UNIVERSITI TEKNIKAL MALAYSIA MELAKA

EVALUATION OF SUGARCANE BAGASSE AS A RAW MATERIAL FOR DESALINATION

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

by

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor's Degree in Mechanical Engineering Technology (Maintenance Technology) with Honours. The member of the supervisory is as follow:

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(Mr. Khairil Amri Bin Kamaruzzaman)

ABSTRAK

Tebu atau *Saccharum officinarum L*. adalah rumput yang terdiri daripada batang, daun dan sistem akar di mana tangkai mengandungi jus yang biasa digunakan untuk membuat gula. Sisa tebu, terutamanya hampas tebu *(SCB)* dan daun *(SL)* telah digunakan untuk aplikasi bioteknologi dan bukan bioteknologi. Serat hampas tebu merupakan sisa buangan yang banyak dikeluarkan oleh produk industri tebu dan bahan berserat yang tinggal selepas menghancurkan tebu. Untuk mengeluarkan hampas tebu merupakan sisa pertanian yang berpotensi digunakan sebagai sumber silika semula jadi. silika semula jadi didakwa sebagai selamat dalam pengendalian, murah dan boleh dijana dari sumber yang murah. Begitu juga, hampas tebu telah digunakan untuk rawatan air sisa. Dari sudut pandangan ini, projek akan digunakan hampas tebu sebagai medium penyahgaraman air laut tiruan. Selain itu, projek ini melibatkan penyediaan hampas tebu sebagai bahan mentah untuk penyahgaraman air laut tiruan oleh pengeringan dan pemeluwapan di hadapan resin pertukaran ion. Selepas itu, analisis rutin kemasinan air laut di sekitar kawasan penambakan di Pulau Melaka akan dilakukan untuk mendapatkan maklumat tentang kemasinan air laut. Berdasarkan kemasinan semulajadi air laut, kepekatan air laut tiruan akan disediakan. Penyahgaraman air laut tiruan ini dilakukan oleh hampas tebu disokong oleh resin pertukaran ion. Penyahgaraman dijalankan mengikut pengunaan kolumn. Projek ini menyediakan maklumat tentang kapasiti hampas tebu dan pertukaran ion resin untuk mengeluarkan kemasinan air laut tiruan melibatkan kadar aliran optimum pengaruhi air dalam kolumn dan pertumbuhan semula sederhana penyahgaraman.

ABSTRACT

Sugarcane or *Saccharum officinarum L*. is a perennial grass that comprised of stalks, leaves and root system where stalk contains the juice that commonly used to make sugar. Sugarcane residues, particularly sugarcane bagasse *(SCB)* and leaves *(SL)* have been explored for both biotechnological and non-biotechnological applications. Sugarcane bagasse is an agricultural waste that is potentially used as natural silica resources. Natural silica claimed to be safe in handling, cheap and can be generated from a cheap resource. From this point of view, this project an apply sugarcane bagasse as desalination medium for artificial seawater. Moreover, this project involves the preparation of sugarcane bagasse as a raw material for desalination of artificial seawater by drying and pulverization in presence of ion exchange resins. Subsequently, routine analysis of salinity of seawater around reclamation area in Melaka Island is performed in order to get the information about the salinity of seawater. Based on the natural salinity of seawater, various concentration of artificial seawater will be prepared. Desalination of this artificial seawater will be performed by sugarcane bagasse supported by ion exchange resins. The desalination was carried out by fabricated column. This project provide information about capacity of sugarcane bagasse and ion exchange resins to remove the salinity of artificial seawater involve the optimum flow rate of water influence in the column and regeneration of the desalination.

