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Analysis of the Electrical Characteristics of Sea Water at Gandoriah Beach and At Tiku Beach Using Cell Conductors of Copper and Nickel Plate as an Alternative Electricity

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Abstract: *Gandoriah Beach and Tiku Beach in West Sumatra are used as electricity indicators in this study to understand the existing voltage and current. In this study, copper (anode) and nickel (cathode) electrode materials were used which were arranged in series using artificial cells that had been made using electrode materials with dimensions of 0.2 mm and 0.5 mm and an area of 56 cm each.² and 94.5 cm². Water volume for each percolation is distributed in stages 50, 100, 150, 200, 250, 300, 350, 400, 450, 500,550, 600, 650, 700,750,800 ml. By using copper electrodes (cathode) and nickel battery electrodes (anode) arranged in series in a seawater electrolyte solution consisting of six cells (six pairs of electrodes), a maximum load voltage of 1.752 Volts and a maximum current of 0.33 mA are measured in series. and the cross-sectional area of the electrode is 56 cm². Then the cross-sectional area of the electrode is 94.5 cm² achieved by using copper electrodes (cathode) and pure nickel electrodes (anode) arranged in series in a seawater electrolyte solution consisting of six cells (six pairs of electrodes), the maximum load voltage is 0.712 Volt and the maximum current is 0.12 mA and the solution seawater electrolyte consisting of ten cells (ten pairs of electrodes), copper electrodes (cathode) and battery nickel electrodes (anode) arranged in series to produce a maximum load voltage of 1.740 volts and a maximum current of 0.61 mA, and an electrode cross-sectional area of 56 cm².*

Keywords*: Electrodes, Copper, Nickel, Voltage, Current, Beach Seawater, Electrolyte Solutions.*

I. Introduction

The territory of the Indonesian state consists of the provincial islands in West Sumatra, which has a sea area of 186,580 km^2 and a coastline of approximately 2,420.4 [1]. Energy sources on earth continue to increase and energy needs continue to increase along with the increasing demand for energy on earth population growth. So that the use of new renewable energy sources and environmentally sound is needed [2]. Effect of salt concentration on the voltage and current generated by an electrolytic cell with copper (anode) and zinc (cathode) electrodes using four cells in series. The electrode has a cross-sectional area of 135 cm^2. On testing *salt water* with karsalt 33 ppm the greatest voltage was 2.81 Volts and current 0.002 A successively at a volume of 500 mL of water [3]. Padang and Bungus in West Sumatra are used as power lines produced with copper and tin electrodes with a diameter of 0.5 mm and dimensions of 35 cm^2 and 90 cm^2 each. The air volume for each percolation is distributed in stages of 50, 100, 150, 200, 250, 300, 350, 400, 450 and 500 ml. Using the Padang beach seawater experiment, the electrode cross-sectional area is 35cm^2 with a salinity of 30%, the tool produces a tertiary voltage of around 1,560 Volts and a current of 0.017 mA then at an electrode cross-sectional area of 90 cm^2 with a salinity of 30 % salt content, the highest yield was 1.686 Volts and a current of 0.043 mA [4]. AVO measuring tools, handles, measuring cups, well water, salt, copper plates, zinc plates, cables, and glass are the equipment and materials used in the investigation of making tools and materials, electrochemical cells up to 10 cells retaining water and salt [5].

II. Literature Review

2.1 Electrochemical Cell

A device capable of obtaining electrical energy from chemical reactions or using electrical energy to carry out chemical reactions. An electrochemical cell that produces an electric current is called a Voltaic cell or a Galvani cel and cells that produce chemical reactions, through electrolysis for example, are called electrolytic cells. Each oxidation-reduction reaction occurs when electrons are transferred from one substance to another, donating or absorbing energy in an electrochemical cell. The electrochemical procedure is identical to immersing the metal in an electrode solution, which consists of a cathode and an anode [6].

2.2 Salinity of Salt Content of Seawater

Available in water salinity changes with depth. At a depth of 100 to 1000 meters Sea water with a salt content of 3.5% is considered salt water. Chloride (55.04%), sodium (30.61%), sulfate (7.58%), magnesium (3.68%), calcium (1.16%), potassium (1.10%), and bicarbonate less than 1 L is the main salt in seawater. Salinity and seawater temperature on the corrosion rate of A36 ship steel in SMAW welding using three-electrode cell testing. The electrode used is AWS A5.1 E6013. The temperature used is 7^0C,17^0C, 27^0C. The salinity used was $32^0/_{00}$, $35^0/_{00}$ and $38^0/_{00}$ [7].

Table 1: Classification of Water Based on Salinity

Designations/Terms	Salinity (ppt)
Freshwater	
Fresh water	<0,5
Oligohaline	0,5-3,0
Brackish water	
Mesohaline	3,0-16,0
Polyhaline	16,0-30,0
Sea water	
Marine	30,0-40,0

There are several factors that affect salinity, including temperature, evaporation, rainfall, the number of rivers submerged in the oceans, and the solubility of solutes and solvents. As public opinion increases regarding certain travel routes, the absorption of salt to surround the air also increases [8].

Table 2: Number of Ions in Seawater

No	Ion	Weight (%)
1	Klorida (Cl^+)	55,04
2	Natrium (Na^+)	30,61
3	Sulfat ($SO_4^{2-)}$	7,68
4	Magnesium (Mg^{2+})	3,69
5	Calcium (Ca^{2+})	1,16
6	Potassium (K^+)	1,10

Figure 2. seawater at Gandoriah beach

Figure 3. seawater at Tiku beach

2.3 Light Diode (LED)

Each LED color (*Light Emitting Diode*) requires forward voltage to turn on. Since the Forward Voltage for LEDs is low, a resistor is needed to control the current and voltage to protect that particular LED

R = $((V\_s - V\_I))/I$...(2.6)

Descrption:

R = Resistor value (Ohms)

V□ = Input voltage (Volts)

V□ = Voltage on the LED (Volts)

I = LED forward current (Amperes)

2.4 Power Characteristics

The process of producing energy in various forms by using electrical energy to activate a mechanical device, drive an electric motor, heat an object, or cool it. Amperes (A), Volts (V), and Watts (W) are units used to measure the required electric current, voltage, and power consumption [9]. The amount of electric power can be known by the following formula:

1. Active Power

Active power is the power that is actually needed by the electric load, where the unit for active power is W (Watt). The active power formula is as follows:

P = V . I . Cos φ ....(2.9)

Specifications:

P = Active Power (Watts)

V = Tegangan (Volt)

I = Arus (A)

Cos Φ = Daya Factor

Whereas the electric power at DC current, is formulated as the multiplication of electric current by voltage, as in the equation below:

P = I . V ....(2.10)

Description:

P = Active Power (Watts)

V= Tegangan (V)

I = Arus (A)

III. Research Methodology

3.1 Research Description

This research is an experiment to measure the amount of voltage and current in the seawater of Gandoriah and Tiku beaches, West Sumatra as an electrolytic solution. In this work, six and ten cells are connected in series to act as electrodes on a copper plate and a nickel plate.

