I hereby declare that this report is the result of my own work except for quotes as cited in the references.

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Date : 15th MAY 2014

I hereby declare that I have read this and in my opinion this report is sufficient in term of the scope and quality for the award of Bachelor of Electronics Engineering (Computer Engineering)

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To my beloved father and mother
who always give me courage to finish this thesis

Also, to those people who have guided and inspired me throughout my journey.

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ABSTRACT

There has been a major increase in the global demand for energy in recent years as a result of industrial development and population growth. In Malaysia, studies have shown that electricity demand in Malaysia is on the rise, having gone from a weekly peak demand of 14,245MW in the last quarter of 2009 to 15,476MW in May 2011. This is expected to rise to more than 16,000MW in 2012, and to 20,847MW in 2020 and will continue to grow by about 3% every year until 2030 when it will reach 24,770MW. In this project, I have looked for other alternative to tackle the forthcoming electricity crisis by using salt. Beside making the food tastier salt is found to be able to generate electric energy. However, correlation between salt and electric energy is not well documented yet. Therefore, in this project such correlation will be investigated in two different angles, i.e., the size of electrodes used and the types of salt. This project is limited to 1 kilogram of salt. Each increment of salinity will be measured in 4 sizes of electrode (3cmx3cm, 5cmx5cm, 7cmx7cm and 9cmx9cm) and 3 types of salt (white, coarse and fine) used. I have found that the obtained voltage was increased as salt quantity (salinity) increased. Fine salt produce higher voltage in short period of time as compare to coarse salt as it is easily soluble in water and the chemical reaction was very fast compare to large size of salt as in coarse salt. White salt has small size which makes it soluble in water fast but that type of salt used as ingredient in foods where it has 20% less Sodium compare to other type of salt. These characteristic makes white salt produce low voltage compare to coarse salt and fine salt. The size of electrodes (aluminium and copper) was not significant with the correlation as there was no different in term of voltage produced in between different sizes of electrodes used. The results are visualised by using a visual basic interface which is informative, interactive and user friendly. Such findings could be useful for the development of the alternative energy using salt.

ABSTRAK

Sejak kebelakangan ini ,terdapat peningkatan besar dalam permintaan global bagi tenaga akibat daripada pembangunan industri dan pertambahan penduduk. Di Malaysia , kajian menunjukkan bahawa permintaan bekalan elektrik di Malaysia semakin meningkat , setelah dari permintaan puncak mingguan 14,245 MW pada suku terakhir 2009 kepada 15.476 MW pada Mei 2011. Ini dijangka meningkat kepada lebih daripada 16,000 MW pada 2012, dan kepada 20.847 MW pada tahun 2020 dan akan terus menaik sebanyak kira-kira 3% setiap tahun sehingga 2030 apabila ia akan mencapai 24.770 MW. Dalam projek ini , saya telah mencari alternatif lain untuk menangani krisis elektrik yang akan datang dengan menggunakan garam. Selain membuat makanan sedap, garam didapati dapat menjana tenaga elektrik. Walau bagaimanapun, hubungan antara garam dan tenaga elektrik tidak didokumentasikan . Oleh itu, dalam projek ini hubungan itu akan disiasat dalam dua sudut yang berbeza, iaitu saiz elektrod yang digunakan dan jenis garam. Projek ini adalah terhad untuk 1 kilogram garam. Setiap kenaikan kemasinan akan diukur dengan menggunakan 4 saiz elektrod (3cmx3cm , 5cmx5cm , 7cmx7cm dan 9cmx9cm) dan 3 jenis garam (putih , kasar dan halus) digunakan . Saya telah mendapati bahawa voltan yang diperolehi telah meningkat dengan kuantiti garam (kemasinan) meningkat . Garam halus menghasilkan voltan yang lebih tinggi dalam masa yang singkat berbanding dengan garam kasar kerana ia adalah mudah larut dalam air dan tindak balas kimia itu sangat cepat berbanding dengan garam kasar yang bersaiz besar. Garam putih mempunyai saiz yang kecil yang menjadikan ia melarut dalam air dengan cepat tetapi garam putih digunakan sebagai penambah rasa dalam makanan di mana ia mempunyai 20% Sodium kurang berbanding dengan jenis garam yang lain. Ciri ini menjadikan garam putih menghasilkan voltan rendah berbanding dengan garam kasar dan garam halus . Saiz elektrod (aluminium dan tembaga) tidak ketara dengan korelasi kerana tidak ada perbezaan dari segi voltan yang dihasilkan dengan menggunakan saiz elektrod yang berbeza. Keputusan adalah digambarkan dengan menggunakan antara muka visual berasaskan maklumat, interaktif dan mesra pengguna. Penemuan seperti ini boleh digunakan untuk pembangunan tenaga alternatif dengan menggunakan garam.

