UNIVERSITI TEKNIKAL MALAYSIA MELAKA

EXPERIMENTAL ANALYSIS OF EARTH BATTERY USING DIFFERENT COMBINATION OF METALLIC AND NON-METALLIC SOLID

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree in Electrical Engineering

(Power Industry)

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2015

"I hereby declare that I have read through this report entitle "Experimental Analysis of Earth Battery Using Different Combination of Metallic and Non-Metallic Solid" and found that it has complied the partial fulfilment for awarding the degree of Bachelor of Electrical Engineering (Industrial Power).

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2015

"I declare that this report entitle Experimental Analysis of Earth Battery Using Different Combination of Metallic and Non-Metallic Solid" is the result of my own 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 : MUHAMMAD SYAHMI BIN ZAINUDDIN`

Date : ……

DEDICATION

Specially dedicated to my beloved mother and father, friends and also my supervisor Puan Anis Niza Binti Ramani who always give me strength, guidance, and encouraged throughout my journey of education

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I, Muhammad Syahmi Bin Zainuddin have taken efforts in this project "Experimental Analysis of Earth Battery Using Different Combination of Metallic and Non-Metallic Solid". However, it would not have been possible without then kind support and help of many individuals and organizations. I would like to extend my sincere thanks to all of them.

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ABSTRACT

Soil has been proven it is capable to generate electricity. Numerous studies have been made regarding its capability of doing so. This is possible through the earth battery concept. Different research successfully applied it making LED's work. In this project, condition of soil, combination of electrode, and type of connection had been conclude. Diverse mixes of metallic and non-metallic solid were examined for most extreme potential energy. Material that will be used are copper, zinc, carbon and lead. Result show the best combination of electrode are zinc and copper. The voltage level was found to increment directly by change the combination of material. Other than that, voltage and current were found to increase by the wet condition of the soil. The humidity also give effect of measurement as the higher humidity, the increment of voltage and current will occur. Operation of earth battery as a free power source was exhibited effectively. Additionally, it is important to find way on the most proficient method to build the ability to be created by an earth battery.

ABSTRAK

Telah dibuktikan bahawa tanah mampu mengalirkan arus elektrik. Pelbagai kajian telah dilakukan untuk membuktikan kemampuan tersebut. Ini dapat dibuktikan dengan konsep bateri tanah. Pelbagai kajian telah berjaya dibuktikan dalam menyalakan LED. Di dalam projek ini, keadaan tanah, kombinasi elektrod dan jenis sambungan telah disimpulkan. Pelbagai gabungan logam dan bukan logam telah dikaji untuk tenaga keupayaan ekstrem. Bahan yang akan digunakan adalah kuprum, zink, karbon dan plumbum. Keputusan kajian menunjukkan kombinasi electrod yang terbaik adalah zink dan kuprum. Peningkatan voltan telah dikenalpasti dengan mengubah kombinasi bahan. Selain daripada itu, kondisi tanah lembab telah dikesan dapat meningkatkan voltan dan arus. Kelembapan juga memberi kesan terhadap bacaan dimana tinggi darjah kelembapan, peningkatan arus dan voltan berlaku.Operasi menentukan bateri tanah sebagai sumber tenaga asli telah berjaya dibuktikan. Tambahan pula, ianya penting untuk mencari langkah terbaik dalam membina keupayaan bateri tanah.

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LIST OF SYMBOLS

Cu	-	Copper
Pb	-	Lead
Zn	-	Zinc
C	-	Carbon
G	-	Gravel
S	-	Sand
W	-	Well graded
P	-	Poorly graded
Pu	-	Uniform
Pg	-	Gap graded
F	-	Fines soil
M	-	Silt (M-soil)
C	-	Clay
L	-	Of low plasticity
I	-	Of intermediate plasticity
H	-	Of high plasticity
V	-	Of very high plasticity
E	-	Of extremely high plasticity
U	-	Of upper plasticity range
Ca	-	Calcium
Mg	-	Magnesium
K	-	Potassium
Na	-	Sodium
NH4	-	Ammonium
H	-	Hydrogen

