UNIVERSITI TEKNOLOGI MARA

DETERMINATION OF CHEMICAL COMPOSITION AND STRUCTURAL CHANGES OF TORRIFIED OIL PALM FRONDS (OPF) PELLETS VIA TAPPI METHOD/FTIR

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This report is submitted in partial fulfillment of the requirements needed for the award of
Bachelor of Chemical Engineering (Hons.)

JULY 2018

ACKNOWLEDGEMENT

In preparing this project, I was in contact with many people, researchers, academicians, and practitioners. They have contributed towards my understanding and thoughts. Besides, I have learned that we need to sacrifice little things in order to achieve one big achievement. First and foremost, Alhamdulillah and gratitude to Allah because without Him, this research would not be finished according to the plan.

In particular, I would like to express my sincere appreciation and gratitude to both my supervisors, Dr. Siti Wahidah Puasa and Madam Sharmeela Matali for constantly encouraging and guiding me throughout the process of this research. Their advice, critics, and suggestion really helped me to go through all the difficulties and confusion during the process of completing this thesis. Without them, this thesis would not be able to be prepared to its final form.

I also would like to thank to all the staff from the Department of Chemical Engineering, Universiti Teknologi Mara Shah Alam for letting the experiment for this research to be done there successfully. Thank you for the great cooperation and hospitality.

I would like to extend my gratitude to colleagues especially Nur Afini, Nur Illya Aqinnah, Nina Suhaila, Filzah Anati and Fazira that have been involved in helping me in the process to complete this thesis. All the views and suggestions are highly appreciated. Last and the most important part of my life, my husband, Encik Mohamad Shahwal bin Jamin, both my parents Encik Khamis bin Kasdo and , and my sisters, Noor Zamira and Nor Azura, whom do not fail to give me endless morale and financial support ever since day one.

ABSTRACT

Torrefaction is a mild thermolysis process, which efficiently convert energy and biomass homogenization that involves in an inert atmosphere and low temperature of 200 to 300 ^{o}C for about 60 minutes at atmospheric pressure. The basic principle of torrefaction involves the process of removing oxygen and hydrogen and also the enhancement of carbon as the final product. This pretreatment helps in reducing moisture content, atomic O/C and H/C ratioS and it also help to boost the heating value, hydrophobicity, grindability, flowability and homogeneity of the biomass. In this research, an agricultural waste from oil palm plantation, oil palm frond (OPF) is subjected to the pretreatment process of torrefaction in a horizontal tube furnace at five temperatures and holding time of 60 minutes. Biomass compositional results and Fourier Transform Infrared Spectrometer (FTIR) analysis of OPF were compared within five temperatures. Results acquired revealed that the highest percentage in extractives, cellulose and hemicellulose was found in raw OPF compared to other torrefied OPF showing that torrefaction process were successful to reduce these composition at the end of this study. Meanwhile, the highest percentage of lignin was at 300 ^{0}C as lignin was the hardest composition to be thermally degraded due to its ability to decompose in a much wider temperature range and known to have stronger chemical bonds.. From FTIR analysis, it was concluded that the structure of hemicellulose and lignin were greatly affected by torrefaction whereas the structure of cellulose were affected slightly. Therefore, result gained proved that torrefaction is a great alternative in converting raw biomass into a promising renewable energy.

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CHAPTER ONE
INTRODUCTION

1.1 Overview

In this chapter, it will cover the introduction to renewable sources available for energy production purposes and its beneficial properties towards the environment. Oil palm frond (OPF) is one of the agricultural waste from palm oil plantation. OPF owns high potential as new sources in producing renewable energy regardless its downsides. The main objectives of this study are identified in order to investigate the effect of torrefaction towards changes on chemical and structural composition of OPF. To overcome disadvantages of raw OPF, thermal treatment technique called torrefaction is conducted using low temperature between 200 - 300 ^{0}C in an inert or nitrogen atmosphere at atmospheric pressure. The changes of chemical composition is conducted using TAPPI method while the structural changes is conducted using Fourier Transform Infrared Spectrometer (FTIR).

1.2 Research Background

Biomass utilization has been highly requested in the last decade either as a power generation, biofuel production or valuable chemical due to rising of economical demand towards sustainable renewable sources. In power generation section, biomass wins over fossil fuels in terms of benefits such as decreasing the emission of carbon dioxide and sulfur during combustion. Thanks to the depletion of fossil fuels and increasing consciousness towards environmental protection, biomass is suitable as an exchange to fossil fuels in the future because it can be found abundantly, clean and carbon dioxide neutral (Xun, 2015).

One of the downsides of using raw biomass as a fuel source is that it is more tenacious and less brittle which leads to the high requirement of energy and more difficult to grind into smaller particles. Besides having naturally fibrous structure and disperse distribution, raw biomass also contains high moisture content, low energy density, hygroscopic behavior which hinders efficient and low-cost