3.2 Research Equipment and Materials

3.2.1 Tools

The tools that will be used in this research are as follows:

1. Avo Meter
2. Combination Pliers
3. Measuring Cup
4. Refractometer
5. Plus / Minus Screwdriver
6. Solder
7. Gluegun
8. Zinc Scissors
9. Sandpaper

3.2.2 Materials

The materials to be used in this study are:

1. Gandoriah Beach Sea Water
2. Tiku Beach Sea Water
3. Copper Plate
4. Plat Nickel
5. Jumper Cable
6. Resistor
7. Led Light
8. Papan Projecboard

3.3 Flowchart

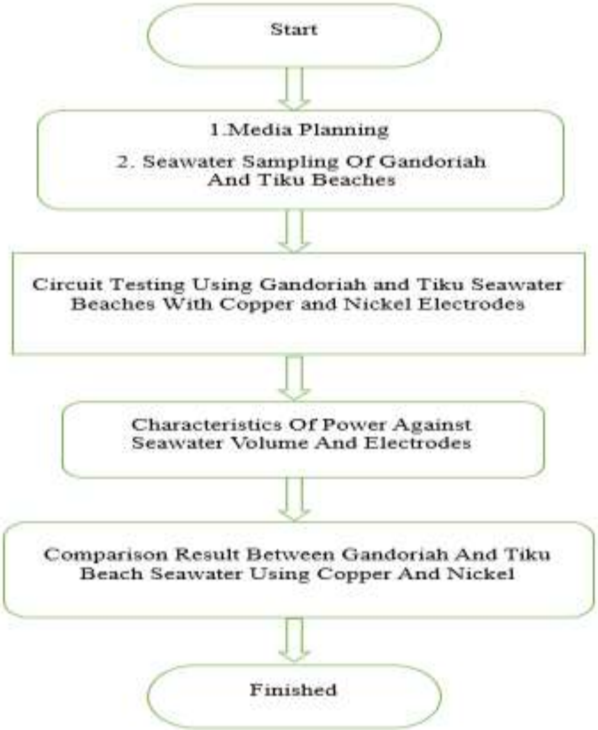

Figure 4. *Flowchart Flow Diagram*

IV. Analysis And Discussion

4.1 Test Procedure

The test will be carried out three times in testing as many as six cells and ten cells which will be carried out for the manufacture of electrochemical cell containers, namely using aquarium glass with a thickness of 5 mm in each cell container, which is 30 cm high and 10 cm wide for electrodes. as a positive using a copper plate with a thickness of 0.2 mm and for negative electrodes using a battery nickel plate with a thickness of 0.2 mm with a cross-sectional area of 56 cm^2.Continued or implemented in the second test, which is to use the electrode material as a positive using a copper plate with a thickness of 0.5 mm and for the electrode as a negative using a pure nickel plate with a thickness of 0.2 mm with a cross-sectional area of 94.5 cm^2 in using six electrode cells followed by a third test carried out using ten electrode cells with a thickness of 0.2 mm using or using copper and nickel batteries with a cross-sectional area of 56 cm^2. Tests carried out for filling electrolyte solutions are carried out in stages, starting from 100 ml, 150 ml, 200 ml, 250 ml, 300 ml, 350 ml 400 ml, 450 ml, 500 ml, 550 ml, 600 ml, 650 ml, 700ml, 750ml, 800ml.

4.2 Design of Artificial Cell Series and Research Materials

A. Aquarium Size
   Length = 25.5 cm
   Width = 30 cm
   Height = 25.5 cm
B. Aquarium cell size
   Lenght = 15 cm
   Width = 10 cm
   Height = 25.5 cm

Figure 5. Cell Design

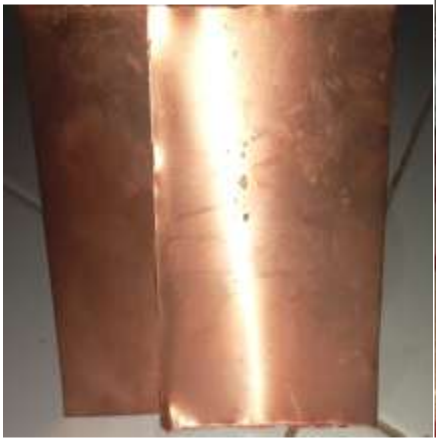

Figure 6. Copper **Figure 7.** Pure Nickel **Figure 8**. Battery Nickel

4.3 Testing of Cell Arrays at Gandoriah Beach and Tiku Beach

In the scenario of two copper and nickel battery electrode plates, pure nickel with a cross-sectional area of 56 cm^2 and 94.5 cm^2 used for testing in the sea off the coast of Gandoriah and Tiku coast, where in the test it was found that six and ten voltaic cells were connected in series to obtain voltage and current results for alternative electricity or new renewable energy.

