UNIVERSITI TEKNOLOGI MARA

MICROWAVE PRETREATMENT OF *LEUCAENA LEUCOCEPHALA* USING DILUTE SULPHURIC ACID

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ABSTRACT

Globally, the production of bioethanol from lignocellulosic biomass is in demand due to fossil fuels depletion and the effects of fossil fuels consumptions such as greenhouse gas emissions and climate change. As biomass sourced from natural forests is not favourable to avoid risks of deforestation, it is desirable to study the use of *Leucaena Leucocephala*, a fast-growing tropical tree and non-crop species to be a fuel supply for bioethanol production. However, it is necessary for lignocellulosic material, due to its recalcitrant structure to undergo pretreatment in order to increase the efficiency of its enzymatic hydrolysis of cellulose into simple sugars, before fermentation process to produce bioethanol. Therefore, the purpose of this study is to determine the effect of dilute sulphuric acid concentration and microwave pretreatment time on the functional groups, thermal degradation profiles and proximate analysis of *Leucaena Leucocephala*. The concentrations of dilute sulphuric acid used were 0.2M and 0.4M with microwave pretreatment time of 5 minutes and 10 minutes. Four types of pretreated samples (0.2M-5min, 0.2M-10min, 0.4M-5min, 0.4M-10min) were prepared with respective dilute sulphuric acid concentration and microwave pretreatment time. An untreated sample, which was not pretreated with dilute H_2SO_4 and microwave heating, was used as a basis of the pretreatment. FTIR results showed that O-H absorption peak for each sample increased after respective pretreatment conditions. Increasing microwave pretreatment time did not necessarily remove C-H functional group of lignin. The disappearance of peak for C-O stretching in hemicellulose and lignin showed removal of major hemicellulose. No significant differences were observed for C-O-C, C-O, C-OH functional groups after pretreatment though small increased in band assignment in the region might indicate cellulose enhancement. Thermogravimetric analysis (TGA) results showed that during pyrolysis, the maximum degradation temperature and maximum mass rate loss obtained were 363.69°C and 2.76 mg min^{-1}, respectively. Increasing severity of microwave pretreatment time from 5 minutes to 10 minutes and dilute sulphuric acid concentration from 0.2M to 0.4M increased the biofuel properties of the sample as higher volatile matter were released with lower moisture and ash content were obtained.

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CHAPTER 1

INTRODUCTION

1.1 RESEARCH BACKGROUND

In recent years, technology for producing biofuels such as ethanol from lignocellulosic material is gaining serious attention due to rapid depletion of fossil fuels, which is still the major source of energy today. Diaz et al. (2015) reported that bioethanol has great potential as a renewable energy due to its compatibility with current infrastructure. *Leucaena Leucocephala*, an example of lignocellulosic biomass, has been considered as potential feedstock for bioethanol production. (Ilham et al,2014).

Various scientific studies on *Leucaena Leucocephala* have been done, due to its biofuel properties. *Leucaena Leucocephala* kernel oil can be blend directly with fossil fuel as the kernel contains fatty acids, potential source for inhibiting the bio-corrosion of metals. (Prasad et al.,2013). The seed oil can be converted into biodiesel via transesterification method. As biomass sourced from natural forests is not favourable to avoid risks of deforestation, it is desirable to study the use of *Leucaena Leucocephala*, a fast-growing tropical tree to be a fuel supply for biomass production. (Abe at al.,2007; Tewari et al.,2004).Studies on *Leucaena* as biochar fuel has been done as well. Anupam et al. (2016) studied the upgradation of *Leucaena* bark to biochar fuel with high energy yielding, through slow pyrolysis, where biomass is heated in limited presence of air to break down the biomass into simpler substances such as solid biochar, pyrolytic gases and liquid bio-oil.

To convert lignocellulosic material into biofuel, enzymatic hydrolysis must be done to obtain fermentable sugars and ethanol. However, the hydrolysis efficiency is often reduced by complex lignin that seal cellulose and hemicellulose structure of biomass. Lignin complex limits susceptibility of enzymes to cellulose. (Keshwani et al.,2007).Hence, it is necessary to pretreated lignocellulosic material in order to increase the efficiency of enzymatic and chemical hydrolysis of cellulose and hemicellulose. Physical, chemical and physico-chemical pretreatments are examples of pretreatment methods that can be assayed for biomass pretreatment.