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DETERMINATION OF CHEMICAL COMPOSITION AND STRUCTURAL CHANGES OF TORREFIED *LEUCAENA LECOCEPHALA* (PETAI BELALANG) PELLETS VIA TAPPI METHOD/FTIR

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ABSTRACT

Alternative energy from renewable resources such as biomass can be used as a substitution to fossil fuel for a greener energy option. However, utilization of biomass has some limitations such as high ash and moisture content, low energy density, low heating value, and high energy is required for size reduction. Torrefaction which is also known as a mild pyrolysis pre-treatment can be implemented to upgrade the physical and chemical properties of biomass. This pre-treatment involves a moderate temperature above 200°C in the absence of oxygen. Torrefaction offers advantages in overcoming the problem arise associated with raw biomass. In this study, a potential energy crop, *Leucaena leucocephala*, a woody biomass will be studied for its energy purposs as to identify their potential usage as bioenergy fuel. The purpose of this study was to determine the chemical composition and structural changes of torrefied *Leucaena leucocephala* pellets by using TAPPI method and FTIR. The torrefaction process of the sample was conducted in a horizontal tube furnace at five different temperatures with 60 min of holding time. The chemical compositions and structural changes of torrefied products were compared to its raw forms. The results obtained show a decrease in cellulose and hemicelluloses and an increase in lignin content as torrefaction temperature became severe. It was concluded that as torrefaction temperature increases, high quality of biomass with low moisture and volatiles content was produced. The results obtained prove that torrefaction as pretreatment process improves the biomass properties.

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CHAPTER ONE

INTRODUCTION

1.1 SUMMARY

The dependence on fossil fuels as main source of energy supply has caused greenhouse gas emissions and depletion in fossil fuel reserves. Therefore, alternative energy from renewable resources such as biomass can be used as substitution to fossil fuels for a greener energy options. Biomass energy sources are recognized as one of the renewable and sustainable energy that are used to create electricity and gas such as methane, hydrogen and carbon monoxide which can be converted to fuels (Cherubini, 2010). Lignocellulosic biomass refers to plant that is composed of cellulose, hemicelluloses and lignin which can be found in all plant substances. It is the most abundant renewable feedstock and low cost raw materials. Thus, optimal utilization of lignocellulosic biomass can lead to sustainable industrial progress and low-carbon economy.

However, utilization of biomass as biofuels has some limitations such as high ash and moisture content, low energy density, low heating value, and high energy is required for size reduction (Wannapeera *et al.*, 2015). Nevertheless, torrefaction which is also known as mild pyrolysis can be carried out in order to overcome these problems as well as to convert biomass into compatible energy fuels. Torrefaction process involves thermal heating in temperature ranges between 200°C and 300°C with absence of oxygen.

Leucaena leucocephala which is also known as "Petai Belalang" is one of the plant species in Malaysia that has the potential as the bioenergy crop material. *Leucaena leucocephala* has been recognized as a potential energy crop and is categorized as woody biomass. *Leucaena* species have high biomass productivity. According to Shrestha *et al.* (2015), *Leucaena leucocephala* is considered an important plant for utilization of biomass as it is a very fast growing species, productive and multipurpose tree and can be grown in wide range of soil.