Electrolysis Through Magnetic Field for Future Renewable Energy

Asaad Zuhair Abdulameer, Zolkafle Buntat, Rai Naveed Arshad, Zainuddin Nawaw

Abstract: ***Hydrocarbon fuels are the best source of energy; however, they have some drawbacks. Because of extensive usage and replacement difficulties, it is not financially possible to entirely disregard them in the coming days. Hydrogen with Oxygen (hydroxide-HHO) gas as a fuel supplement is one possible way to reduce consumption and emissions of hydrocarbon fuels. However, the accessibility and rate of compressed hydrogen (H2) have made it challenging. Electrolysis of water, resolve numerous possible complications of using hydroxide for fuel to progress hydrocarbon burning. This research introduces a new design of electrolyzer with proper selection of electrode material and types integrated with magnetic field system, which can reduce the energy consumption. The effect of the optimum magnetic field strength was measured for this process with tap and distilled water. Two supplementary compounds, Sodium Hydroxide (NaOH) and Soda (NaHCO3), with concentration 3333ppm 1.5 litres of the electrolyte was used in this process. NaOH showed better performance and can be utilized in future development.***

Index Terms: ***Electrolysis, Magnetic field, compressed hydrogen, Renewable energy***

I. INTRODUCTION

Hydrocarbon fuels are used as the main source for energy but contain some dangerous productions of harmful gases [1, 2]. Due to their wide usage and replacement complications, it's not financially possible to exclude them in the coming days [3, 4]. Some processes are required to considerably decrease the dangerous emissions of hydrocarbon fuels [5, 6]. Hydrogen with Oxygen (hydroxide-HHO) gas as a fuel supplement is one way for reducing usage and emissions [7, 8]. Hydrogen (H2) is known as the most abundant element in the universe. On earth, hydrogen is found in combination with other elements; it is also found in water with oxygen while as in petroleum, natural gas, and coal, hydrogen combined with carbon. However, hydrogen is not a primary energy source, but a secondary energy vector (so-called energy carrier). Hence, it has to be produced from one of the primary energy sources.

Revised Manuscript Received on June 10, 2019.

Asaad Zuhair Abdulameer, FKE, UTM, Malaysia; Engineering Technical College of Al-Najaf, Al-Awsat Technical University, Najaf Governorate, Iraq. asaad_z14@yahoo.com

Zolkafle Buntat, Institute of High Voltage and High Current, School of Electrical Engineering, UTM, 81310, Skudai. Malaysia.zolkafle@fke.utm.my

Rai Naveed Arshad, Institute of High Voltage and High Current, School of Electrical Engineering, UTM, 81310, Skudai, Malaysia. rainaveed@yahoo.co.uk

Zainuddin Nawawi, Department of Electrical Engineering, Faculty of Engineering, Universitas Sriwijaya, Indonesia. nawawi_z@yahoo.com

Production of Hydroxide through the electrolysis of water, resolve numerous possible problems of using hydroxide as a fuel supplement [9, 10]. In this attempt, magnetic field electrolysis is a technique of electrolysis that is a more convenient light source to compare with solar energy for commercial electrolysis [11]. Although this process gives a small proportion of hydrogen production by using the current method, we believed that this process would contribute a lot to society if the existing methods are upgraded with suitable materials and substances.

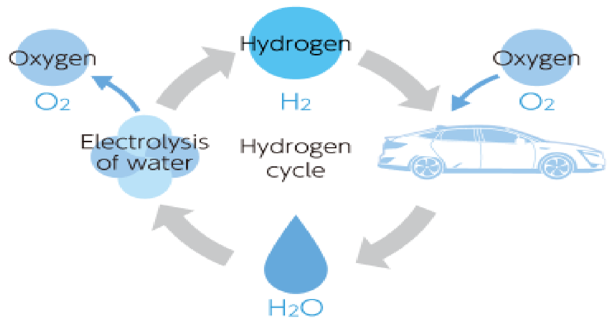

Fig.1. The ideal hydrogen energy cycle

Electrolytic polarization lowers the efficiency of electrolysis of water. Polarization occurs as hydrogen gas molecules adhere to the surface of the electrode and thereby partly passivating it [12]. Polarization hinders ion flow and causes reverse reactions in which gas molecules return to ions, causing a voltage drop [13]. Current solutions for polarization are stirring the electrolytic cell and using depolarizers. However, stirring requires additional energy while depolarizers are consumables, some of which are hazardous. Due to this, the electrolysis of water only makes up 4% of hydrogen production [14].