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LIST OF ABBREVIATIONS

MW - MilliWwatt

PC - Personal Computer

NaCl - Natrium Chloride

PCB - Print Circuit Board

PIC - Programmable Integrated Circuit

ADC - Analogue to Digital Converter

VB - Visual Basic

LIST OF APPENDIXS

CHAPTER 1

INTRODUCTION

1.1 Introduction

Salt, sodium chloride, touches our lives more than any other chemical compound. The chemical properties and physical properties of sodium chloride are a treasure to mankind. Salt also can be used to generate electricity. However, the actual quantities of salt that can generate electric energy still not documented yet. Therefore, in this project the correlation between salt and electric energy will be investigated. This project is limited to 1 kilogram of salt, size of aluminum and copper (3cmx3cm, 5cmx5cm, 7cmx7cm, 9cmx9cm), volume of water will be fixed for 1 liter without any changes but the type of salt and quantity of salt will be the variables. At the end of this project, a user friendly visual basic system will be develop to relate the correlation between salt and electric energy.

There has been a major increase in the global demand for energy in recent years as a result of industrial development and population growth. Since the early 2000s the

demand for energy, especially from liquid fuels, and limits on the rate of fuel production has created such a bottleneck leading to the current energy crisis. Sahir and Qureshi [1] has quoted that energy is considered to be the life line of an economy, the most vital instrument of socioeconomic development and has been recognized as one of the most important strategic. It is referred to the shortage of oil, electricity and other natural resources. The planet is progressively stepping towards a serious electric energy crisis, due to an escalating desire of electric energy becoming greater than its provide.

An now an energy crisis is facing Malaysians as local resources are depleting, there is an increased dependency on imported fuels, and those imported fuels are getting more expensive [2]. Studies such as [2][3] have shown that electricity demand in Malaysia is on the rise, having gone from a weekly peak demand of 14,245MW in the last quarter of 2009 to 15,476MW in May 2011. This is expected to rise to more than 16,000MW in 2012, and to 20,847MW in 2020 and will continue to grow by about 3% every year until 2030 when it will reach 24,770MW.

Oil, gas and coal currently constitute 94% of the total energy generation mix [2] but the rising demand of electricity and these natural will eventually extinct, there is a need to be greater diversification of power supply sources. Hence, unlimited source to generate electricity is becoming popular such solar and wind. However, harvesting solar and wind power has several shortcomings for instances, expensive and high maintenance system and not all place are suitable for solar and wind setting.

We have to look for other alternative to tackle the forthcoming electricity crisis. Several researchers such as [4][5] have started to investigate the feasibility of salt as a source to generate electric. As in [4], salt is reported to be promising as alternative to lithium for rechargeable battery and [5] reported that the mix of freshwater and saltwater could generate electricity. We already know that salt acts as an electrolyte

to bring electrons from anode to the cathode. Salt molecules are made of sodium and chlorine.

When salt enters water, the water causes the salt's sodium and chloride atoms to pull apart and make the salt crystals begin to disappear. As a result, a sodium ion and a chlorine ion are formed. The sodium ion is missing an electron, which gives it a positive change. The chlorine ion has an extra electron, which gives it a negative charge. When electrodes such as copper (cathode) and aluminum (anode) are applied into the salt water, the chlorine ions will move from the anode to the cathode to complete the circuit and produce a current accordingly. However, the study on the characteristic of salt or sodium as electric source has not well documented. In this preliminary study, we will investigate the correlation between salinity and electricity through electrolysis based system and monitors the amount of variable used, i.e., salinity and the size of electrodes.

1.2 History

Alessandro Volta was a physicist born in Italy in 1745. He became known in 1800 as the inventor of the first electric battery. Unlike the friction batteries known up to that time, the Volta battery provided continuous electric current, and was one of the great inventions of the century. This achievement by Volta paved the way for the likes of Georg Ohm, the German physicist who measured the conductivity of metals, and in 1827 discovered the now-famous Ohm's law[6].

