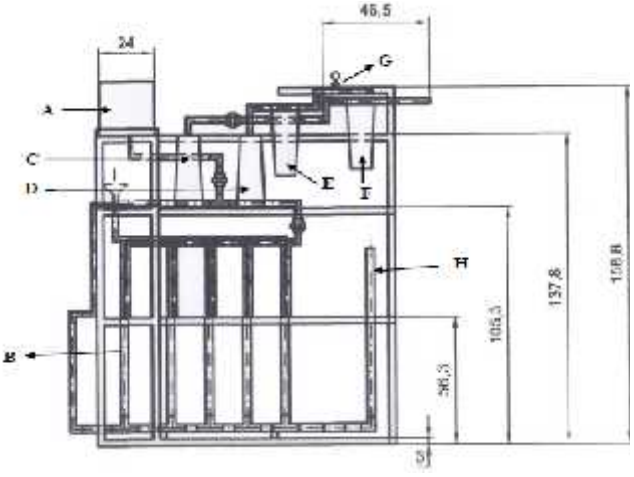
It has been proven water can be decomposed into hydrogen and oxygen using a strong magnetic field [10]. Ongoing research needs to be done to get the best technology in an attempt separation of the gases produced. So that hydrogen gas can be used directly through combustion in free air and not only do the internal combustion engine because of fears of explosion if electrolysis products (HHO gas) produced is still in a mixed state. It has been employed by mixing pure hydrogen gas with HHO gas prior to combustion processes [11]. H + and O- ions that have unraveled in the electrodes can be kept in a separate condition to exert a force on electromagnetic induction outflow area of each product.

II.EXPERIMENTAL

a. Design Approach

The circuit unit of equipment on Hydrogen Fuel Generator prepared with consideration of its usefulness. Electrolizer hydrogen in the form of stainless steel pipe is the venue for the electrolysis reaction. Inside the electrolysis reaction occurs between the cathode (reduction) and an anode (oxidation) that serves to ionize the hydrogen ions and oxygen ions of water molecules with the catalyst / electrolyte of potassium hydroxide. Which then flowed a stream of filling the batteries using solar cells.

Four (4) pairs of electrode, which are arranged parallel. So the process can always be continuous, material accommodated in advance into a feed tank before being discharged to the respective electrodes.



Noted :
A. Feed Tank;
B. Electrode Stainless Steel;
C. Oxygen Gas Container Vessel;
D. Hydrogen Gas Vessel Container;
E. Vessel Hydrogen Gas Filter;
F. Vessel Filter Gas Oxygen;
G. Pressure Gauge;
H. Disposal Pipeline.

To get the production rate of hydrogen gas, downstream section fitted container vessel equipped with a pressure gauge. Through the ideal gas equation, We get amount of volume each unit of time resulting in practice. While the comparison of results obtained theoretically is to follow Faraday's law:

$$Q = n. F \quad .....(3)$$

where Q (quantity of cargo, C), n (the number of electrons, mole), and F (electric charge per 1 mole of electrons, Coulomb / mole).

b. Experimental Procedure

- Construction of Electrodes

a) Cut the stainless steel pipe of two rods
b) Prepare each electrode in accordance with their respective poles: positive and negative;
c) Connect each pole with an electric current that is used to create a magnetic field;
d) The electrode is ready for use for the electrolysis process

- Tools Experiments

a) Make a catalyst solution (0.25 M KOH in 15 liters);
b) Put the feed solution into the tank;
c) Install the positive electrode to the positive terminal and a negative terminal to the negative electrode (the number varied electrode 4 s / d 8 rod electrodes);
d) Turning on the Power Supply, and wait until the electrode reacts to produce gas.
e) Power supply current is varied with voltage regulation (11-15 Volt);
f) Wait until the water level in the Container Vessel Hydrogen gas down to the bottom limit and observe the pressure generated;
g) Open the valve nozzle welding to remove hydrogen gas
h) Fire hydrogen produced is used in metal welding;
i) Repeating the experiment with other power supply variation.

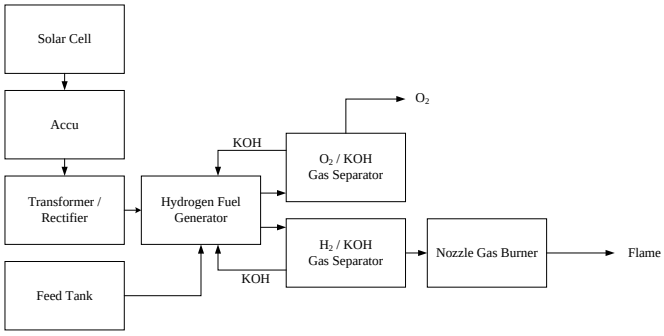


Fig 4. Process Flow Diagram Hydrogen Production

III. RESULTS AND DISCUSSION

Provision of electricity needs for Hydrogen Fuel Generator units are of solar panels (max. 17.4 V; 100 W) and stored temporarily in the battery before the trials. By setting the voltage on transformers, the amount of current supplied to the device can be varied. Based on Faraday's law, a large current (electrical charge) is proportional to the mass of a substance produced in an electrode [12] theoretically.
Stoichiometric,

$$H_2O_{(l)} \rightarrow H_{2(g)} + \tfrac{1}{2}\, O_{2(g)} \quad \ldots (4)$$

Mol H_2:O_2 gas moles was 2:1. After the experiments were conducted, the measurement results of gas obtained in each product container vessel has a ratio of 2: 1 as well as existing theoretical. This is an indication that the addition of electromagnetic induction style, fig. 3, the units Hydrogen Fuel Generator has managed to separate gas molecules H_2 and O_2 are produced.