Table 3. Measurement of Copper And Nickel Electrodes

Electrode	Electrode Size	
	Long	Wide
Copper 0.2 mm	8 cm	7 cm
Copper 0.5 mm	10.5 cm	9 cm
Battery Nickel 0.2 mm	8 cm	7 cm
Pure Nickel 0.2 mm	10.5 cm	9 cm

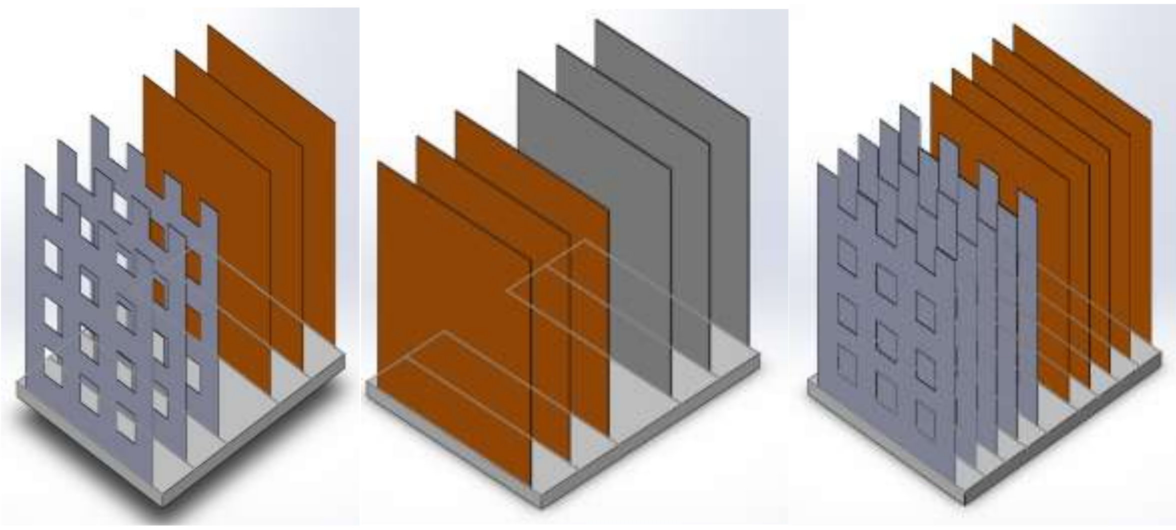

Figure 9. Copper And Nickel Batteries, Pure Nickel (Six Cells And Ten Cells)

4.4 Results of the 1st test with a pair of 56 cm six-cell electrodes[2] Gandoriah Beach Seawater

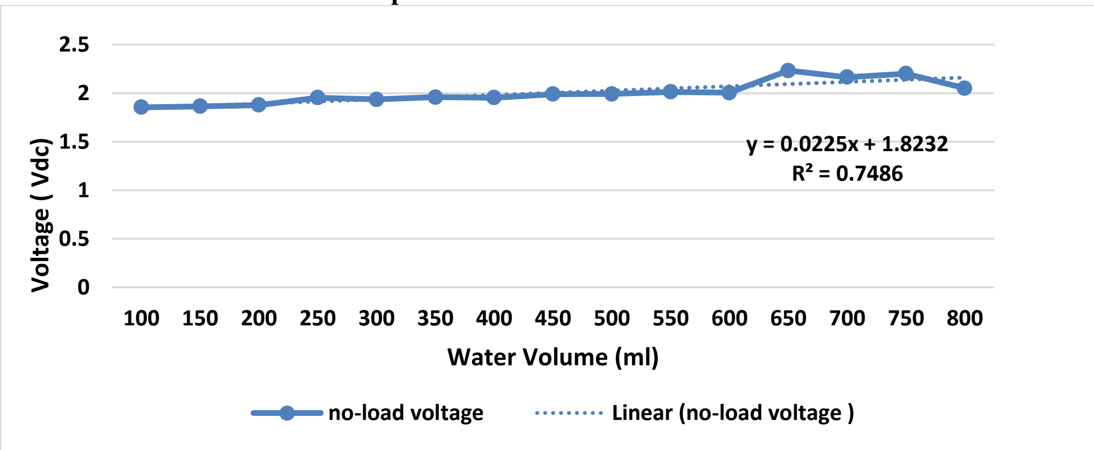

Figure 10. Graph of the 1st Test of Gandoriah Beach

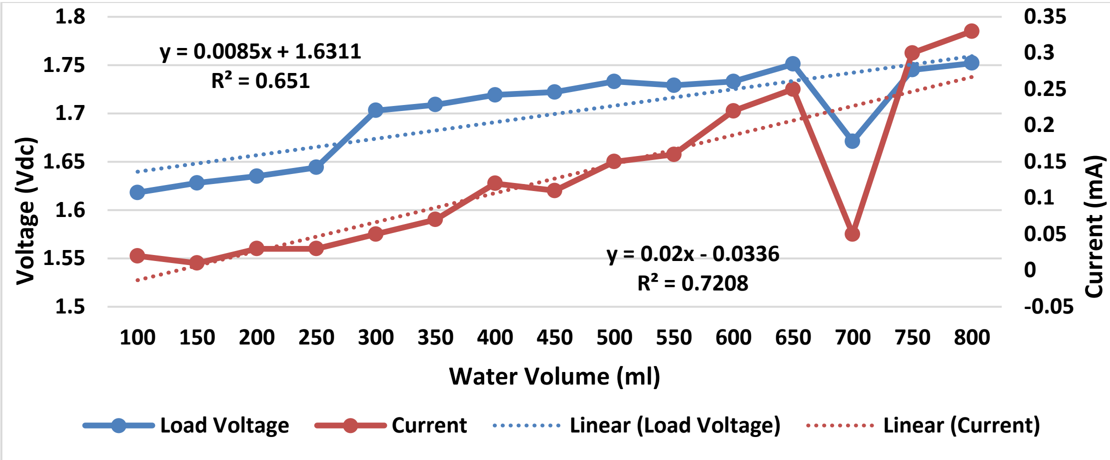

Figure 11. Graph of the 1st Test of Gandoriah Beach

The results of the data contained in the Gandoriah beach seawater chart which is shows the no-load voltage of a volume of 100-800 ml producing 1,854 volts - 2,050 volts and data results show a load voltage of 1,618 volts - 1,752 volts from a volume of coastal sea water of 100-800 ml in indicates a current of 0.05 mA – 0.05 mA from a volume of 100-800 ml of seawater. Can be used in voltage calculations load equation (2.9) the electrical or power characteristics for each volume of sea water of 800 ml t as follows: for example cos φ = 1 p = v x I x cos φ P = 1.752 x 0.33 x 1 P = 578.16 watts.