This study introduces a new design of electrolyzer with proper arrangement of its dimensions, proper selection of electrode material and type integrated with a magnetic field system, which can reduce the energy consumption. The optimum magnetic field strength, direction angle of the magnetic field and the effect of the permanent or variable magnet fields are analysed experimentally and numerically. A simulations study that takes into account all the parameters influencing the HHO production will be conducted. In this research, the concentration, type of auxiliary materials, temperature of electrolyte and magnetic field, this parameter are simulated and verified experimentally for best HHO production.

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II. EXPERIMENTAL SETUP

The electrolyzer is used to analyze water to generate HHO gas. The capacity of electrolyzer is 1.5 litres of water and it is constructed from a capacitive cell having 25 plates of stainless steel (each plate 18.3x3.8cm), having four stacks and 24 water cells. This cell is constructed from two electrodes, positive and negative. When the current passes through the water containing auxiliary materials such as Sodium Hydroxide (NaOH), Potassium Hydroxide (KOH) or Soda (NaHCO3), the electrolyzer analyses the water and generates HHO gas. This gas flows from electrolyzer to filter by plastic piping, this filter contains at the water, this filter works as a filtering gas from the vapour of water and the same time works as a device to protect the Electrolyzer from backfire. The gas output from the filter is a pure gas of HHO.

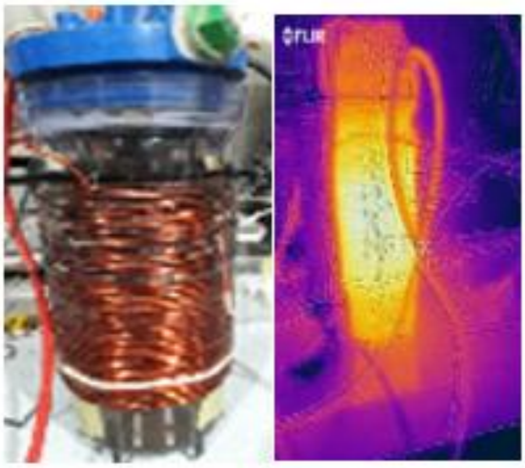

Fig.2. Electrolyzer with a thermal image during operation

Fig. 2 shows the electrolyzer constructed from container and electrolysis cell, a 2-liter container holding 1.5-liter electrolyte and capacitive cell constructed from 25 stainless steel plates two shapes (solid and mesh) (18.3x3.8cm), 4 stacks and 24 water cells, with Coil around the container constructed from Copper wire 100 turns diameter size 2.67mm, This coil connected in the series with the electrodes of electrolyzer. This electrolyzer is considered as a generator of HHO gas production with a magnetic field.

