THE ALUMINUM AIR BATTERY PERFORMANCE BY USING RED BRICK AS THE CATHODE TO TURN ON THE LED LIGHTS ON SHIPBOARD

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ABSTRACT

Metal battery technology of air into a promising alternative power source and its development is being observed throughout the world, this technology is applied in various fields such as electric cars and even electric boats. Aluminum into the anode material has advantages over other metals, red brick became one alternative cathode materials for battery air-conditioned metal, a mixture of these two materials have been studied in many developed countries as an alternative material manufacture battery cathode. In Indonesia, it will be used since the time of our ancestors in many good purposes pottery, building material until the red brick. Then conducted trials to determine the ability of this material as a cathode air on Aluminum-air battery with 6 Mol Potassium Hydroxide as a solution of electrolytes, voltage values with cell dimensions of Ø25 mm and 10 mm thick produce the highest voltage value of 1.28 volts and a current of 29 mA, battery cells can be applied optimally in the light 1 watt when strung together 27 series battery cells. Series or parallel with the system's expected battery by utilizing residual red brick waste can be used for alternative energy sources lighting. Energy produced has properties Sustainable Environment, does not damage the environment, have the availability of the primary material, and has a good safety compared to other batteries.
Keywords : air battery; red brick; cathode; Aluminum ;anode

1. INTRODUCTION

Alternative sources of energy into things that are often discussed by the by scientists around the world, technological developments spur any developed and developing countries to continue to improve the quality of its technology, some of this year metal batteries air is of particular concern to the researchers because the battery is able to produce electricity from a reaction oxidation of the metal by air.

Selection of a good electrode material will affect the amount of energy produced, known to some developed countries have studied the material mix of carbon and clay to obtain a battery electrode [1]. If this method is applied in such countries as measures to advance the technology, then the method of mixing between the two materials have been known by our ancestors since time immemorial. It is known that the material of bricks have in common where materials are used using the material clay and rice husk ash as binders or binder. Similarly been discussed on how to improve the quality of the air cathode of this battery uses chemical and physical treatment. Where is the red brick basically given a heat treatment up to 1500 °C, therefore, from this hypothesis we conclude that this material can be used as an air cathode in Aluminum-air battery. For the next will be tested manufacture of battery cells and measuring the voltage and current generated by the battery's cells. In addition to alternative energy sources, this study will be very helpful as one of the initial steps in introducing a form of renewable energy sources that are environmentally friendly, abundant availability, easily obtained,

and has a value of cheap material prices to the public.

2. EXPERIMENTAL

2.1. Material Preparation

This research was conducted at the Laboratory of Materials Science Darma Persada University Department of Marine in October 2017 until January 2018. Tools to be used in this research are Grinding machines and scissors used to cut Aluminum in the manufacture of electrodes, hacksaw to cut through the air cathode current collector, measuring cup as a measure of the volume of water to the mixture of potassium hydroxide, solder is used to connect a cable to the electrode, digital multimeter which is used as a measure of the current and voltage of the device., documentation camera to record the activity of manufacture of Aluminum-air battery prototype, the alligator clip is used for making the connection and a variety of circuits such as serial and parallel, lamp socket and power switch as experimental tools and sandpaper is used as a tool to clean the surface of the anode. While the materials used in this study are Aluminum rod diameter of 25 mm with a thickness of 5 mm, as materials for the anode per cell, Potassium Hydroxide solution as 6 mol as Aluminum air battery electrolyte, separator tissue paper as a material that separates the anode and cathode, PVC pipe as a battery container, red brick that had been pulverized and heat-treated and 1 watt DC lamp as a testing current and voltage instrument.

This study was conducted to design and perform experiments on multiple cell battery which has been prepared to determine the value of the resulting voltage and current of each cell. The first to be done is to cut Aluminum bars with a diameter of 25 mm and 5 mm thick to be used as anode material in Aluminum-air battery. The cleaning process is done manually using sandpaper to remove the outermost layer in order to obtain the effective value in the experiment, which is feared to disrupt the maximum oxidation process that will take place at the anode, further preparations cathode to be used, the manufacturing process of cathode material air from red brick and given the incomplete combustion process, in which the red brick that has been refined in the oven with a variable specific time at a temperature of 700 °C [2]. From this process, it will get material that will be used as the material for the manufacture of cathode air. Preparation of electrolyte solution with the size of the mixture of water and potassium hydroxide. Further adjustments and arrangement between the anode, separator, electrolyte and the air cathode customized with a design that has been design

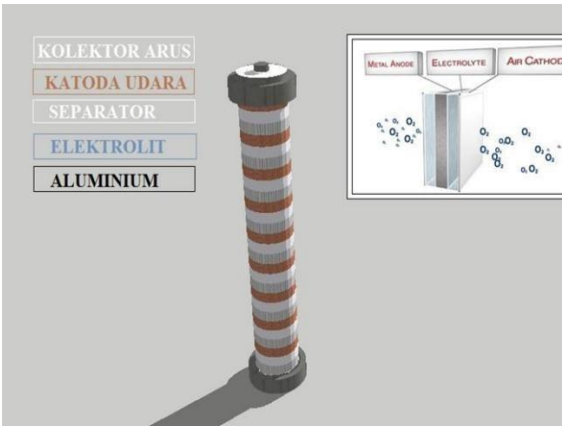

Fig. 1. Battery Circuit Design

Fig. 2. Preparation of Battery Anod

2.2. Battery Testing

Further testing is done with measurement tool a single cell battery is made will result in the level of voltage and current strength using a digital multimeter. Tests conducted to determine how current generated by the battery cells of this. From these results we obtained data to determine how much power is generated by alternative energy sources and furthermore can be determined what types of circuits that need to be made to produce power that is able to turn the lights on DC with a load of 1 watt.