DEDICATION

To my beloved parents

To my kind lecturers

And no forgetting to all my fellow friends

For their

Love, Sacrifice, Encouragement, and Best Wishes

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TABLE OF CONTENT

LIST OF FIGURES

LIST OF TABLES

LIST OF EQUATION

LIST OF APPENDICES

LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

ATC	-	Automatic temperature compensation
Cl	-	Chlorine
DCMD	-	Direct contact membrane distillation
DO	-	Dissolved oxygen
ED	-	Electro-dialysis
EDS	-	Energy dispersive spectroscopy
FO	-	Forward osmosis
FTIR	-	Spectroscopy infrared
HCL	-	Hydrochloride
HDH	-	Humidification – dehumidification desalination
IERs	-	Ion exchange resins
IDA	-	Internal desalination affiliation
LLE	-	Liquid – liquid extraction
MBR	-	Membrane bioreactor
MD	-	Membrane distillation
MED	-	Multi result distillation
MF	-	Micro-filtration
MSF	-	Multistage flashing
MVC	-	Mechanical vapor compression
MWCO	-	Molecular weight cut off
Na^+	-	Sodium ions
NaCl	-	Sodium chlorine
NaOH	-	Sodium hydroxide
NF	-	Nano filtration
NSW	-	New south wales
OH^-	-	Hydroxyl ions
PV	-	Photovoltaic
RO	-	Reverse Osmosis
SCB	-	Sugarcane bagasse
SCBC	-	Sugarcane bagasse carbon
SCBNC	-	Sugarcane bagasse non carbon
SL	-	Sugarcane leaves
SD	-	Solar distillation

SG	-	Specific gravity
TDS	-	Total dissolved solids
UF	-	Ultra-filtration
UV	-	Ultraviolet
VC	-	Vapor compression
g/L	-	gram per liter
km	-	kilometer
m	-	meter
m^3	-	meter cube
ml	-	mililiter
mm	-	millimeter
mg/L	-	milligram per liter
ppm	-	parts per million
PSU	-	Practical salinity units
ppt	-	parts per thousand
rpm	-	revolution per minute
^oC	-	Celsius
^oF	-	Fahrenheit
%	-	percent

CHAPTER 1
INTRODUCTION

1.1 Background research

Water is one of the regular assets that demonstrate a critical part of human life. The water supply is basic to the life in which fundamental elements of society likewise requires water for cleaning of group well-being. The amount of water on Earth is surface is seawater 92.7%, 2.05% is water ice and 0.65% is water surface. Although practically sufficient water supply for all countries in the world at the moment but we have to think about the risk of a lack of water could supply future.

Desalination is the few process that removed the abundance salt and others minerals from seawater with a specific end goal to get fresh water so the water can be utilized. In this project, strong anion exchange resin is prepared from bagasse effectively and as an anti-bacterial. Bagasse obtained hydrolyzed reactive dyes bind with high affinity. Todays, in the industry by using our simple cost using ion exchange resin. This process uses ion exchange resin (*i*2EX C100 strong acid cation exchange resin and *i*2EX A300 strong base anion exchange resin) supplied by *i-Chem Solution Sdn Bhd*. Tests and analysis were done in the laboratory using two column and monitoring the salinity of artificial seawater using digital refractometer for the testing process of desalination.

1.2 Problem statement

Before this realized that the process is done through electrodialysis desalination, reverse osmosis, ultrafiltration and membrane forms. Each process requires a costly and high expense. Presently, a few islands in Malaysia having issue with the water supply. According to revealed in Borneo post on March 20, 2016 inhabitant in *Kampung Wallafe Bay, Tawau* confront troubles in acquiring clean water. The present redesigning of dam for water treatment plant around there is inadequate of water because of absence of rain. The water plant should be intensified and extended it tries again to oblige the volume of water for a period of six to eight months, even without rain. Legislative Assembly, believe the Engineers of *Tawau* water can quickly make an overview about this since this is a sincere prerequisite for the nearby people. He likewise wants to redesign the plant will be of extraordinary advantage to the group, amid the dry season, as well as to six different towns on the island that presently cannot seem to get perfect water supply.

As of now the built up desalination technologies are reverse osmosis (*RO*) and photovoltaic (*PV*). These information are introduced on a little scale *PV* fueled *RO* desalination system as displayed by Aybar et al. (2010). Besides, the adequacy of sun oriented power on *RO* of desalination has demonstrated. Be that as it may, these advances are exorbitant. To conquer the issue of water supply on the island amid the storm season, sugarcane bagasse as crude material can be utilized as a part of desalination process. *PV* control *RO* system cannot be utilized amid the rainstorm season. Moreover, the option procedure that utilizing as a part of industry is all the more unassumingly with particle trade pitch. Particle trade innovation displays colossal favorable circumstances for clearing boron in a desalination application. This appearance is very special it produces only corrosive boric from water and has no critical effect on the concentration of various particles.