4.5 Results of the 1st test with a pair of 56 cm² six-cell electrodes Tiku Beach Seawater

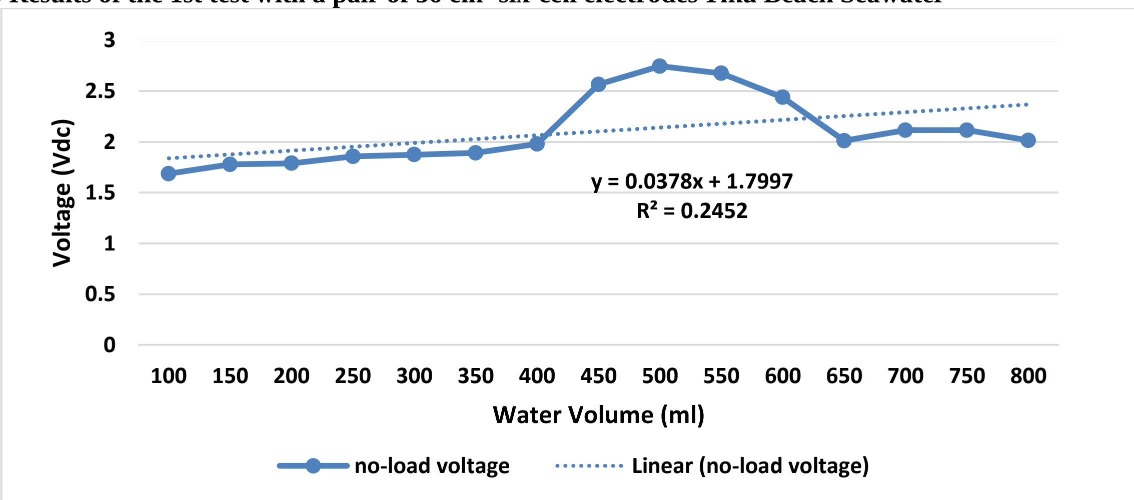

Figure 12. Tiku Beach 1st Test Graph

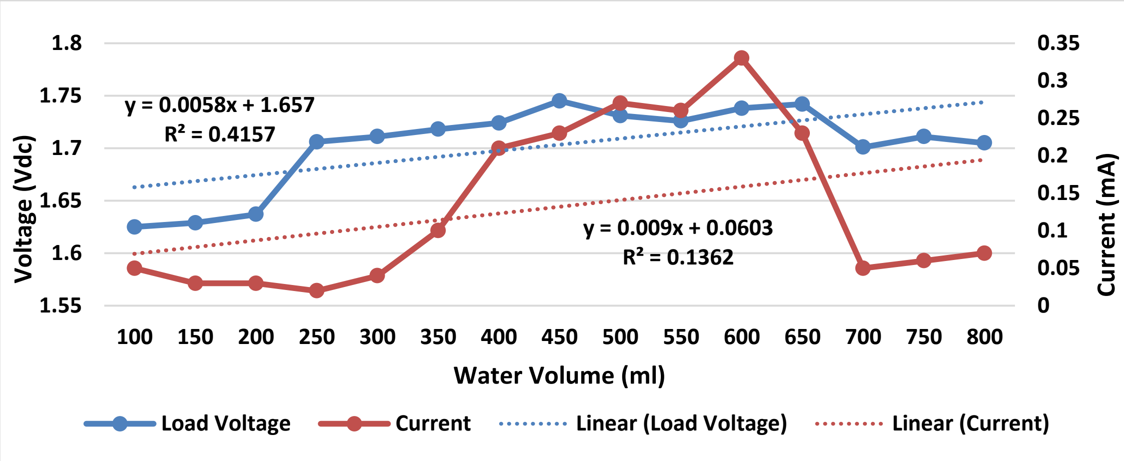

Figure 13. Tiku Beach 1st Test Graph

The results of the data obtained by Tiku beach sea water which is shows the no-load voltage of a volume of 100-800 ml producing 1,686 volts - 1,686 volts and the results of the data in show a load voltage of 1,625 volts - 1,625 volts from a volume of beach sea water of 100-800 ml at indicates a current of 0.05 – 0.05 mA from a volume of 100-800 ml of sea water. It can be used in calculating the load voltage equation (2.9) for the electrical characteristics or power for each volume of sea water of 600 ml as follows: for example cos φ = 1 p = v x I x cos φ P = 1.738 x 0.33 x 1 P = 573.54 watt.

4.6 Results of Comparison of Power Generated by Gandoriah Beach Sea Water and Tiku Beach Sea Water

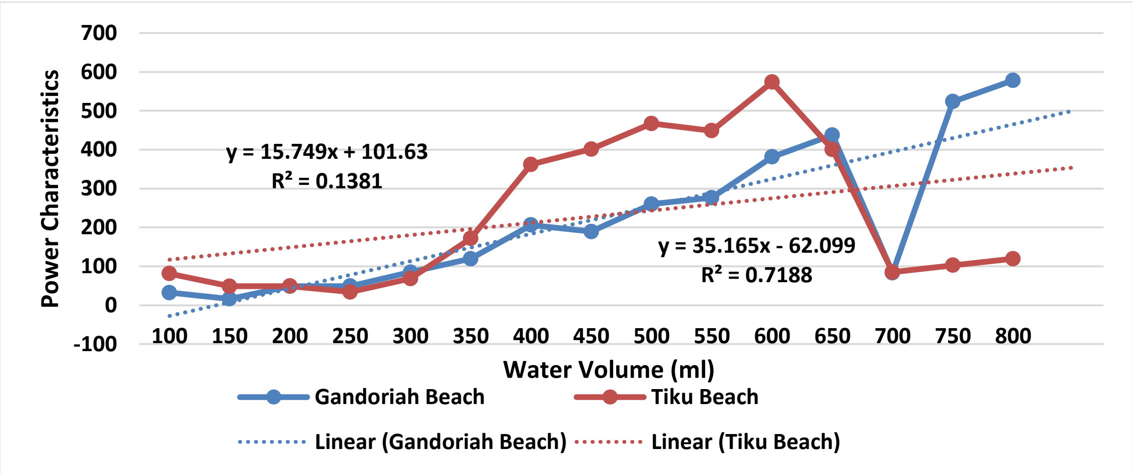

Figure 14. Power Graph

Result -1 is the power graph obtained from the Gandoriah beach seawater as a result of the volume of water seashore 100–800 ml has 32.36 watt – 578.16 watt and the power chart is on the beach Tiku sea water volume of 100–800 ml produces 81.25 watt – 119.35 watt power.

