FEASIBILITY STUDY ON EFFECTIVENESS LARGE SURFACE AREA OF ELECTRODE FOR EARTH BATTERY

MUHAMMAD IZZUDDEEN BIN KHAZALI

A report submitted in partial fulfilment of the requirement for the degree of Bachelor of Electrical Engineering (Power Industry)

Faculty of Electrical Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2015

"I hereby declared that I have read through this report entitle "*Feasibility Study on Effectiveness Large Surface Area of Electrode for Earth Battery*" and found that it has comply he partial fulfilment for awarding the degree of *Bachelor of Electrical Engineering (Industrial Power)."*

Signature : ……

Supervisor's Name : ……

Date : ……

To my beloved mother and father

ACKNOWLEDMENT

In the name of Allah, The Most Beneficent, The Most Merciful.

Praise be to Allah for His bless and kindness for giving me strength to me to complete this report. I would like to give thank you to those who have helped me a lot in completing this report the title is "*Feasibility Study on Effectiveness Large Surface Area of Electrode for Earth Battery".* I have put a lot of effort in completing this report. I also would like to recommend a say thank you to my supervisor Madam Anis Niza Binti Ramani whom supervised me to complete my case study and completing the report. I would like to grateful to my panel Miss Arfah Binti Ahmad and Mr. Mohamad Faizal Bin Baharom because give some advice and knowledge to complete my report.

Next, I would like to recommend a say thank you to my friends who help me a lot in doing this report. I would like to recommend a say thank you to my family who give me moral supports to complete my studies in this final year project research. Not only that, I would like to recommend a say thank you to Allah, for giving me the good healthy body for me to survive. Furthermore, I would prefer to send thank you to my classmates and UTeM staffs for all the helps and effort that they have help me to complete my final year project studies and completing my report. Lastly, I would like to recommend a say thank you to those who have helped me directly or indirectly in completing this report.

I declare that this report entitle "*Feasibility Study on Effectiveness Large Surface Area of Electrode for Earth Battery*" is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : ……

Name : ……

Date : ……

ABSTRACT

Earth battery is one of the alternative energy that produces the electricity. Basically the operation of the earth battery is the production of electrical energy from chemical reaction between two type of material of the electrode and the organic soil as the electrolyte medium. The objectives of this project are to determine the best distance between two electrodes and to investigate the effect of depth of the electrode in soil. Besides that, this project investigates the effect of moisture content on the soil and the duration of the wet soil battery. The type of material of electrode that used in this experiment are aluminium (Al) and copper (Cu). Other than that, the type of soil that used in this earth battery is organic soil. The arrangement of the battery cell is in cascade connection and the total cells in this experiment are 25 cells. The consideration of the distance between two electrode, the depth of electrode in the soil, the condition of the soil whether dry or wet and the measurement output value for every 12 hours for wet soil battery must take and controllable in order to get the output voltage and current. It can be concluded that the voltage value and current produced form earth battery are related with distance between two electrodes and depth of electrode in the soil.

ABSTRAK

Bateri tanah adalah salah satu tenaga alternatif yang boleh menghasilkan tenaga elektrik. Pada asasnya operasi bateri tanah adalah penghasilan tenaga elektrik daripada tindak balas kimia antara dua jenis bahan elektrod dan tanah organik sebagai medium elektrolit. Objektif projek ini adalah untuk menentukan jarak yang terbaik di antara dua elektrod dan untuk mengkaji kesan kedalaman elektrod di dalam tanah. Selain itu, projek ini mengkaji kesan kandungan kelembapan di dalam tanah dan tempoh bateri tanah yang basah. Jenis bahan elektrod yang digunakan dalam eksperimen ini ialah aluminium (Al) dan tembaga (Cu). Selain daripada itu, jenis tanah yang digunakan dalam bateri tanah ini adalah tanah organik. Susunan sel-sel bateri adalah selari dan jumlah sel-sel dalam eksperimen ini adalah 25 sel bateri. Jarak di antara dua elektrod, kedalaman elektrod di dalam tanah, keadaan tanah sama ada kering atau basah dan nilai output pengukuran untuk setiap 12 jam untuk bateri tanah yang basah mesti diambil kira dan dikawal untuk mendapatkan voltan keluaran dan arus. Dapat disimpulkan bahawa nilai voltan dan arus bateri tanah adalah berkaitan dengan jarak di antara dua elektrod dan kedalaman elektrod di dalam tanah.