Michael Faraday was born in 1791, the son of an English blacksmith. At age 13, he became a bookbinder's apprentice, which gave him access to many books. In 1833, he became an assistant to Professor Davies of the Royal Research Laboratory[6]. He did prominent work in the fields of chemistry and physics, and in 1833, he conceived the law of electrolysis, and he envisioned ion as made of corpuscles that conveyed electricity in solution.

The conductivity of electrolytes was energetically measured by Friedrich Kohlrausch of Germany between 1869 and 1880. It is said that he started measuring conductivity as a means of obtaining ionic product[6]. The Kohlrausch bridge, which he invented at that time for the purpose of measuring conductivity, is still well known today.

1.3 Problem Statement

Salinity can produce electric energy. Salt water can be used as a temporary battery but the accurate of the electric energy from salt chemical reaction is unknown. Since, he theory of the correlation between salinity and electric energy was not research in previous so the research in this project was take place to investigate about it. To compare the typical battery life with salt water. The salinity can produce electric energy but how far salinity can produce electric energy. If the electric energy using salt can be used in daily life then how long the electric energy using salt can be used in daily usage. How far the energy generates from salt chemical reaction can be used in daily usage means how much the voltage output can be generated. Some source said that salinity concept can be used as alternative electric energy where maybe in future it can replace the usage of battery. Salt water can be used as alternative electric energy is unknown.

1.4 Objective

There are three objectives to be achieved in end of this project. The main objective is to measure the correlation between salt water and electric energy. The correlation between salinity and electric energy will be measured and display in LCD display and also by using Visual Basic approach. The other objective is to analyze the salinity used to generate electric energy. To analyze the electric energy for three different types of salt and four different type of size of electrodes this is used to do

the research. The documentation of the above mentioned correlation will be presented informative, interactive and user friendly by visual basic approach.

1.5 Scope

This project is focus on electric energy that produces using salinity or also knows as salt water. So to make the project rub successfully 3 type of salt was used such as Fine Salt, Coarse Salt and White Salt 1. Each type of the salt was investigated till 1Kg. Size of aluminum and copper used in this project is 3cmx3cm, 5cmx5cm, 7cmx7cm and 9cmx9cm. The volume of water was fixed at 1 liter to get the more accurate electric energy. The electric energy which is display in LCD was connected to PC for display voltage using Visual Basic.

CHAPTER 2

LITERATURE REVIEW

2.1` INTRODUCTION

In this chapter, the motivation of the research is discussed to do investigation on the correlation between salinity and electric energy was discussed. The concept of electric energy and the theory about the salt and also its salinity was discussed in more detail. The basic ideas of how the salt conducts electricity suppose to look like. Salt is known as sodium chloride which is an ionic compound with the formula NaCl[1]. Sodium chloride is the salt most responsible for the salinity of the ocean and of the extracellular fluid of many multicellular organisms. As the major ingredient inedible salt, it is commonly used as a condiment and food preservative.

2.2 RESEARCH BACKGROUND

2.2.1 History

Name	Country	Year
Alessandro Volta	Italy	1745-1827
Georg Ohm	Germany	1787-1854
Michael Faraday	England	1791-1867
Friedrich Kohlrausch	Germany	1840-1910

Table 2.1: Historic overview

2.2.2 Definition of conductivity

If we have not heard of the term conductivity or of its unit of measurement (mS/cm or μS/cm), we would like to know simple terms what conductivity is all about [7]

The electric power generated at a power station is transmitted through an electric wire and reaches our home. The usage of electric power at home, it means that electric current flows from a distant power station to reach your home [7]. If it were the force of flowing water, the power station would be the high-ground source of a river, and our home would be downstream near the sea [7]. Electric resistance hinders this flow from upstream to downstream, as we have mentioned already.

Let think for a moment of electricity as a man and the substance through which electricity flows which is usually electric wire as a road. There are paved roads, gravel roads and muddy roads. Furthermore, a narrow road hinders the man's passage, causing him to expend much more energy on a long trip.

