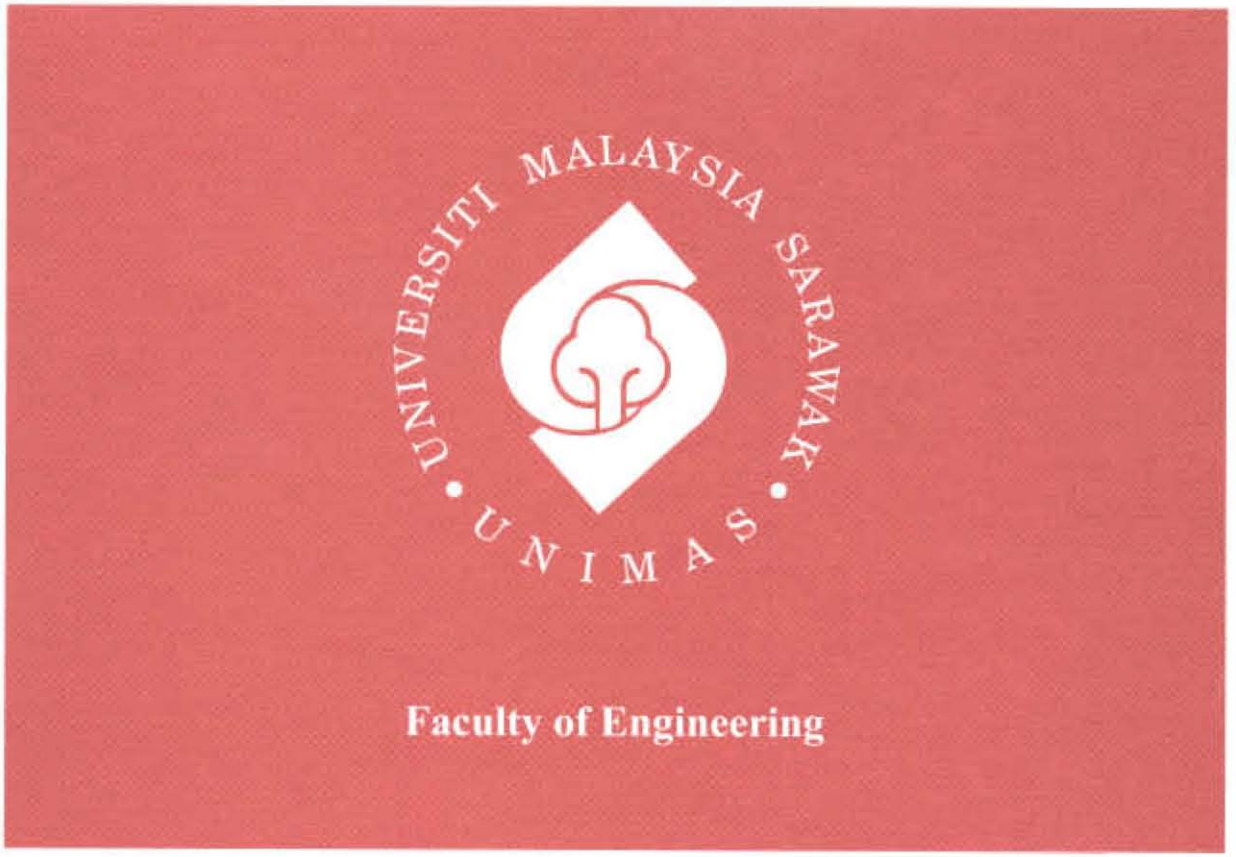

POTENTIAL AND PROPERTIES OF SEAWATER DESALINATION IN PULAU SALAK

Syazie Nordzaima Binti Ali Mohamad

Master of Engineering (Civil)
2011

POTENTIAL AND PROPERTIES OF SEAWATER DESALINATION IN PULAU SALAK

SYAZIE NORDZAIMA BINTI ALI MOHAMAD

A dissertation submitted in partial fulfillment of the requirements
for the degree Master of Engineering (Civil)

Faculty of Engineering
UNIVERSITI MALAYSIA SARAWAK
2011

UNIVERSITI MALAYSIA SARAWAK

BORANG PENGESAHAN STATUS TESIS

Judul: **POTENTIAL AND PROPERTIES OF SEAWATER DESALINATION IN PULAU SALAK**

SESI PENGAJIAN: 2010 – 2011

Saya **SYAZIE NORDZAIMA BINTI ALI MOHAMAD**
(HURUF BESAR)

mengaku membenarkan tesis * ini disimpan di Pusat Khidmat Maklumat Akademik, Universiti Malaysia Sarawak dengan syarat-syarat kegunaan seperti berikut:

1. Tesis adalah hakmilik Universiti Malaysia Sarawak.
2. Pusat Khidmat Maklumat Akademik, Universiti Malaysia Sarawak dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Membuat pendigitan untuk membangunkan Pangkalan Data Kandungan Tempatan.
4. Pusat Khidmat Maklumat Akademik, Universiti Malaysia Sarawak dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
5. ** Sila tandakan (✔) di kotak yang berkenaan

☐	SULIT	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972).
☐	TERHAD	(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/ badan di mana penyelidikan dijalankan).
☑	TIDAK TERHAD	

Disahkan oleh

(TANDATANGAN PENULIS)

(TANDATANGAN PENYELIA)

Alamat tetap: NO.1, 347A, BATU 2 1/1,
JALAN MATANG, 93050
KUCHING, SARAWAK.

PN. ROSMINA AHAMAD BUSTAMI
(Nama Penyelia)

Tarikh: 17/10/2011

Tarikh: 13 OKTOBER 2011

CATATAN

* Tesis dimaksudkan sebagai tesis bagi Ijazah Doktor Falsafah, Sarjana dan Sarjana Muda.

** Jika tesis ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh tesis ini perlu dikelaskan sebagai SULIT dan TERHAD.

Final Year Project Report below:

Title : Potential And Properties of Seawater Desalination in Pulau Salak

Author : Syazie Nordzaima binti Ali Mohamad

Matric No. : 10031711

Has been read and certified by:

Pn. Rosmina Ahmad Bustami
Supervisor

13 October 2011
Date

ACKNOWLEDGEMENT

First and foremost, I would like to thank God after completing this thesis. Without His bless, I may not complete this project successfully.

Secondly, I personally want to thank and appreciate my supervisor, Madam Rosmina Ahmad Bustami for her helpful comments, support, advices and all the way through the path of the project.

My sincere thanks and appreciation also goes to my friends and the supportive techinicians for their help, advices and for their great support during the processes of completion of this thesis.

Last but not the least; I am eternally grateful to my dearest family for their encouragement and moral support throughout my study. This study was not being conducted so smoothly and successfully without your support.

Thank you and God bless you all.

ABSTRACT

In this new era of high technology, seawater desalination has turned out to be one of the high main concerns due to the urbanization and growths. Thus, the analysis of properties and potential of seawater desalination at Pulau Salak is one of the significant ideas. This show the process can help to improve the issue of freshwater at Pulau Salak. The main objective of this study is to see the properties of the seawater desalination at Pulau Salak. As the villagers had use the well water as their daily used, the well water sample also will be tested to see the potential of the desalination processes. This study is focused on Pulau Salak area which can only reach by boat. The area has no electricity and freshwater supply. The properties of seawater shows that the river still did not achieve the Class IIB standard and after the desalination process, only some of the parameters reach the Class I standard of National Water Quality Standard of Malaysia (NWQSM). For the well water it is in Class IIB and after the desalination processes, the parameter shows the water is in Class I except for the pH value. Further study and concern from certain agency may help to improved the water quality of the water as well as the social needs of the villagers.

ABSTRAK

Dalam era baru berteknologi tinggi kini, penyahgaraman air laut telah menjadi salah satu daripada kebimbangan utama disebabkan oleh tahap urbanisasi dan peningkatan populasi. Oleh itu, analisis sifat-sifat dan potensi penyahgaraman air laut di Pulau Salak adalah salah satu idea yang penting untuk mengetahui bagaimana prose situ boleh membantu untuk memperbaiki isu air tawar di Pulau salak. Objektif utama kajian ini adalah untuk mengkaji sifat-sifat penyahgaraman air laut di Pulau salak. Oleh kerana penduduk kampung menjadikan air perigi sebagai kegunaan harian mereka, maka sampel air perigi ini juga akan diuji untuk melihat potensi proses penyahgaraman. Kajian ini hanya tertumpu di Pulau Salak yang mana hanya dapat di jejaki dengan menggunakan bot. Kawasan ini juga tisak mempunyai bekalan elektri dan air bersih. Ciri-ciri air laut menunjukkan bahawa tahap kuality air sungai masih tidak mencapai Class IIB dan selepas proses penuahgaraman, hanya beberapa parameter sahaja yang mencapai Class I National Water Quality Standard of Malaysia (NWQSM). Bagi air perigi pula, tahap kualiti nya adalah dalam Class IIB dan selepas proses penyahgaraman, parameter menunjukkan air dalam Class I kecuali untuk nilai pH. Kajian lanjut harus dilakukan dan perhatian daripada agensi tertentu harus diambil bagi membantu untuk meningkatkan kualiti air serta keperluan sosial penduduk kampung.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1 Introduction