4.7 Results of the 2nd Test With a Pair of Six-Cell Electrodes 94.5 cm^2 Gandoriah Beach Seawater

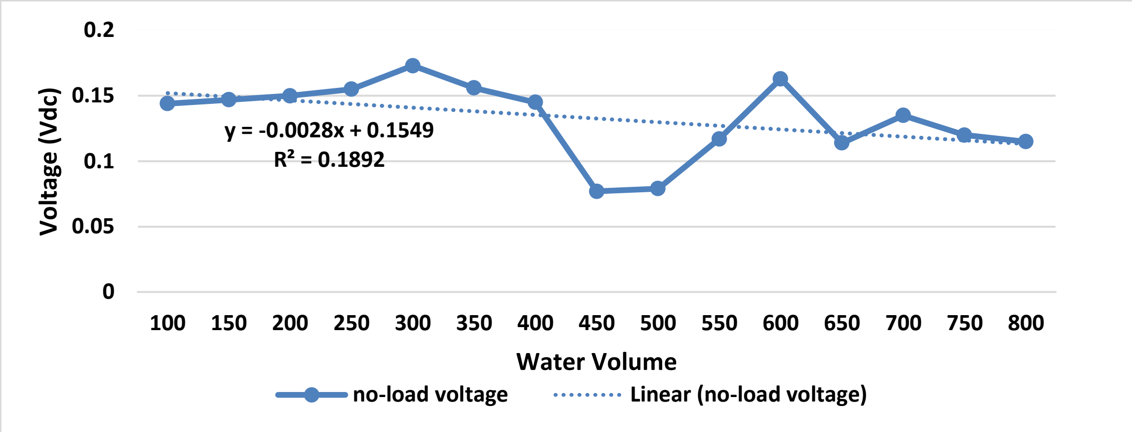

Figure 15. Graph of the 2nd Test of Gandoriah Beach

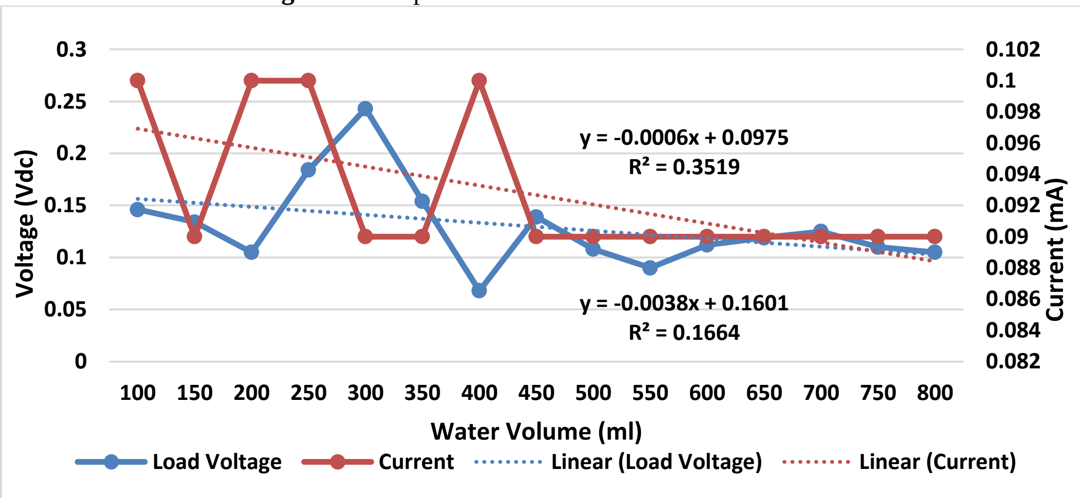

Figure 16. Graph of the 2nd Test of Gandoriah Beach

The results of the data obtained on the Gandoriah beach seawater chart which is shows the no-load voltage of a volume of 100-800 ml producing 0.144 volts - 0.115 volts and the data results show a load voltage of 0.146 volts - 0.105 volts from a volume of coastal sea water of 100-800 ml in indicates a current of 0.10 mA – 0.09 mA from a seawater volume of 100-800 ml. It can be used in calculating the load voltage equation (2.9) for the electrical or power characteristics of each volume of sea water of 300 ml as follows: suppose cos φ = 1 p = v x I x cos φ P = 0.243 x 0.10 x 1 P = 0.0243 watt .