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CHAPTER 1

INTRODUCTION

1.1 Project Background

Earth battery was construct by Scottish inventor Alexander Bain in 1841. This invention was first used to power his electric clock. The combination the plates that he used is zinc and copper. An earth battery is the simple homemade cell. Almost any liquid or moist object that has enough ions to be electrically conductive can serve as the electrolyte can serve as the electrolyte for a cell [1]. Production of small amount of electricity can be demonstrate by insert two electrodes into a lemon, potato and glass of soft drink. These homemade cells are of no real practical use because it just can produce small current and cost far more per unit energy generated than commercial cells. Earth batteries were used around the end of the 19^{th} and beginning of the 20^{th} century to power telegraph lines. They were buried in convenient locations along the power lines and supplied free for that infrastructure. The technology was discarded and replaced with hydroelectric because hydro was a measurable, finite source that industry could use to make money.

The earth battery bears resemblance to the common chemical or acid battery. Basically, the battery consist of two metal sheets or rods; one copper or carbon and the other zinc or aluminium. These metals are present as positive and negative terminal of the battery. An earth battery acts as the electrolyte system in voltaic cell because the conductive plates from different location are buried in the ground. This cell operating just like operating devices, these devices were not continuously reliable owing to drought condition. To obtain natural electricity, experiment would thrust two metal plates into the ground at a certain distance from each other in the direction of a magnetic meridian or astronomical meridian [2].

Notwithstanding, earth soil compound responses and electron partiality based earth batteries may be investigated for low to high voltage DC potential. Besides that, it also can considered to supplant high voltage low current charging force supplies or ionization power supplies. Like earth batteries the sea batteries likewise may be considered for comparable applications. Nonetheless, air batteries can be utilized for mass force creation and matrix framework operation. It has turn out to be essential to search for option vitality sources to keep down mankind from engagement to an awesome vitality war

1.2 Problem Statement

Nowadays, many type of generation were used to generate electricity in daily life. The generation can be generating by renewable source and non-renewable source. Example of renewable generation are wind generation, solar generation and hydro generation while non-renewable generation are comes from fossil fuel and nuclear fuel. The generation from the renewable source is very expensive and make a lot of cost to construct it. There has an alternative way to reduce the cost and generate electricity by using soil. It is very easy to construct and also pollution free. Other than that, relationship between combinations of material utilized as a part of the setup and the measure of voltage produce need to consider wisely. Besides that, it is important to know the relationship between the types of connection to generate lots of energy.

1.3 Objective

This objectives of this project are:

i. To determine the best type of electrode that will give better generation of the electricity.
ii. To investigate the effect of metal and non-metal electrode when connect with the load in different types of connection
iii. To explore the effect of moisture in different condition of soil.
iv. To analyse the performance electricity of earth battery.

1.4 Scope of work

This research project will focus primarily toward zinc and copper as the combination of the electrode that will be used in Earth battery. This is because the, copper and zinc have tendency that will produce high voltage, current and power. Besides that, zinc, graphite and lead also were used to find the best combination of electrode. This project will be attempt in five days and the reading will be measure five times.

Furthermore, the soil that will be used in this research is organic soil. Due to this, organic soil is the best type of soil because of the moisture of organic soil is very moist and can stand the moist condition in several day and also it is very easy to find. The selection of soil also will affect the production of voltage, current and power. Moreover, the effect of soil in temperature and humidity also will done. Additionally, the test will be done in ice cube and the distance between two materials have been fix. The distance would be use is 40mm.

1.5 Thesis outline

Chapter 1 of this report are discussed about the introduction of the research. This includes the abstract, project background, problem statement, objectives and scope of the study. Chapter 2 of this report is discussed about the literature review. This chapter present an overview of the research from introduction of earth battery, material of electrode, type of soil and galvanic cells. Furthermore, Chapter 3 discuss about the research methodology. This including the technique used, the procedures need to be complied and also describe the flow of the research and analysis parts are proceeding. Chapter 4 is discussed on the result and discussion. Chapter 5 will discuss about conclusion. It also includes the recommendation of the project.