Water is one of the important components for the most part for all existing in this world including human, animals and also plants. For human, it is used for drinks, foods and activities such as washing clothes and dishes, cooking and others. There are many sources of water in this world and one of it is from the ocean. From the distribution of the earth's water, 97% of the earth's water is from the oceans (seawater) and only 3% of the distribution is from the freshwater.

Seawater or also known as saltwater is originally from an ocean or a sea. On average, seawater in the world's oceans has a salinity of about 3.5% (35g/L or 599 mM) which means that in every kilograms (one litre by volume) of seawater has approximately 35 grams that is equals to 1.2 oz of dissolved salts (Sodium Chloride; Na^+, Cl^-).

The seawater average density at the ocean surface is 1.025 g/ml, which makes it denser than both freshwater and pure water which density is 1.0 g/ml because the dissolved salts add mass without contributing significantly to the volume.

Water that is well for human use is called the potable water. Potable water is usually produced by the non-potable water by the process of distillation or filtration. Desalination is the process of removing the salts and other minerals from the seawater to potable water. There are two methods of desalination which are the vacuum distillation and the reverse osmosis processes.

Seawater desalination has come into view as the alternative for future water supply at Pulau Salak as their water resources are from the wells which are from the streams at nearby Salak Mountain and rain which provided clean water for the villagers. For the time being, the villagers are lacking of the basic necessities such as potable water. This study is focusing on the potential of the seawater characteristics of Pulau Salak for the seawater desalination processes.

1.2 Statement of Problems

1.2.1 Issues of Freshwater Quality Status in Pulau Salak

Due to the rapid development in most of the countries nowadays, everyone knows that our climate is changing and this result some areas to be drier and some others become wetter. (Water Corporation, 2008). Referring Intergovernmental Panel on Climate Change (IPCC) 2007, the changing of the climate is in accordance with the predictions of global climate models that are used to simulate the effects of rising levels of greenhouse gases in the atmosphere. It also predicts that climate change will continue for at least the next century, even if we are successful in cutting emissions by 60% by 2050.

Figure 1.1 Well in Pulau Salak

As the villagers in Pulau Salak can only get clean water from the well they built (Figure 1.1), seawater desalination is one of the research projects that will be done to study the potential of it in Pulau Salak. This is to resolve the problem for the villagers especially when come to the dry season where water shortage was unavoidable.

Apart from that, there is also a contrary impact on the quality of seawater in the Sungai Salak which forms the boundary of the site from the stone quarry operation in Pulau Salak area. Since Pulau Salak is surrounded by the seawater, hence the villagers experienced difficulties to search freshwater for their activities.

Commonly, river water is potable where it is fit for human consumption with very minimum treatment where it is not affected by the human activities. (Kailasam K., 2006) But unfortunately, many rivers in this day and age are polluted and used as disposal for wastes. Water Pollution is defined as the changed that occurred in the way of the contents, textures and colours until it is not suitable to use and will effects the healthiness of people, plants and animals. The water pollution is the most frequent pollution that occurs and increases from time to time as there is no effective way that can be done to overcome this problem. (Peary H.S. et all, 2002)

In the 21st century, freshwater will become the main resources for human. Though 70% of the earth is covered by water but most of it is unusable for human consumptions and activities. Besides, only 3% of the earth water distribution is freshwater leaving the 97% of the seawater as shown in Figure 1.2.

