

UNIVERSITI TEKNOLOGI MARA

**COMPOSITION DETERMINATION
FOR ELECTRON BEAM
IRRADIATION AND IONIC LIQUID
PRETREATMENT OF OIL PALM
FROND (OPF)**

SITI AISYAH BINTI MOHD ZAMRI

Thesis submitted in fulfillment
of the requirements for the degree of
**Bachelor of Engineering (Hons.)
(Chemical and Bioprocess)**

Faculty of Chemical Engineering

July 2018

ABSTRACT

This research project was conducted to study the effect of electron beam irradiation and ionic liquid as the pretreatment process on lignocellulosic biomass. The lignocellulosic biomass that were used in this research are Oil Palm Frond (OPF). Prior to the determination of composition of lignin, cellulose and hemicellulose, the lignocellulosic biomass was pretreated with ionic liquid and electron beam irradiator. The chemical pretreatment of lignocellulosic biomass was by using ionic liquid which is 1-ethyl-3-methylimidazolium acetate or [EMIM]Ac. Physicochemical pretreatment adopted using electron beam irradiator was conducted at Malaysia Institute for Nuclear Technology (MINT). Before the OPF were irradiated with electron beam irradiator at 100, 200, 400, 600, 800 and 1000 kGy, they were pretreated with 50% of [EMIM]Ac first. Morphological characteristic of the biomass was observed by using Fourier Transform Infrared Spectroscopy (FTIR) and X-Ray Diffraction (XRD). The chemical compositions of lignin, hemicellulose and cellulose were determined by using Kappa number and TAPPI method. The results from the research found that, the higher the irradiation doses of electron beam irradiation, the greater the dissociation of cellulose and more accessible surface area of cellulose toward next hydrolysis process in order to produce biofuels.

.

ACKNOWLEDGEMENT

Alhamdullilah, all praises to Allah for all the strength, health, guidance and His blessing given in accomplishing this research. I would love to express my special thanks of appreciation to my supervisor, Madam Amizon Binti Azizan and my co-supervisor Nur Amira Aida Binti Jusri for their continuous aids and advice. Their extended encouragements throughout this research have contributed to the success of this research project.

Secondly, I would like to offer my deepest gratitude towards my family members that have supported me to the fullest. My appreciation also goes to the Fundamental Research Grant Scheme (FRGS) (600-RMI/FRGS 5/3(12/2015)) from Ministry of Higher Learning for the financial support. Special thanks to the head of programme of Bachelor in Engineering (Hons) Chemical and Bioprocess, Dr. Fazlena binti Hamzah and towards research project coordinators Madam Siti Fatma Binti Abdul Karim and Dr. Siti Noor Suzila Binti Maqsood-Ul-Huque for the significant dedication during my Final Year Project.

Lastly, my thanks go to my classmates and my friends for their inspirational motivation throughout the years.

TABLE OF CONTENT

	Page
AUTHOR’S DECLARATION	ii
PLAGIARISM DECLARATION	iii
SUPERVISOR’S CERTIFICATION	iv
COORDINATOR’S DECLARATION	v
ABSTRACT	vi
ACKNOWLEDGEMENT	vii
TABLE OF CONTENT	viii
LIST OF TABLES	xi
LIST OF FIGURES	xii
LIST OF ABBREVIATIONS	xiii
CHAPTER ONE	1
INTRODUCTION	1
1.1 Research Background	1
1.2 Problem Statement	3
1.3 Objectives	3
1.4 Scope of Research	4
CHAPTER TWO LITERATURE REVIEW	5
2.1 Lignocellulosic Biomass	5
Lignin	7
Cellulose	8
Hemicellulose	9
2.2 Valuable Products that Uses Lignocellulosic Biomass as Feedstock	9
2.2.1 Biofuel	9
2.2.2 Polyhydroxyalkanoates (PHAs)	11

CHAPTER ONE

INTRODUCTION

1.1 Research Background

In these recent years, focus of producing biofuels is moving from the first-generation biofuels to second-generation and third-generation biofuels. First-generation biofuels are biofuels that are produced directly from crops like maize and sugarcane. However, this type of biofuels production brings about ethical issue on using food as feedstocks. Biofuels generated from second-generation biofuels is what this research is discussing about. The second-generation biofuels are also known as advanced biofuels which means that the fuels are manufactured from a various range of biomass. While, third-generation biofuels are just recently becoming a mainstream subject of discussion where the biofuels are derived from algae. There are many possible fuels that can be derived from algae which include biodiesel, ethanol, methane and many others.

Since fossils are not considered sustainable and it has been depleting in resource, the scientists had their intention in producing a sustainable biofuel from renewable source. Furthermore, burning of fossil fuels contributes to the increasing of carbon dioxide emission. The adverse effect of greenhouse gas like global warming to the environment has created so many researches being investigated in order to reduce these.

Lignocellulosic biomass mainly consists of three polymers which are cellulose, hemicellulose and lignin simultaneously with small quantity of other components such as acetyl groups, minerals, and phenolic substituents. The major components of lignocellulosic biomass are cellulose followed by hemicellulose and lignin (Isikgor & Becer, 2015).

There are many types of pretreatments used to treat the lignocellulosic biomass in order to reduce the complexity of the structure. Physiochemical type pretreatment that is used in this research is electron beam irradiation. It is an environmentally friendly