CHAPTER 2

LITERATURE REVIEW

2.1 Theory and Basic Principle

A simple explanation of earth battery is that it is a water activated battery. When the distances of the two plates are far from each other, it can tap an electric current that moves underground or through the sea. An Earth battery is a pair of electrodes made of two dissimilar metals, such as iron and copper. It consists of conductive plates from different locations in the electro potential series, buried in the ground so that the soil acts as the electrolyte in a voltaic cell. As such, the device acts as a rechargeable battery [2].

At the point when sample of two plates, for example, zinc and copper are joined together through a substance that permit electrical current to stream and an electrochemical reaction procedure is started. When the procedure of plates are connect together with the right condition of soil, the electrochemical reaction occur to ensues production zinc ions from the zinc metal which travel through the ground toward the copper terminal. The chemical reaction of zinc will affect the plant and topsoil but it also affect groundwater, so it is important to limit the amount of zinc [3].

The soil is an unutilized chamber of natural energy. The chemical reaction in the soil produce independent ions which are left unresolved. The soil take actions as an electrolyte with two dissimilar electrodes buried in the soil and thus produce a potential difference. This process is called an 'earth cell'. To increase the voltage, connection in series is needed whereas to increase the current, connection in parallel should be done. Earth battery consists of electrodes buried in the earth, as therefore constructed, have not been capable of giving an electromotive force greater than that obtainable from a single couple.

2.2 Soil Groups

Soils consist of one or more distinct layers called horizons. These layers are alluded to as O, A, E, B, C and R relying upon their position and nature [2]. Figure 2.1 show the layer of the soil.

- O: Layers overwhelmed by natural material. Generally not introduce under warm-dry conditions.
- A: The mineral soil horizon that is as a rule at the surface or beneath an O horizon. It more often than not has more natural carbon than hidden layers. In some cases this layer is missing or truncated because of disintegration or evacuation. Likewise, all surfaces coming about because of furrowing, feeding, or comparable aggravations are alluded to as A horizon.
- E: Horizon characterized by eluviation (removal of materials such as silicate clay, iron, aluminium, or organic matter), if distinct from the A horizon. Frequently not present. Usually more pale coloured than the A horizon.
- B: A skyline, framed underneath An, E, or O skyline, which is ruled by demolition of all or quite a bit of the first shake structure and which shows proof of soil development, for example, alluvial (moved down from an above skyline) amassing of silicate dirt, iron, aluminium, humus, carbonates, gypsum, or silica; improvement of soil shading or structure; or weakness, and so on.

- C: Horizons or layers, barring hard bedrock, that are minimal influenced by pedogenic (soil framing) procedures what's more, that need properties of O, A, E or B skylines.
- R: Hard bedrock

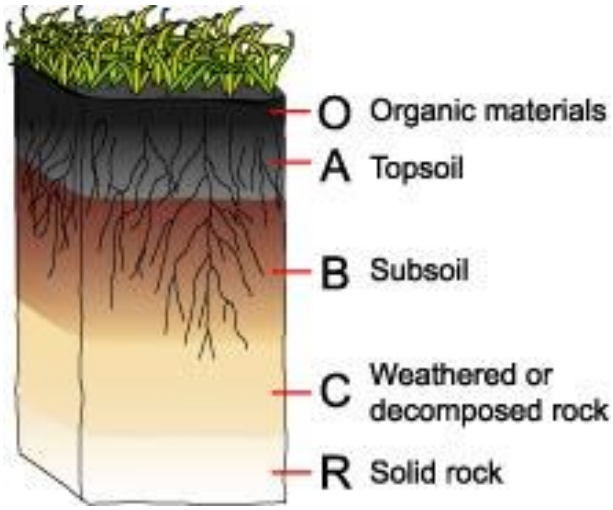

Figure 2.1 Layer of soil [4]

Table 2.1 shows the soil groups which is coarse soils, fine soils and other soil. In the coarse soils, it consist of gravel and sand while the fine soils consist of silt and clay whereas the other soil is organic soil [5].