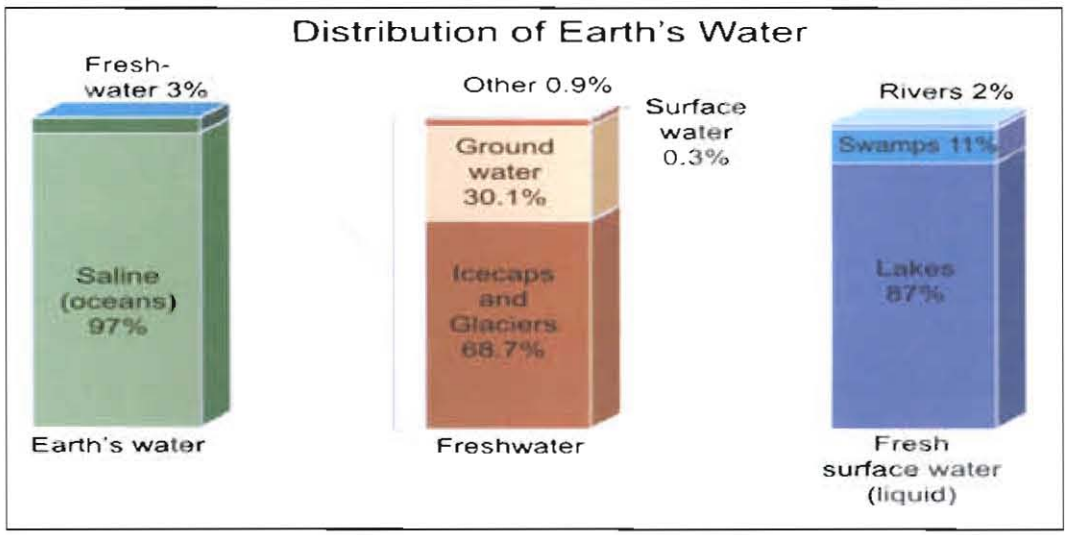

Figure 1.2 The distribution of the earth's water.

To make an evaluation and classification of the river system, the average of the concentration of different monitoring parameter is statistically reviewed. Then, it will be compared to the National water Quality Standards for Malaysia (NWQSM) and Class IIA of the standards which has been set as the major problem in Sungai Salak. The pollution that comes upon by the faecal bacteria in Sungai Salak is mainly endorsed from the quarrying activities nearby. The other pollutants that moderately degraded the Sungai Salak water quality are identified as nutrients and organic loads.

1.3 Rational of study

In order to improve the needs of freshwater for Sungai Salak, seawater desalination can be one of the ways. Thus, research has been done at the Sungai Salak to analyze the potential and the characteristics of the seawater for the purpose of desalination. The objective of doing the seawater desalination is to improve the quality of the freshwater as well as to satisfy the needs of freshwater for people who live in Pulau Salak.

For the year 2003, statistics published by the Department of Environment (DOE) reveal 8% of our rivers to be polluted, 44% slightly polluted and remaining 48% to be clean. From this statistics, it indicates that Malaysia now are facing serious environmental problem especially the river water quality. Those studies then point out the 3 main sources of river pollution in Malaysia which are the residential, agricultural and industrial wastes.

Moreover, the degradation of water quality due to pollution causes adverse effects to aquatic life forms, disturbs the balance of life and reduces the bioavailability of the freshwater. (Kailasam K., 2006)

The difficulties to supply enough freshwater is likely to be increase from years to years. According to studies that have been done by Kaisalam K. (2006), the demand is growing at 4% annually which projected to reach 20 billion m^3 by the year 2020.

As the rivers form 97% of the freshwater resource, this is a sign that our water supply for human consumption has to be treated comprehensively in the future at the same time as a reminder for us to alert with our river water quality to make sure our river cleanliness is according to the NWQSM.

1.4 Objectives of Study

1.4.1 *General Objective*

The general objective is to study the potential and properties of water desalination project for Pulau Salak. For that purpose, water quality analysis of Sungai Salak is conducted to give information about what has happened, what is happening, and what might happen out there along the process of the water desalination.

1.4.2 *Specific Objective*

The specific objectives of the study were:

1.5.2.1 To collect and study the potential of seawater surrounding Pulau Salak.

1.5.2.2 To determine the properties of water desalination for Pulau Salak.

CHAPTER 2

LITERATURE REVIEW

2.1 Background of Pulau Salak

Pulau Salak as shown in Figure 2.1 is located about 7km from the center of Kuching in the vicinity of 110°17'00" E longitude and 1°40'00" N latitude. This island (Figure 2.2) is reachable by boat from Kampung Pasir Pandak where it takes 15 to 20 minutes boat ride. Pulau Salak is a fishing village that is popular tourist attraction for the Proboscis monkey and dolphin watching. Furthermore, at night the tourists have the opportunity to see fireflies in the sides of the river. (Wikimapia.org)