TABLE OF CONTENTS

LIST OF TABLE

LIST OF FIGURE

LIST OF SYMBOL

A	-	Ampere
C	-	Celsius
Cu	-	Copper
d, D	-	Diameter
r	-	Radius
Al	-	Aluminium
K	-	Potassium
s	-	Cross sectional area
FYP	-	Final Year Project
I	-	Current
ℓ	-	Length
m	-	Meter
RH	-	Relative Humidity
R	-	Resistance
SV	-	Supervisor
σ	-	Electrical conductivity
V	-	Potential difference/ voltage

π	-	Pi
ρ	-	Soil Resistivity
Ω	-	Ohm
W	-	Power (Watt)
cm	-	Centimetre
mm	-	Millimetre
h	-	Height
DC	-	Direct Current

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Research background

Earth battery is one of the alternative energy that can be used to produce the electricity. The meaning of the earth battery is the combination of clay soil and electrode such as cooper electrode (Cu) with zinc electrode (Zn) or other metal that can produce potential difference (V) and current (A). The high value of the conductivity and electricity can affect output voltage [17].

Soil resistivity is defined as the resistivity of the soil in the flow of electricity. The SI unit is Ohm-Meter (Ω/m). Each type of soil has different value of the resistivity. The soil resistivity value is depending on moisture, temperature, and chemical content in the soil. The characteristic of the soil that used in this project is low resistivity and high moisture. If the soil resistivity is low, the easier the electricity can flow through the system.

Metal is an element, compound or material that has a conductor of electricity and heat. Metal are usually shiny, hard, malleable and ductile. The high value of conductivity and electricity can affect output voltage and current of the design system. The combination of soil and electrode can produce potential difference and this called earth battery.

The arrangement of the earth battery is divided into three parts. The arrangement is in series, parallel, and cascade. For the general knowledge, the voltage of the series connection is increase while the current is same. But for the parallel connection is reverse than series, which are the current is increase while the voltage is same. Meanwhile for cascade connection can control both output voltage and output current.

1.2 Problem Statement

The use of the normal battery or dry cell leads to the greenhouse effect. The environment will contaminated because of the mercury, silver, lithium, cadmium, lead and acid in dry cell or normal battery. If these batteries are burned or land filled, the heavy metals in prototype can affect the environment. Although the value of the output voltage of this battery is higher compared to soil battery or earth battery but the effect face in the long term is harmful. Therefore, by using earth battery will be reducing the greenhouse effect and give benefit to the green technology. However, earth battery produce low voltage compared to the dry cell battery. Therefore earth battery is only use for small load.

1.3 Objectives

The main objectives of this research are:

i. To determine the best distance between two electrode.
ii. To investigate the effect of depth of electrode in the soil on the output current and voltage.
iii. To investigate the effect of moisture content on the soil to the output current and voltage.
iv. To investigate the performance of wet soil battery.

1.4 Scope

This project only involve in determining the effect of distance between two electrode and depth of electrode in the organic soil. The distances between two electrodes and the depth of the electrode in the soil that use in this project are 1 cm, 2 cm, 3 cm and 4 cm. The material of the electrode that be used in this project are copper (Cu) and aluminium (Al). The size of the width and the length of electrode that used in this project are 2.5 cm and 5 cm respectively. Total amount of batteries cell that used in this experiment is 25 cells batteries. For one battery cell contained 117.8 $cm^3$of organic soil. The equipment that be used in this project are digital multimeter and temperature humidity meter. Besides that, the experiment also used to study on moisture content that affecting the performance of earth battery in term of current and voltage. The amount of water that use for each cell is 6 ml for wet soil condition. The measurement of output value will recorded for every 12 hours in 4 days to investigate the performance of wet soil battery.