1.3 Objectives

The objective of this study is about desalination of artificial seawater are:

1. To observe salinity on seawater around reclamation area in Melaka Island.
2. To remove the salinity of artificial seawater by applied sugarcane bagasse in desalination process.
3. To analyze the effect of ion exchange resins as a supporting material for sugarcane bagasse during desalination.

1.4 Scope

This project, observed, monitor regularly the salinity of seawater and artificial seawater using digital refractometer. Besides that, analyze the effect of ion exchange resins as a supporting material for sugarcane bagasse during desalination.

1.5 Limitations

This research is about the desalination of seawater that there few angles that are restricted in this project. Mostly, only the salinity of the seawater and artificial seawater was with monitor and analysed for the water quality by a digital refractometer. In the analysis, the level of salinity and to measure the salinity of seawater around reclamation area in the *Malacca Island*. Based on observations of the salinity of the seawater around the reclamation area in the Malacca Town, the concentration of artificial seawater is provided.

CHAPTER 2
LITERATURE REVIEW

2.1 Seawater Environment

Seawater is used in many situations, including desalinization systems and saltwater aquariums; it is also used as a heat change medium and as flushing water for water closets and urinals. The important differences among seawater and other styles of non-potable water are that the water is reasonably smooth, there are residing organisms gift inside the water supply, and the seawater accelerates corrosion to metal pipes and valves. Over 70% of the Earth is covered with water, most of this water is inside the oceans; about 97% of the arena's water is salt water and is undrinkable or unusable without a few form of treatment to dispose of the salt. Seawater is the most effective electrolyte containing a particularly immoderate concentration of salts that takes area commonly in nature, masking because it does over two-thirds of the earth's floor. It is far each the maximum familiar and one of the maximum excessive of natural corrosive agents.

However, desalination is an extremely highly-priced and energy in depth process. Hence, the water inside the seawater is inaccessible for maximum countries or groups around the world. Only approximately 3% of the water on this planet is sparkling. The freshwater reserves consist of: rivers and lakes, marshes, the vadose zone, groundwater aquifers, glaciers and other completely snow-included regions, permafrost, organic entities, and the atmosphere. No longer is all of this water easily available or exploitable 68.7% is locked in ice caps and glaciers and 30.1% is in clean groundwater, leaving a completely small component 1.3% in surface and different freshwater resources for human intake. Table 2.1 shows a Water Reserves on Earth (Shiklomanov, 1993).

Table 2.1: Water Reserves on Earth (Shiklomanov, 1993)

Water source	Water volume, in cubic miles	Water volume, in cubic kilometres	Percent of freshwater	Percent of total water
Oceans, seas & Bays	321,000,000	1,338,000,000	-	96.5
Groundwater	5,614,000	23,400,000	-	1.69
Fresh	2	10,530	0.76	30.1
Soil moisture	-	16.5	0.001	0.05
Glaciers and permanent snow cover	16,227	24,064.1	1.74	68.7
Antarctic	13,980	21,600	1.56	61.7
Greenland	1,802	2,340	0.17	6.68
Arctic islands	226	83.5	0.006	0.24
Mountainous regions	224	40.6	0.003	0.12
Ground ice/permafrost	21,000	300	0.022	0.86
Water reserves in lakes	2,0548.7	176.4	0.013	–
Fresh	1,236.4	91	0.007	0.26
Saline	822.3	85.4	0.006	–
Swamp water	2,682.6	11.47	0.0008	0.03
River flows	148,800	2.12	0.0002	0.006
Biological water	510,000	1.12	0.0001	0.003
Atmospheric water	510,000	12.9	0.001	0.04
Total water reserves	510,000	1,385,9844.61	100	–