UNIVERSITI TEKNIKAL MALAYSIA MELAKA

STUDY ON DESALINATION OF SEAWATER BY WATER HYACINTH

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

by

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I hereby, declared this report entitled "**Study on desalination of seawater by water hyacinth**" is the results of my own research except as cited in references.

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirement for the Degree of Engineering Technology (Maintenance Technology) with Honour. The member of the supervisor is as follow:

……

(Project Supervisor)

EN. KHAIRIL AMRI BIN KAMARUZZAMAN

Abstrak

Keladi bunting adalah tumbuhan akuatik rumpai pickerel yg berkembang secara berpanjangan. Tumbuhan ini menjadi risiko utama kepada sesebuah ekosistem yang disebabkan oleh pertumbuhan yang berpanjangan lalu memberi kesan ekologi iaitu boleh menyebabkan penyaliran tasik dan sungai tersumbat. Walaubagaimanapun, tumbuhan ini boleh bertindak sebagai biosorben dengan menyingkirkan bahan logam disebabkan kompisisi kimia di dalam keladi bunting tersebut. Dari sudut pandangan ini, projek ini akan menggunakan keladi bunting sebagai medium didalam proses penyahgaraman air laut tiruan. Selain itu, projek ini melibatkan penyediaan keladi bunting sebagai bahan mentah dengan melakukan proses pengeringan dan pelumatan. Resin penukaran ion jenis resin kation asid kuat (12EX C100) dan resin anion kukuh asas (12EX C200) digunakan didalam proses tersebut. Seterusnya, analisis kemasinan air laut di sekitar kawasan tambak Bandar Melaka akan dilakukan untuk mendapatkan maklumat mengenai kemasian air laut. Berdasarkan kemasinan air laut semulajadi, perlbagai kepekayan air laut tiruan akan dihasilkan. Proses penyahgaraman air laut tiruan akan dilakukan oleh keladi bunting di bantu oleh resin penukaran ion. Proses tersebut akan dilakukan dengan mengunakan kolum fabrikasi. Projek ini akan memberi maklumat tentang kapasiti keladi bunting dan resin penukaran ion didalam proses pembuangan kemasinan air laut tiruan dengan melibatkan kadar optimum aliran air didalam kolum dan pertumbuhan semula penyahgaraman sederhana.

ABSTRACT

Water hyacinth is a quickly growing lasting aquatic pickerel weed plant. This plant as a major risk for a ecosystem due to the spectacular growth and ecological impact namely clogging and draining of lake and river. However, this plant can act as a bio-sorbent and good removal for heavy metals because of the chemical composition in water hyacinth. From this point of view, this project would apply water hyacinth as desalination medium for artificial sea water. Moreover, this project involves the preparation of water hyacinth as a raw material for desalination of artificial sea water by drying and pulverization in presence of ion exchange resins (strong acid cation resin 12EX C100 and strong base anionic resin 12EX C200). Subsequently, routine analysis of salinity of sea water around reclamation area in Melaka town will be performed in order to get the information about the salinity of sea water. Based on the natural salinity of sea water, various concentration of artificial sea water will be prepared. Desalination of this artificial sea water would be performed by water hyacinth supported by ion exchange resins. The desalination would be carried out by fabricated column. This project will provide information about capacity of water hyacinth and ion exchange resins to remove the salinity of artificial sea water involve the optimum flow rate of water influence in the column and regeneration of the desalination medium.

DEDICATION

This report is dedicated to my beloved parents (late) for their spirit and endless love. Al-Fatihah.

Furthermore, I want to thank my brothers and sisters for their support and love that helped me to be motivated throughout my love.