1.5 Thesis Outline

This research has 5 chapters. Introduction is the first chapter which contain motivation, problem statement, research objective and scope of the research. In first chapter describe what the issues of the problem arise; the objective and scope will guide the researcher from off topic. In Chapter 2, Literature Review contains a lot of paper, journal, conference, previous research and technical manual that related to the project. There are several topics that related to this research which are soil resistivity testing, material of electrode, type of soil and reactivity of the electrode. Methodology is in Chapter 3. Methodology describes the flow of the research and analysis parts are proceeding. The list of equipment and research setup procedure is parts of methodology. Another part of methodology is discussing the testing procedure, measurement parameter and analysis part. Result and Discussion are in Chapter 4. All of measured data will be recorded and data are analysed. The last chapter is Chapter 5. This chapter is Conclusion

and Recommendation. This chapter will state the significant conclusion and give some recommendation to improve for further research.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter will present the past article that related with this project. This case study review about the type of soil used for earth battery, potential difference or voltage output of two metal electrode that have been choose, the depth of the electrode in soil and the distance between two electrode. Basically literature review will expose the previous work to understand this project. Literature review also helps to find overall information about earth battery to make sure the objective of this project is fulfilled.

Basically the operation of the earth battery is the production of electrical energy from chemical reaction between two type of material of the electrode and the organic soil as the electrolyte medium. The effect for this reaction will change the chemical reaction to electrical energy.

2.2 Soil resistivity

Soil resistivity is a measure of how much the soil resists the flow of electricity. It is a critical factor in design of systems that rely on passing current through the Earth's surface. The soil resistivity is a basic parameter necessary for design of effective grounding and lighting protection system. The characteristic of soil also include as the different layers in the substance, the function of their porosity, permeability, ionic content and mineral. Soil resistivity is consisting of the moisture of soil. The moisture of the soil is the greatest impact on resistivity [8]. Figure 2.1 show one of the type soil resistivity testing.

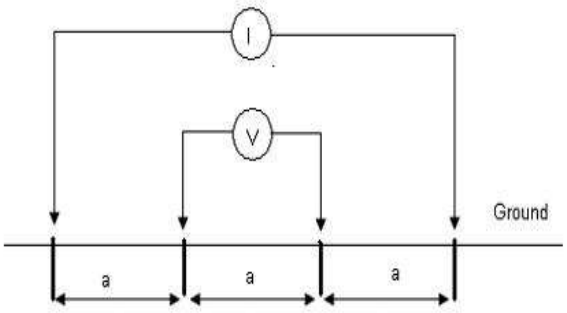

Figure 2.1: Soil resistivity testing [10]

2.3 Material of the electrode

The next parameter to be considered is the type of electrode. Generally, materials have characteristics behaviour of resisting the flow of electrical charge. The ability to resist current is one of the physical properties that used to conduct electricity. Metal is used because it has high conductivity and electricity value. Different type of electrode gives different value of potential difference. Electrode selection is based on the conductivity value of a material. In this part, to increase the voltage, the electrode used must have features such as low resistivity, high conductivity, and high melting point and durable [5]. There are four metal used to investigate the electrical conductivity of the DC supply from organic soil which are copper, aluminium, brass and gold as shown in Figure 2.2.

(a) Copper electrode

(b) Aluminium electrode

(c) Brass electrode

(d) Gold electrode

Figure 2.2: Types of electrodes [5-7]

Copper is a metal which an excellent electrical conductivity because copper are in group 11 of the periodic table where copper have high ductility and electrical conductivity. The colour of copper is red brown. Copper also is a ductile metal. It can be easily being shape for example in cable wire which has many type of size. In market, copper metal is very high compared to the aluminium and brass [6].

Aluminium is soft, durable, lightweight, ductile and malleable metal with appearance ranging from silvery to dull grey, depending on the surface roughness. It is nonmagnetic and does not easily ignite. Aluminium has about one-third the density and stiffness of steel. It is easily machined, cast, drawn and extruded. Aluminium is a good thermal and electrical conductor, having 59% the conductivity of copper, both thermal and electrical conductivity, while having only 30% of copper's density. Corrosion resistance can be excellent due to a thin surface layer of aluminium oxide that forms when the metal is exposed to air, effectively preventing further oxidation. The strongest aluminium alloys are less corrosion resistant due to galvanic reactions with alloyed copper [7].