The maximum flow rate of hydrogen gas produced at the highest voltage and electrolyte concentration as in fig. 4 ie 1.10 ml / sec. With the greater the voltage, the electric current will be distributed more the water molecules are decomposed.

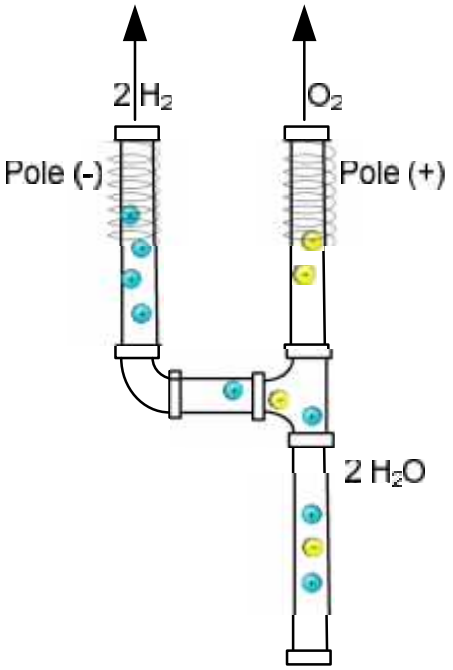


Fig 5. Separation of H + and O- ions through electromagnetic induction in the electrolysis process water

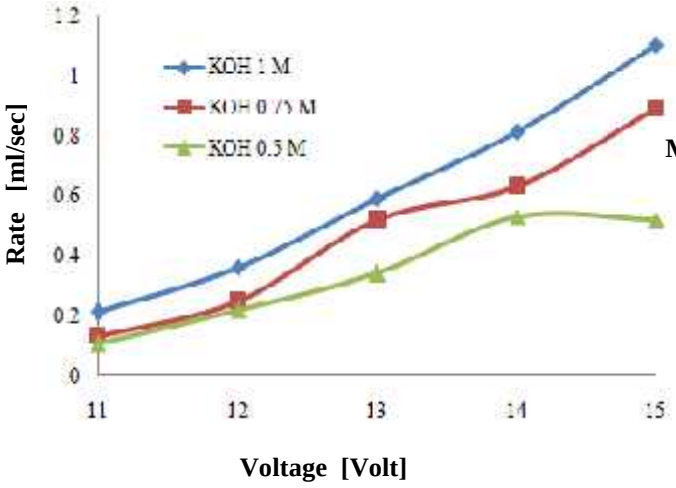


Fig 6. The rate of hydrogen gas production

The resulting gas is passed at a different pipeline to keeps its purity. Oxygen gas is successfully formed, fig. 6, most obtained in the same state as the formation of hydrogen gas, voltage of 15 volts and 1 M KOH concentration, ie 0.82 ml / sec.

In the pipeline hydrogen, is added as a safety and a flashback arrestor to prevent fire back the time of the test process fuel. Flashback arrestor is coupled together with the gas nozzle is used. Hydrogen gas that comes out through the gas nozzle is allowed to flow for about 1 minute as a preventive action to dispose (purging) of oxygen that is already in the unit equipment.

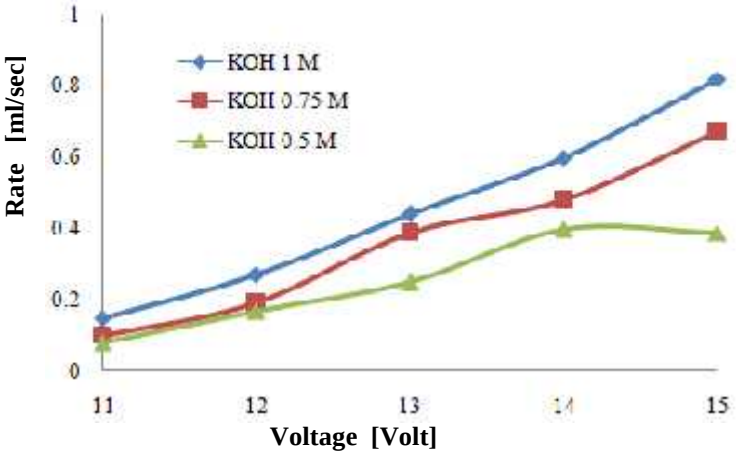


Fig 7. The rate of oxygen gas production

Hydrogen burns with a pale blue flame that is almost invisible in daylight. Fire can appear yellow if there are impurities in the air such as dust or sodium. Speed maximum combustion of H_2 / O_2 approximately eight (8) times greater than the combustion of CH_4 / O_2 and C_3H_8 / O_2 [13]. High combustion speed of hydrogen is the underlying researchers to use it as fuel in metal welding processes. Objects M in fig 5. indicate metal has managed to put together / welded to other metals.

Fig. 8. Metal welding process with hydrogen as fuel

IV. CONCLUSIONS

Electrolysis process is very dependent on the voltage and large electric current flowed. More and more electric charge is supplied, then the number of ions that will unravel. Hydrogen produced from electrolysis process can be directly burned in an open environment by separating them in advance with oxygen gas that is formed. Separation to

obtain pure hydrogen gas can be done by utilizing electromagnetic induction. Fire hydrogen gas with low radiation and high combustion speed then allow it to be used as fuel welding metal.

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