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LIST OF ABBREVIATIONS

ATC	Automatic temperature compensation
BOD	Biochemical oxygen demand
COD	Chemical oxygen demand
CWH	Carbon water hyacinth
DCMD	Direct contact membrane distillation
DO	Dissolved oxygen
DVB	Divinylbenzene
ED	Electro-dialysis
EDX	Energy dispersive x-ray
ENSO	El Nino Southern oscillation
FO	Forward osmosis
Frz	Freezing
FTIR	Fourier-transform infrared spectroscopy
g/L	gram per liter
GAC	Granular activated carbon
G.Hyd	Gas hydrate
H^+	Hydrogen ions
HCO_3^-	Bicarbonate ions
HDH	Humidification – dehumidification desalination
IERs	Ion exchange resins
IDA	Internal desalination affliliation
km	kilometer
LLE	Liquid – liquid extraction
m	meter
m^3	meter cube
MBR	Membrane bioreactor
MD	Membrane distillation

MDDEC	Malaysia design development center
MED	Multi result distillation
MF	Micro-filtration
mg/L	milligram per liter
mm	millimeter
MSF	Multistage flashing
MVC	Mechanical vapor compression
MWCO	Molecular weight cut off
Na^+	Sodium ions
NaCl	Sodium chloride
NCWH	Non-carbon water hyacinth
NF	Nano filtration
NSW	New South Wales
OH^-	Hydroxyl ions
ppm	parts per million
ppt	parts per thousand
PSU	Practical salinity units
PV	Photovoltaic
RO	Reverse osmosis
rpm	revolution per minute
SADA	Syarikat Air Darul Aman Sdn Bhd
SD	Solar distillation
SEM	Scanning electron microscopy
SG	Specific gravity
SSG	Seawater specific gravity
TDS	Total dissolved solids
UF	Ultra-filtration
UV	Ultraviolet
VC	Vapor compression
WH	Water hyacinth

^{o}C	Celsius
^{o}F	Fahrenheit
%	percent

CHAPTER 1

INTRODUCTION

1.1 Background Research

As the world population is growing, the need for fresh water is increasing. Desalination may be described as any system that gets rid of salts from water. Desalination procedures might be utilized as a part of municipal, industrial, or commercial applications. With upgrades in era, desalination procedures are becoming to be price-competitive with one-of-a-kind techniques for developing usable water for our growing wishes. Throughout global struggle, it turned into felt that desalination technology - "desalting" because it turned into referred to as then - have to be created to trade over saline water into usable water, wherein new water resources were constrained (Kucera, 2014).

According to Cotruvo (2004), desalination is an imperative and quickly developing wellspring of savoring water the world starting from sea water or brackish water. Desalination suddenly come of the water is essentially to be modified and after that in part reconstituted to accomplish a steady item that can be disseminated in channels. This water contrast from regular water as in its creation is controllable while characteristic water fluctuates over an extensive variety of organization that involves geography and possibility. Most desalination plants utilize seawater or brackish water as their sources. It creates the impression that thorough execution, working and item quality determinations have advanced for all intents and purposes on a site-by-site premise with respect to source and the particular finished result water utilize.

Desalination process with water hyacinth and ion exchange resin that using the environment material, so that can avoid the natural phenomena such as a global warming.

This project involves the preparation of water hyacinth as a raw material for desalination of sea water by drying and pulverization. Furthermore, routine analysis of seawater would be performed. Simplify the high salinity of sea water turns in high point resulted the water to turn salty. The previous desalination process has been done by using an evaporation and reverse osmosis. By doing this way, it requires funding and expensive treatment. Now days, alternative process that using in industry is more modestly with ion exchange resin with water hyacinth act as an anti-bacterial. This projects apply strong acid cation resin 12EX C100 and strong base anionic resin 12EX C200 as an ion exchange resin. Salinity will be analyze doing at laboratory and two column are using for the testing process of desalination.

1.2 Problem Statement

Salinity is one of the important parameter in water quality. Currently, several islands in Malaysia having problem with the water supply. As per reported in Borneopost on March 20, 2016 resident in Kampung Wallafe Bay, Pulau Sebatik, Tawau faced difficulties in obtaining clean water. The present upgrading of dam for water treatment plant in that area is insufficient of water due to lack of rain. The water plant should be enlarged and deepened it tries again to accommodate the volume of water for a period of six to eight months, even without rain. A Member of Legislative Assembly, hope the Engineers of Tawau Water can quickly create a survey about this because this is an urgent need for the local population. He also hopes to upgrade the plant will be of great benefit to the community, not only during the dry season, but also to six other villages on the island that has yet to receive clean water supply.