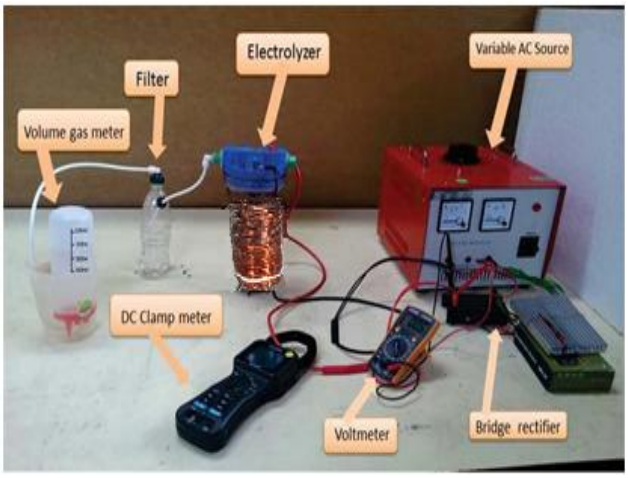

Fig. 3. Experimental Setup of magnetic field electrolyzer

Fig. 3 shows the system diagram of a magnetic field electrolysis system. In this part of the study, HHO Gas is generated from analysis of water by using Variable AC power supply range of voltages from (0-250V) and current (30A) and they supplied the power to the system. The variable AC power supply connected to the bridge that converts the voltage from AC to DC. The Bridge Rectifier and the heat sink connected to the bridge rectifier and used to dissipate the high temperature. The output of the bridge which as connected to the electrolyzer through the input measurement devices. The HHO gas generated inside the electrolyzer was interred to Gas Volume meter to measure the volume of HHO gas generated.

The Gas volume meter with a capacity of 150 ml. This device was used to measure the volume of HHO gas production. It is filled with water, and when the gas begins to generate, gas removal of the water and the volume of gas is read by gradations on the scale. DC clamp meter is used to measure the input DC current of the system, and voltmeter to measure the input voltage on the system. TDS & ES conductivity meter was used to measure the conductivity and concentration ratio of the Electrolyte [15]. Thermometer. This device is used to measure the temperature of the electrolyte.

Volume gas meter will measure the volume of HHO gas generated per min. when the gas flow from the bubbler filter. This project used the constant volume of HHO gas (100ml) and measured the time of generating this volume of gas by a stopwatch. DC Clamp meter and Voltmeter were used to measure the input voltage and current of the system. Two types of water, namely tap water and distilled water, are used and two auxiliary materials are used in this project (Potassium Hydroxide: KOH) and (Sodium Hydroxide: NaOH). These auxiliary materials are used in concentrations 3333ppm.

This project measured the currents and times for different voltage values from 6 volts to 22 volts and repeated these measured values three times. This project also calculated the MMW (milliliter /min./watt) and calculate the average values for each current, time and MMW, then calculate the input energy and the efficiency of the system.

III. RESULT AND DISCUSSION

This section discusses the preliminary results of the experimental work as well as simulations study of the magnetic electrolyzer.

A. SIMULATION STUDY

The cell of electrolyzer (parallel plates) designed implemented by Feko software as shown in fig. 4. And the container electrolyzer system with coil 100 turns implemented shown in fig. 5.

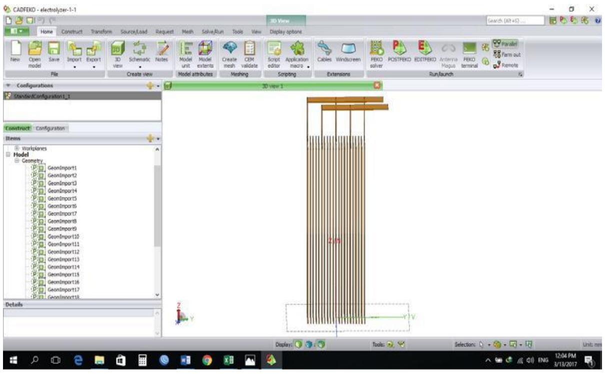

Fig. 4. A cell of electrolyzer (parallel plates)

The cell of Electrolyzer contains on 25 plates, three plates (+) and 2(-) and between every two electrodes five plates as a neutral without connection, working to reduce the losses in energy consumption as a temperature. Every two plates are working as a water cell.