4.8 Results of the 2nd Test With Six Electrode Pairs of 94.5 cm^2 Tiku Beach Seawater

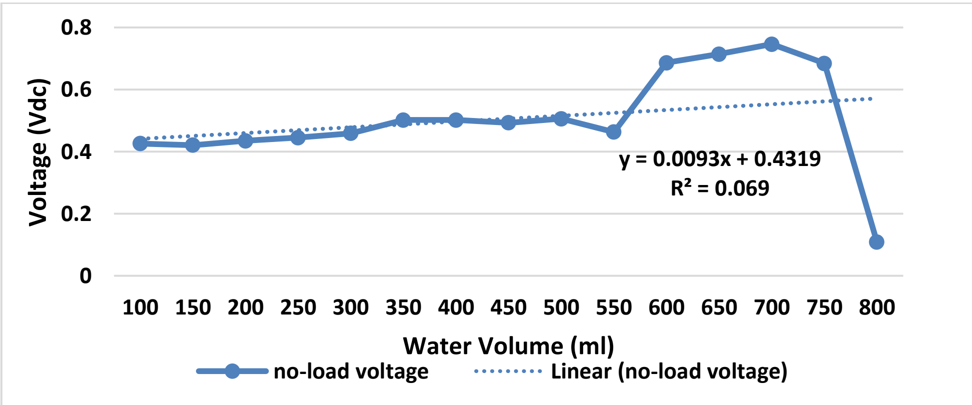

Figure 17. Graph of the 2nd Test Tiku Beach

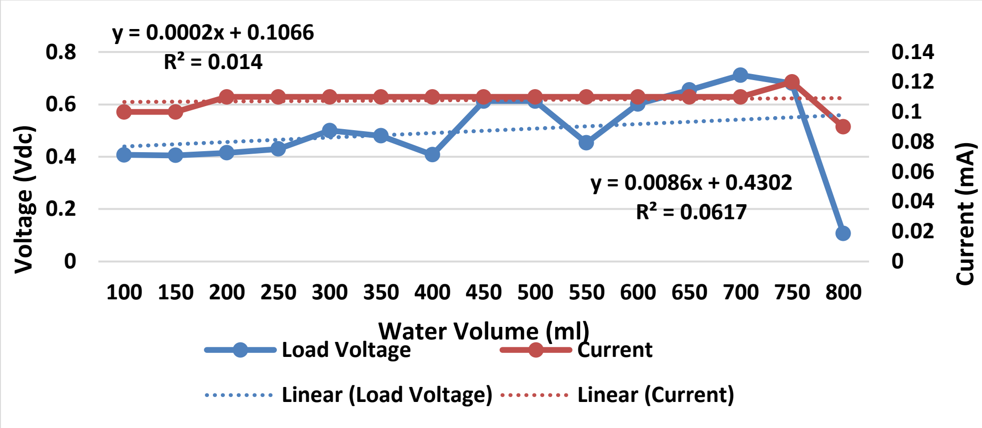

Figure 18. Graph of the 2nd Test Tiku Beach

The results of the data obtained from the Tiku beach seawater graph show the no-load voltage from a volume of 100-800 ml producing 0.426 volts – 0.109 volts and the data results show a load voltage of 0.407 volts – 0.107 volts from a volume of seawater 100-800 ml in indicates a current of 0.10 mA – 0.09 mA from a volume of 100-800 ml of sea water. Can be used in the calculation of the load voltage equation (2.9) the electrical or power characteristics for each volume of sea water of 700 ml as follows: suppose cos φ = 1 p = v x I x cos φ P = 0.712 x 0.11 x 1 P = 0.07832 watt.

4.9 Results of Comparison of Power Generated by Gandoriah Beach Sea Water and Tiku Beach Sea Water

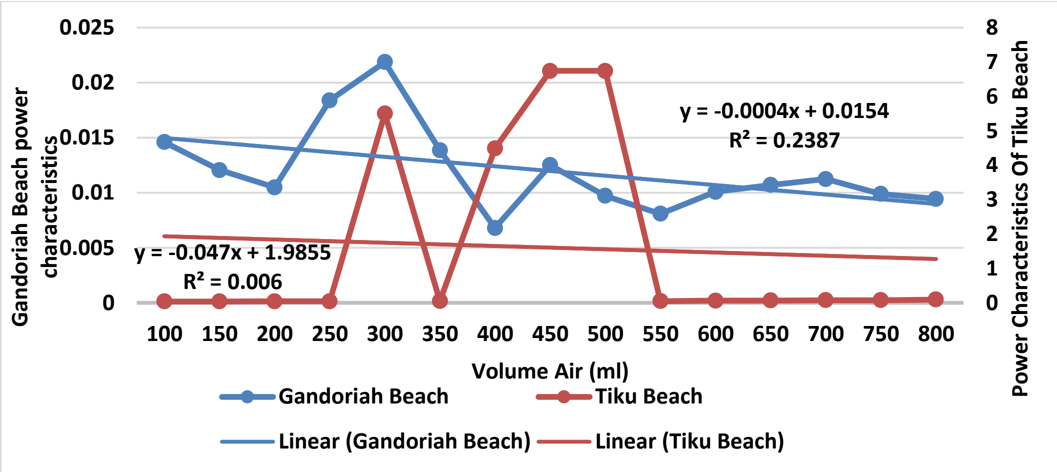

Figure 19. Power Graph

Result -2 is the power graph obtained from the Gandoriah seawateras a result of the volume of seawater 100-800 ml beach has 0.0146 watt - 0.00945 watt and the power graph is in Tiku beach sea water volume of 100–800 ml produces 0.0407 watt – 0.0963 watt power.