3. RESULTS AND DISCUSSION

After testing using a digital multimeter to the battery cell Aluminum air there are 3 samples with sample data A (without activation) sample B (700ºC) within 30 minutes and the sample C (700ºC) within 60 minutes and each cell consists of 5 grams air cathodes made of red brick, 6 Mol of Potassium Hydroxide and tissue paper as a separator, then obtained a voltage with a current value as follows:

Table 1. Voltage and Current Test Results

Heat Treatment 700 °C/Minutes	Voltage (V)	Average Voltage (V)	Current (mA)	Average Current (mA)
Sample A (without heat treatment)	1.21	1.197	20	18
	1.2		16	
	1.18		18	
Sample B (30 minute)	1.25	1.21	25	21.33
	1.18		20	
	1.2		19	
Sample C (60 minute)	1.29	1.28	30	29
	1.25		28	
	1.3		29	

Then from the table above can be made the following comparison charts:

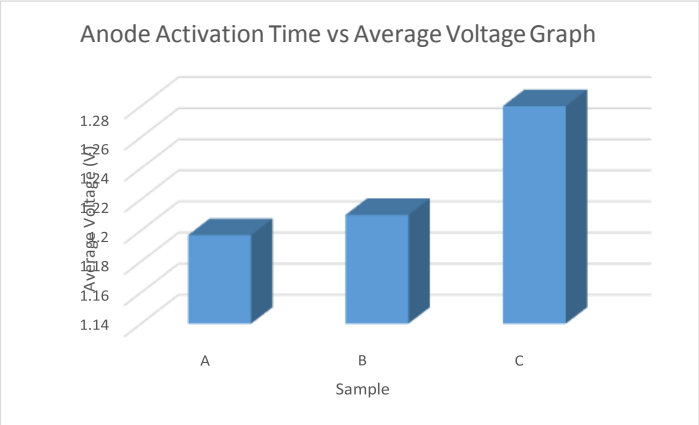

Fig. 3. Anode Activation Time vs Average Voltage

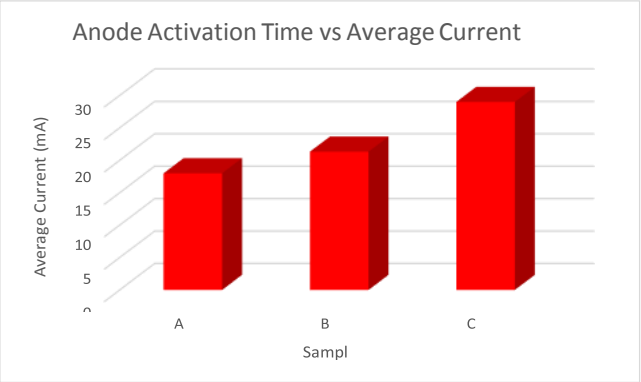

Fig. 4. Anode Activation Time vs Average Current

From the above data shows that the sample C which has been activated at a temperature of 700 °C for 60 minutes has voltage and current values most effectively, it can be concluded that physical treatments with heat giving 700 °C on a red brick material to improve the effectiveness of the air cathode. Furthermore, sample C will be made in series to get a good power value, wherein a set series of Aluminum-air battery cells will be used as an alternative source to meet the needs of lighting with power 1 watt DC lamp. To calculate the power by an alternating current (AC) to direct current (DC) is different, because of an AC current having a frequency that has its own calculations. As for the DC current that passes through the resistor to calculate the power it generates can use the formula:

$$P = V.I \quad (1)$$

Where: P = the power in units of Watts
V = Voltage in units of Volt (V)
I = electric current in units of Ampere (A)

From the above data we tried to get the power to supply the needs of a lighting system with a load of 1 watt therefore it will count how many cells needed to construct the circuit in the battery design. From the above data it obtained the power value of each sample as follows:

- Sample A: 1.197 x 0.018 = 0.0215Watt
- Sample B: 1.21 x 0.0213 = 0.0257Watt
- Sample C: 1.28 x 0.029 = 0.0371 Watt

From the above calculation is obtained the sample C with the highest value for the next sample C will be used as a benchmark to meet the lighting power of 1 watt DC, then from the data obtained by the number of cells by 27 cells with the cell size diameter of 25 mm and a thickness of 10 mm will be used in the design of the battery.

If it is known that Ferry Ro-Ro 2000 GRT has a power requirement for the system of emergency lighting for 1,600 Watts, it can count the number of batteries needed to meet the power load that the 1,600 set by the number of battery cells per set of 27 cells x 1600 = 43.200 cells, wherein the battery cells are known to the anode weight is 30 grams of it can be seen the total weight of the anode is required by 30 gr x 43.200 cells 1,926 kg.

Fig. 5. The test trial of 1 Watt LED lamp

5. CONCLUSIONS

Red brick material can be applied as a cathode air on the air the Aluminum battery with the highest voltage value of ± 1.28 volts and currents ± 0.029 A. Sample C had a better performance than the sample A and sample B and the obtained value of the voltage and current values obtained respectively each of 1.28 volts and the current 0.029 A. Obtained old conclusion activation process will affect the effectiveness of the performance of air cathode material made of red brick. To meet the power requirements of 1 watt DC with rated power at 1 cell high of 0,037 watts it takes 27 cells in series.

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