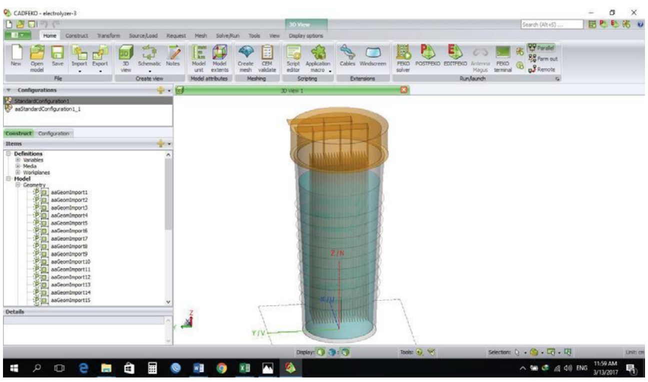

Fig. 5. A container of electrolyzer system with coil

Fig. 5 shows the Container of Electrolyzer with the Capacitive Cell constructed from 25 plates (stainless steel 316) with The Coil (100 turns two layers' diameter of wire 2.67mm) around the container.

B. EXPERIMENTAL STUDY

In this study, the experimental work was performed to measure the HHO gas generation from analysis of water by using different types of water (tap and distilled) with different concentrations of auxiliary materials (Soda: NaHCO3 and Sodium hydroxide). In addition, it discusses the characteristics of MMW with different voltage and measures the efficiency of the system with a different concentration of materials by using the ideal factor (output energy) calculations.

The type of water (tap and distilled), type of auxiliary materials (Sodium bicarbonates NaHCO3 and Sodium Hydroxide NaOH with concentrations 3333ppm), types and concentrations of this materials due to the limited type of electrolyte and degree of conductivity of this electrolyte is measured.

Material weight is 5 g with the volume of water 1500ml

Concentration of material = (5 g / 1500 g) $*10^6$ = 3333ppm

A measured volume of HHO gas =100 milliliter
Time of generation 100 milliliter=T1=332.33 Sec.
Measured volume of HHO gas/min. = 100*60/332.33 = 18.05 ml/min.
Power consumption =Voltage of cell * Current of cell =8*1.4=11.2 watt
Milliliter/min/watt (MMW) = 18.05 / 11.2 = 1.62 MMW

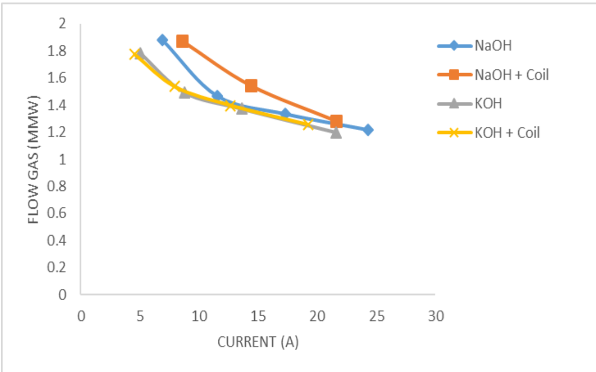

Figure 6. Characteristic of current with MMW by 3333ppm concentration with the magnetic field

i. The maximum value of HHO gas was generated when using (NaOH) as an auxiliary material with 0.33% concentration with distilled water with a magnetic field.
ii. At the same voltage used, the same volume of (100ml) HHO gas was obtained, but the time was different. Using NaOH decreased the time consumed.
iii. Maximum efficiency was (44%) of auxiliary material type (NaOH) with (3333ppm) concentration with distilled water with a magnetic field.
iv. It is recommended that (NaOH) be used as an auxiliary material with low concentration to generate HHO gas.

IV. CONCLUSION

A. Figures and Tables

The HHO gas generated from analysis of water is affected by many parameters including the type of water and types of auxiliary materials, this parameter due to a limited type of electrolyte and degree

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of conductivity of this electrolyte. Usage of a direct magnetic field reduces electrolytic polarization is an energy- saving, semi-permanent method of increasing the efficiency of water electrolysis. By utilizing this application of magnetic fields, it will be possible to make a clean, renewable cycle of hydrogen energy in which hydrogen, produced from water, in turn, produces energy and becomes water. This study includes using two different types of water (tap and distilled) using two different auxiliary materials, Sodium Hydroxide (NaOH) and soda ($NaHCO_3$), with concentration 3333ppm 1.5 litres of electrolyte). NaOH was considered best for this process.

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