4.10 Results of the 3rd Test With a 56 cm^2 Ten Cell Electrode Pair Gandoriah Beach Seawater

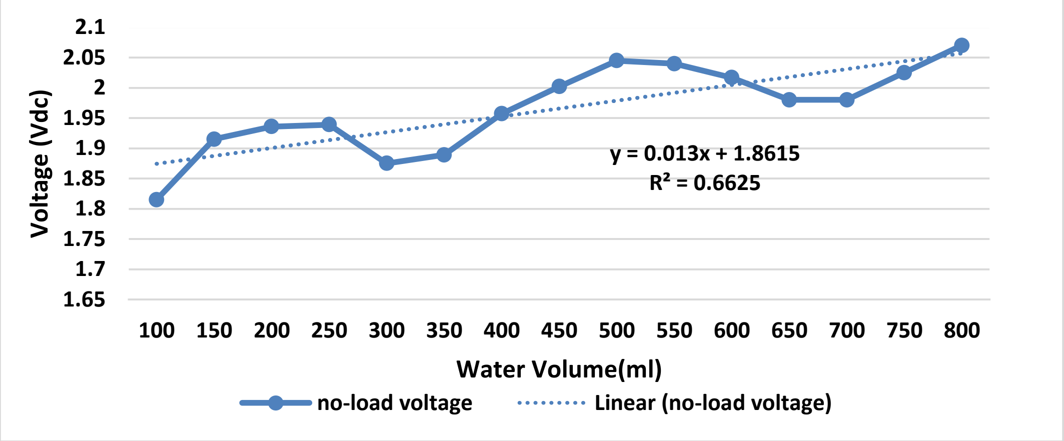

Figure 20. Graph of the 3rd Test of Gandoriah Beach

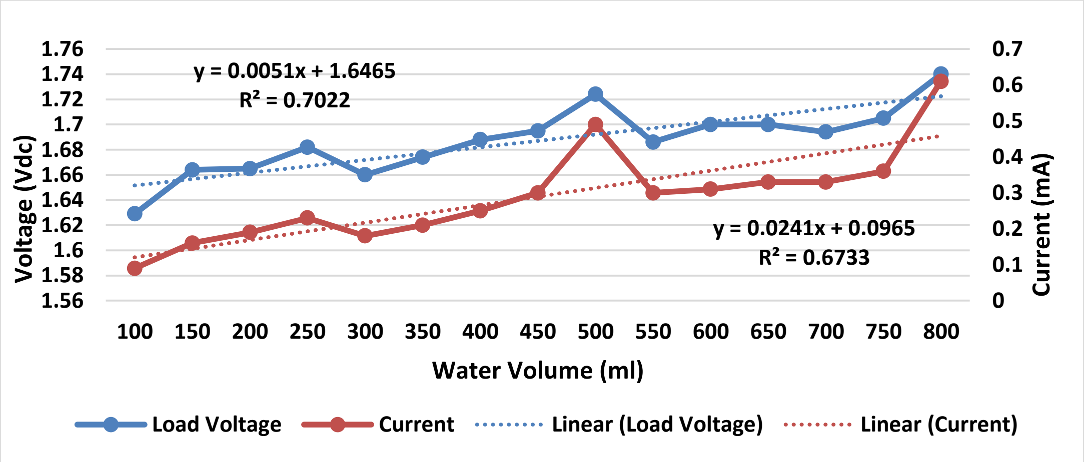

Figure 21. Graph of the 3rd Test of Gandoriah Beach

The results of the data contained in the Gandoriah beach seawater chart which is shows the no-load voltage of a volume of 100-800 ml producing 1,815 volts - 2,070 volts and the data results show a load voltage of 1,629 volts - 1,740 volts from a volume of coastal sea water of 100-800 ml in indicates a current of 0.09 mA – 0.61 mA from a seawater volume of 100-800 ml. Can be used in voltage calculations load equation (2.9) the electrical or power characteristics for each volume of sea water of 800 ml t as follows: for example cos φ = 1 p = v x I x cos φ P = 1,740 x 0.61 x 1 P = 1,061.4 watts.

4.11 Results of the 3rd Test With a 56 cm^2 Ten Cell Electrode Pair Tiku Beach Seawater

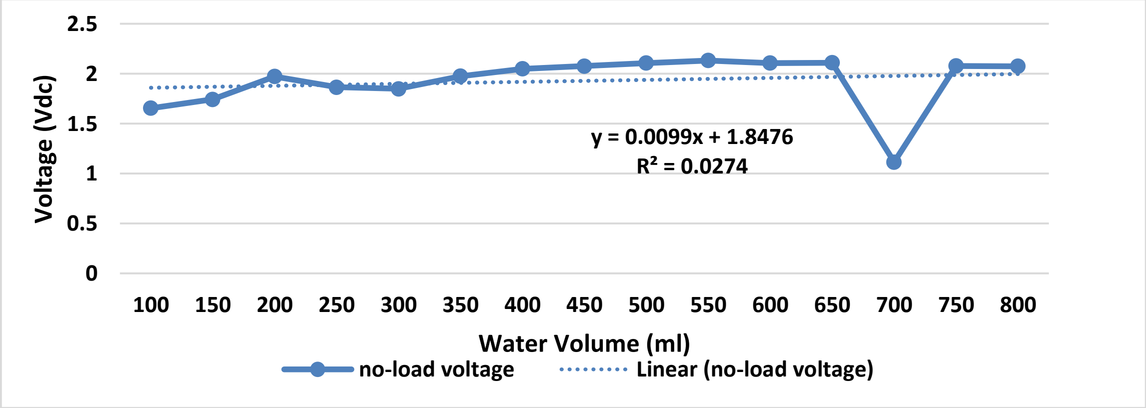

Figure 22. Graph of the 3rd Tiku Beach Test

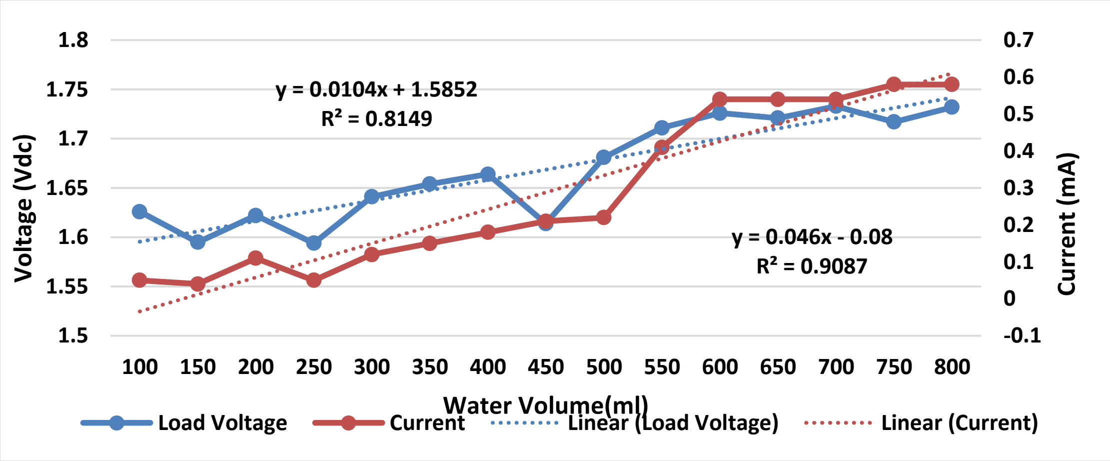

Figure 23. Graph of the 3rd Tiku Beach Test

The results of the data contained in the Tiku beach seawater graph show the no-load voltage of a volume of 100-800 ml producing 1,655 volts - 2,077 volts and the data results show a load voltage of 1,626 volts - 1,717 volts from a volume of coastal sea water of 100-800 ml in indicates a current of 0.05 mA – 0.58 mA from a volume of 100-800 ml of seawater. Can be used in the calculation of the load voltage equation (2.9) the electrical or power characteristics of each 800 ml sea water volume as follows: for example cos φ = 1 p = v x I x cos φ P = 1.732 x 0.58 x 1 P = 1.004.56 watts.