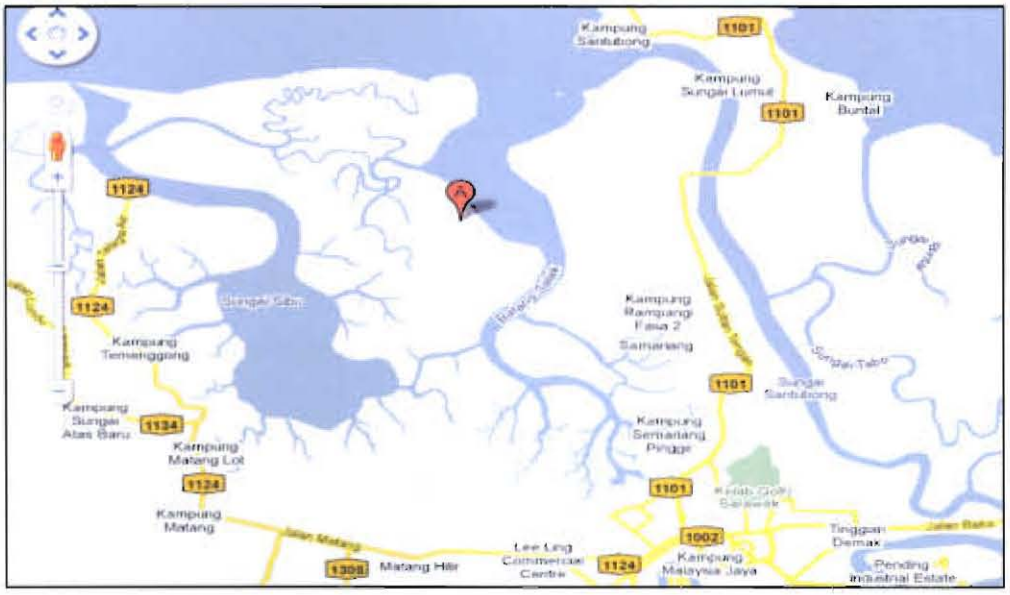

Figure 2.1: The Map of Pulau Salak

Figure 2.2 Kampung Pulau Salak

2.2 Desalination Process

According to Water Corporation (2008), desalination is a process for producing potable water from saline water via a technique such as distillation or reverse osmosis. The distillation involves using a heat source such as the sun or fossil fuels to evaporate saline water, which is subsequently condensed to separate it from the salt water.

The reverse osmosis involves drawing water from a saline source, such as the ocean, filtering it and then passing it through a semi-permeable membrane under pressure to remove most of its salt content. Part of the intake water is returned to the ocean with an enhanced level of salinity; often double that of the original water. (Water Corporation, 2008)

The desalination process needs a relatively clean supply of saline water, an appropriate site for the large processing plant and many amounts of energy to drive the process. Product of this desalination process is a high quality of water supply, which is as good as freshwater (potable water) that is suitable for human consumptions.

From the research that has been done by Kologirou S.A. (2005) on the study of Seawater Desalination Using Renewable Energy Sources, he stated that desalination process require significant quantities of energy to achieve separation of salts from seawater as this is highly significant as it is a recurrent cost, which few of water-short areas of the world can effort. Many countries in the Middle East, because

of oil income, have enough money to invest in and run desalination equipment. People in many other areas of the world have neither the cash nor the oil resources to allow them to develop in a similar manner.

2.2.1 The Distillation Process

The distillation process is one of the traditional methods for desalination. The result of product water is usually heated to such a high temperature that pure water rises in vapour whereas particulates remain behind in sea water. Condensation of the steam is done in separate container. However in this process less fresh water as a percentage of impure water is produced. The recovery rate as compare to reverse osmosis process is also low. (TheWaterTreatmentPlant.com, 2009)

Compared to brackish water, salt concentration in sea water is higher than in the brackish water. Thus, desalting seawater incur higher cost rather than brackish water. Precautions must be taken to keep the intake pipes for desalination plants away from the sewage treatment plant to avoid intake of discharged effluent. The quality produced by the distillation process is of high quality and it ranges from 1.0 to 50.0 ppm tsd.

Removing the substances that would interfere with the desalting process can result for the smooth desalination process. Microorganism like, algae and bacteria can grow in distillation plants, hence it is necessary to clean the system using