[7]The difficulty of passage on a bad road may be represented by the following formula:

$$\text{Difficulty of passage} = \frac{\text{kind of road} \times \text{length of road}}{\text{width of road}}$$

We may notice that the above formula can be directly converted to a formula for electric resistance:

$$\text{Resistance } (\mathbf{R}) = \frac{\text{Resistivity } (\boldsymbol{\rho}) \times \text{length } (\mathbf{L})}{\text{Area } (\mathbf{S})}$$

Units : $\mathbf{R}$: Ω, $\mathbf{L}$: cm, $\mathbf{S}$: cm^2, $\boldsymbol{\rho}$: Ω·cm

Think about the resistance of an electric wire. The greater the length and the smaller the cross-sectional area, the greater the resistance. We may also understand that the greater the resistivity with the same length and the same area, the greater the resistance value. Each substance has its own resistivity value. For example, aluminum wire has a resistivity of about 1.6 times the resistivity of copper wire. This means that when an aluminum wire and a copper wire of the same size are compared, the aluminum wire has more resistance against the flow of electric current than the copper wire.

Thus, resistivity becomes an index of difficulty of flow of electric current. And the reciprocal of resistivity (1/resistivity) is conductivity. So, conductivity becomes an index of ease of flow of electric current. Its unit is written S/cm, meaning siemens per centimeter. Also, 1/1000 S/cm is a called millisiemens per centimeter, and 1/1000 of a millisiemens per centimeter is a microsiemens per centimeter.

$$\text{Conductivity}(\mathbf{k}) = \frac{1}{\text{Resistivity}(\boldsymbol{\rho})} = \frac{1}{\text{Resistance}(\mathbf{R})} \times \frac{\text{length}\ (\mathbf{L})}{\text{Area}\ (\mathbf{S})}$$

2.2.3 Ions in water and conductivity

A metal, such as in an electric wire, contains a great number of free electrons. These electrons pass electric current from one to the next, just like a line of people forming a bucket brigade. Such a metal is called a conductor.

The next subject involves what is called an ion conductor, basically ions in an electrolyte solution, which also affect the conducting of electricity. [8]When a certain substance is dissolved in liquid--water in the case of Twin--and if the liquid thus obtained can conduct electricity, such a liquid is called an electrolyte

solution, and the dissolved substance is called an electrolyte. And each corpuscle that carries electricity is called an ion.

[8]Common table salt, NaCl is an electrolyte, and when this is dissolved in water to form salt water, it becomes sodium ions, Na^+ and chlorine ions, Cl^- each of which is a corpuscle that conducts electricity.

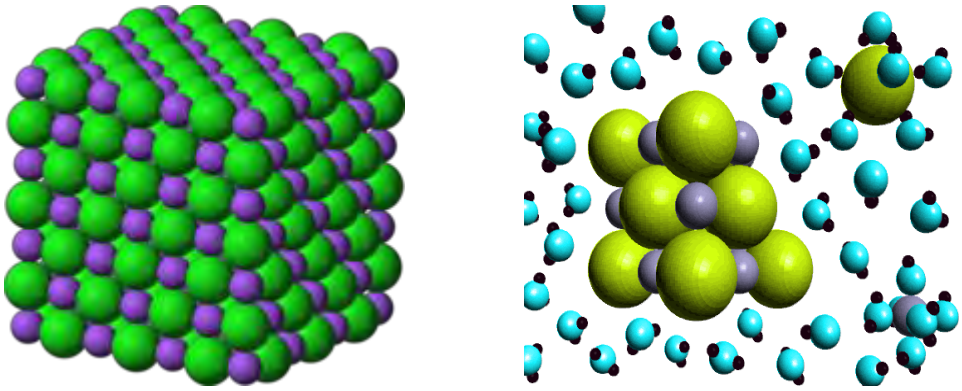

Figure 2.1: The left figure is table salt, NaCl in solid state while the right figure is sodium ions, Na^+ and chlorine ions, Cl^- when dissolve in the water.

Source from [www.chemistrybonds.com]

Conductivity is an index of how easy it is for electricity to flow. [8]In water, it is the ions that pass electricity from one to the next. This means that the more Na^+ and Cl^- contained in water the more electricity is carried, and the higher the conductivity.

To sum up, if we know the conductivity of a sample of salt water, we can calculate just how salty the water is. (This is what happens in the salinity conversion to arrive at the value displayed by the Twin conductivity meter.)