4.12 Results of Comparison of Power Generated by Gandoriah Beach Sea Water and Tiku Beach Sea Water

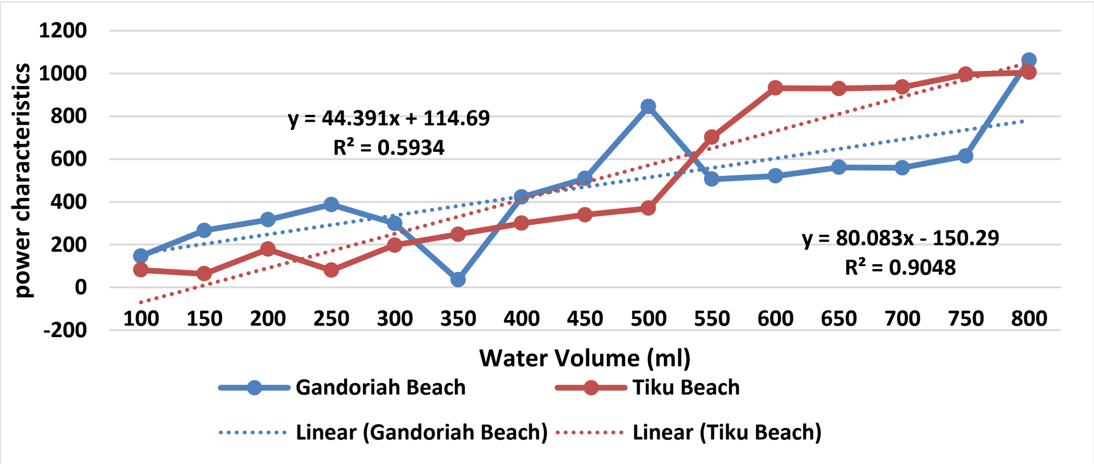

Figure 24 . Power Graph

Results -3 which obtained power graph from Gandoriah beach seawater as a result of a volume of 100–800 ml seawater having a volume of 146.61 watt – 1,061.4 watt and power graph in Tiku seawater volume of 100–800 ml producing power 81.3 watts – 1,004.56 watts.

4.13 Calculation Results Of Led ResistanceValues From Gandoriah Beach Seawater And Tiku Beach Seawater

The use of LEDs in this experiment aims to measure the brightness and dimness produced by electrodes which have a cross-sectional area of 56 cm^2 and 94.5 cm. Equation (2.6) below uses the properties of the LED resistance value. The voltage and current used are the highest values from the experiments that have been carried out. The classification of the type of red LED is 1.8 Volts with a maximum voltage of 2.3 Volts in a current resistance of 20 mA used in research.

R = $(Vs - Vled)/I$

R = Resistor value (ohms)

Vs = Input voltage (volts)

Vled = Voltage on the LED (volts)

I = LED forward current (amperes)

1) In the 1 st test, find out how much resistance is in seawater at Gandoriah beach and seawater at Tiku beach with a volume of 800 ml and 600 ml.

Vs	= 1.752 V	Vs	= 1.738 V
Vled	= 1.8 V	Vled	= 1.8 V
I	= 0.33 mA	I	= 0,33 mA
R	$= (\mathrm{Vs} - \mathrm{Vled})/\mathrm{I}$	R	$= (\mathrm{Vs} - \mathrm{Vled})/\mathrm{I}$
R	$= (1.752\ \mathrm{V} - 1{,}8\ \mathrm{V})/(0.33\ \mathrm{mA})$	R	$= (1.738\ \mathrm{V} - 1{,}8\ \mathrm{V})/(0.33\ \mathrm{mA})$
R	$= (1.750.2\ \mathrm{mA})/(0.33\ \mathrm{mA})$	R	$= (1.736.2\ \mathrm{mA})/(0.33\ \mathrm{mA})$
	= 5.303 Ω (Gandoriah)		= 5.261 Ω (Tiku)

2) In the 2nd test, find out how much resistance is in seawater at Gandoriah beach and seawater at Tiku beach with a volume of 300 ml and 700 ml.

Vs	= 0.243 V	Vs	= 0.712 V
Vled	= 1.8 V	Vled	= 1.8 V
I	= 0.09 mA	I	= 0.11 mA
R	$= (\mathrm{Vs} - \mathrm{Vled})/\mathrm{I}$	R	$= (\mathrm{Vs} - \mathrm{Vled})/\mathrm{I}$
R	$= (0.243\ \mathrm{V} - 1.8\ \mathrm{V})/(0.09\ \mathrm{mA})$	R	$= (0.712\ \mathrm{V} - 1.8\ \mathrm{V})/(0.11\ \mathrm{mA})$
R	$= (241.2\ \mathrm{mA})/(0.09\ \mathrm{mA})$	R	$= (710.2\ \mathrm{mA})/(0.11\ \mathrm{mA})$
	= 2.680 Ω (Gandoriah)		= 6.456 Ω (Tiku)

3) In the 3rd test, find out how much resistance is in seawater at Gandoriah beach and seawater at Tiku beach with a volume of 800 ml and 700 ml.

Vs	= 1.740 V	Vs	= 1.733 V
Vled	= 1.8 V	Vled	= 1.8 V
I	= 0.61 mA	I	= 0.54 mA
R	$= (\mathrm{Vs} - \mathrm{Vled})/\mathrm{I}$	R	$= (\mathrm{Vs} - \mathrm{Vled})/\mathrm{I}$
R	$= (1.740\ \mathrm{V} - 1.8\ \mathrm{V})/(0.61\ \mathrm{mA})$	R	$= (1.733\ \mathrm{V} - 1.8\ \mathrm{V})/(0.54\ \mathrm{mA})$
R	$= (1.738.2\ \mathrm{mA})/(0.61\ \mathrm{mA})$	R	$= (1.731.2\ \mathrm{mA})/(0.54\ \mathrm{mA})$
	= 2.849 Ω (Gandoriah)		= 3.205 Ω (Tiku)

V. CONCLUSION

By using copper electrodes (cathode) and nickel battery electrodes (anode) arranged in series in a seawater electrolyte solution consisting of six cells (six pairs of electrodes), a maximum load voltage of 1.752 Volts and a maximum current of 0.33 mA are measured in series. and the cross-sectional area of the electrode is 56 cm^2. Then the cross-sectional area of the electrode is 94.5 cm^2 achieved by using copper electrodes (cathode) and pure nickel electrodes (anode) arranged in series in a seawater electrolyte solution consisting of six cells (six pairs of electrodes), the maximum load voltage is 0.712 Volt and the maximum current is 0.12 mA and the solution seawater electrolyte consisting of ten cells (ten pairs of electrodes), copper electrodes (cathode) and battery nickel electrodes (anode) arranged in series to produce a maximum load voltage of 1.740 volts and a maximum current of 0.61 mA, and an electrode cross-sectional area of 56 cm^2.

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