Table 2.1: Soil Group [6]

Coarse Soils		Fine Soil		Other Soil
Gravel	Sand	Silt	Clay	Organic Soils

2.2.1 Gravel and Sand

Gravel and sand contain of rock fragment of different sizes and shape that can be either rock fragment or single mineral. The term uniform was describe as the narrow range of particle sizes present while the broad range of particle sizes is describe as well graded [6].

2.2.2 Silt

Silt is the intermediate among fined sand and clay. Silt is less plastic and more permeable than clay. Quick behaviour in silt is the impulse of silt to liquefy when shaken or vibrate. Dilatancy is refer to the tendency to sustain volume increase when deformed [6].

2.2.3 Clay

Clay consist of particles with a grain size of less than 4 micrometre and present in properties of cohesion and plasticity. That properties are not present in gravel or sand. Cohesion is the fact that material will stick together whereas plasticity is the property that grant substance to be deformed without volume change or rebound and without cracking or crumbling [6].

2.2.4 Organic Soil

Organic soil is different category from coarse or fine soils and it does not behave like silt or clay if the organic content is high. When the content of the organic is small to moderate, it still contain the properties of silt or clays [6]. Organic matter comprises of dead plant parts and creature and microbial waste items in different phases of disintegration. In the long run, these things separate into humus, which is generally steady in the dirt.

2.2.5 Soil Conductivity

Soil conductivity is a measure of the amount of salt in the soil. Soil conductivity is an important material in an earth battery. Soil conductivity determines the output power of the cell. The conduction in dirt occur through the moisture-filled pores that happen between individual soils particles. Naturally excess salt in soils containing in arid and semiarid climates. Salts level in the soil can increase as a result of cropping, irrigation and land management [7]. Although soil conductivity does not give a direct measurement of specific ions or salt compounds, it has been correlated to the concentrations of nitrates, potassium, sodium chloride, sulphate and ammonia. Therefore, the electrical conductivity of soil is determined by the following soil properties [8].

a. Porosity: The higher soil porosity, the more efficiently electricity is conducted. Soil with lot clay content has bigger porosity than sandier soil.
b. Water content: Dry soil is much lessened in conductivity than moist soil.
c. Salinity level: Increasing absorption of electrolytes (salts) in soil water will dramatically increase soil electrical conductivity. The salinity level in most soils is very low.
d. Cation exchange capacity (CEC): Mineral soil containing high levels of organic matter (humus) and/or 2:1 clay minerals such as Montmorillonite , illite , or vermiculite have a much higher ability to retain positively charged ions (such as Ca, Mg, K, Na, NH4, or H) than soil lacking these constituents. The presence of these

ions in the moisture-filled soil pores will enhance soil electrical conductivity in the same way that salinity does.

e. Temperature: As temperature decreases toward the freezing point of water, soil electrical conductivity decreases slightly. Below freezing, soil pores become increasingly insulated from each other and overall soil EC declines rapidly.

When managing for salinity on irrigated land, irrigation water salinity must be measured. If the quantity of the irrigation is too small, it will difficult to leach salts but when the water that high with amount of salts, it will be allows salts to accumulate in the root zone and increasing electric conductor in the soil. Good soil management measures to maintain soil organic matter and overall soil health and must be utilized to maintain the desired soil electric conductor level [8].

2.2.6 British Soil Classification System (BSCS)

From the Table 2.2, soil can be classify into group symbols of main terms and qualifying term in type of soil component. In BSCS, the soil consider as fine soil when it contains more than 35% fines while less than 35%, it is regarded as coarse soil. The boundary in fine soil is 65% fines whereas the boundary subgroup in coarse soil, between gravel and sand is 50% of 20mm coarse size as shown in Table 2.3. Figure 2.2 shows the British standard range of particle size