Similar issue was also observed in Langkawi Island where water supply issue also appeared in 2016 (Bernama August 2016). Langkawi Island is a travel destination island; therefore this place has needs a consistent clean water supply. A Chief Executive Officer of Syarikat Air Darul Aman Sdn Bhd (SADA) proposed process plant seawater to overcome water supply issues in Langkawi. This study focused on the issue of non-revenue water supply faced that has now reached about 42 % of the total water supply. Now, 52 % of the fresh water is obtained through the plant in Sungai Baru while the rest is supplied by water supply plants in Padang Matsirat, Padang Saga and Bukit Malut in these islands. According to him, before a study was conducted by the SADA itself together with Taliworks Sdn Bhd which is a water plant operator owned by SADA shows Langkawi will face water crisis by 2018. He said the expectation was based on the improvement and development of water users grew at a somewhat faster in the next few years.

Desalination is considered to be one of the most suitable options for tackling these water shortage troubles. The 1.4-1012 m^3 of water reserves on the planet, 97.6 % is salt water. The closing 2.4 % of sparkling water, handiest 1 % is inside the form of liquid on this planet‘s surface and consequently available for human consumption—a mere 0.024 % of global water resources (Manahan, 1997). Therefore, the intention of this project is to solve the problem by producing clean water by desalination.

An excessive amount of saltiness in water is unsafe for human health. Saltiness up to 500 mg/L is ordinary, but less is better. Up to 1,000 mg/L saltiness is viewed as the farthest point for long haul human utilization. Anything more than 1,000 mg/L has long haul unsafe health impacts, for instance, high blood pressure which can bring heart disappointment or stroke.

Currently the established desalination technologies are reverse osmosis (RO) and photovoltaic (PV). These data are presented on a small scale PV powered RO desalination system as presented by Aybar et al. (2010). Moreover, the effectiveness of solar power on RO of desalination has proved. However, these technologies are costly.

To overcome the problem of water supply on the island during the monsoon season, water hyacinth as raw material can be used in desalination process. PV power RO system cannot be used during the monsoon season. Furthermore, the alternative process that using in industry is more modestly with ion exchange resin. Ion exchange technology exhibits huge advantages for evacuating boron in a desalination application. This complexion resin is so specific; it removes just boric acid from water and has no noteworthy impact on the centralization of different particles.

Water hyacinth is discovered to be able to absorb organic and inorganic compounds (Zhou, 2007). With this statement, a hypothesis for this study was developed. It is forecasted that water hyacinth could be used to absorb salt (NaCl) from seawater as an agent of desalination for function of inorganic absorbent imposed by water hyacinth.

1.3 Objectives

The purpose of this study is about desalination of sea water are:

1. To observe salinity on seawater around reclamation area in Melaka City.
2. To analyze the effect of water hyacinth and ion exchange resin in desalination of seawater.
3. To analyze the effect of ion exchange during desalination.

1.4 Scope

This project focuses on:

1. To monitoring the salinity, gravity and temperature of sea water with the refractometer.
2. Analyses on the effect of ion exchange resins during the desalination process.
3. To study the ratio between water hyacinth and ion exchange resins for desalination of sea water.
4. To establish desalination on artificial sea water.

1.5 Limitations

Although this project are about the desalination of sea water, but there are several aspects that are limited in this project. Firstly, only salinity of seawater will be analyzed for water quality by digital refractometer. In analysis section, the salinity level of sea water around reclamation area act as an indicator in monitoring of sea water. The direct observation to measure the salinity of seawater around reclamation is in Melaka City. Based on the salinity from the observation of seawater around the reclamation area in Melaka City, concentration of artificial seawater would be prepared. The ratio of water hyacinth with and without ion exchange resins would be monitored in ratio to get the suitable result of salinity.

CHAPTER 2

LITERATURE REVIEW

2.1 Marine Environment

The Earth is a blue planet. Seas and ocean cover over 70 % of the Earth‘s surface and, with a mean intensity of over 3.2 km, the entire volume of marine ecosystems is massively more than that of terrestrial and freshwater environments combined, comprising 98 % of the entire inhabitable area on the planet (Speight and Henderson, 2010). Marine ecosystems include 31 of the 33 phyla of animals, every of which constitutes a unique and one-of-a-kind frame plan, with 15 of those phyla going on handiest in the sea (Angel, 1993).

Therefore, marine ecosystems can be seen as having a critical position in global meals protection. It is miles an increasing number of recognized that they make contributions tons extra than that to human properly-being, in economic, social and cultural phrases. This reputation changed into to start with crystallized when Costanza et al. (1997) estimated that coastal seas, open oceans, estuaries and saline marshes offer an expected 68 % of the entire monetary fee of all environment items and offerings derived from the herbal surroundings. While the section of Costanza et al.‘s valuations has been finally disputed with the aid of environmental economists, their evaluation did alert a miles wider target market to the overpowering importance of marine environments to human properly-being. The essential anthropogenic sources of heavy metals into the marine environment are shown on Figure 2.1.

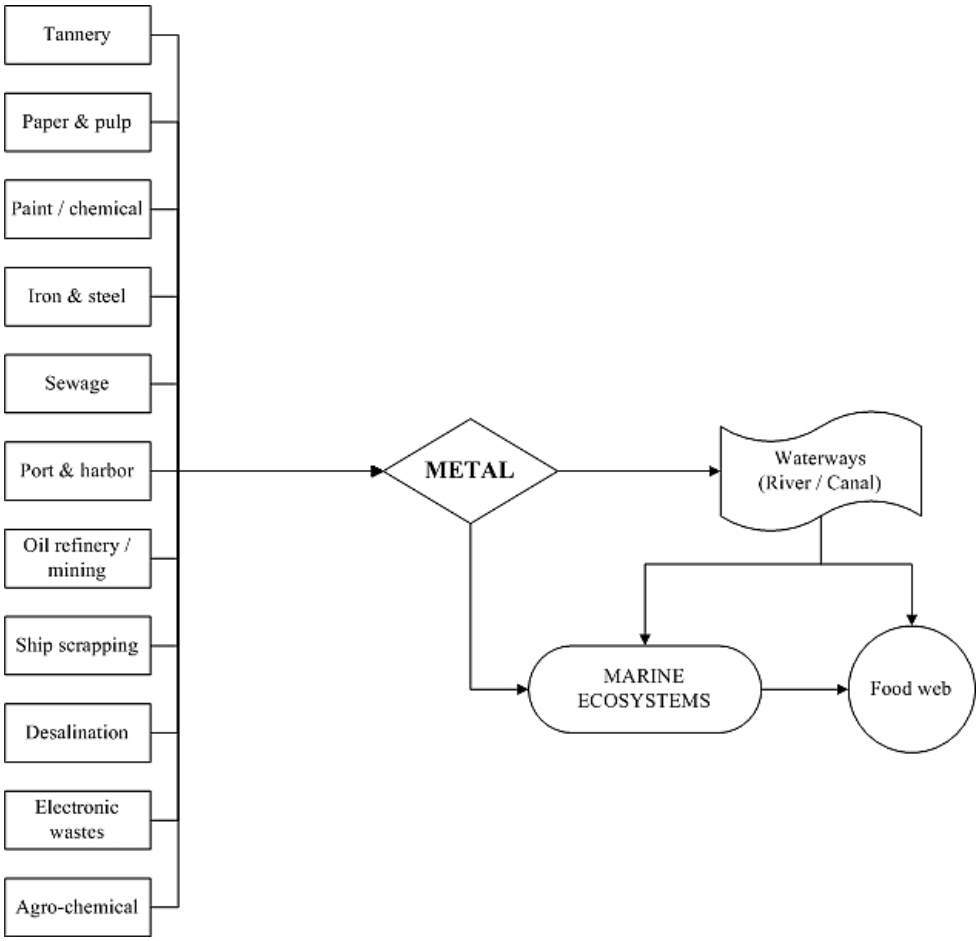

Figure 2.1: Essential anthropogenic sources of heavy metals into the marine environment

(Sharifuzzaman, 2016)

According on Cooley et al. (2013), in an evaluation of coastal and estuarine electricity flora in California, York and Foster find that ~~–i~~mpingement and entrainment affects identical the lack of biological productiveness of lots of acres of habitat". However while it is widely distinguished that these systems harm the marine surroundings, the whole extent of those influences can also by no means be absolutely understood due to the fact complete tracking and evaluation of the encompassing ecosystems become not achieved.