UNIVERSITI TEKNOLOGI MARA

# PRETREATMENT OF OIL PALM FROND BY ELECTRON BEAM IRRADIATION AND IONIC LIQUID METHOD

NURUL FAAIQAH BINTI NASARY

B. Eng

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# ABSTRACT

In this study, the studied lignocellulosic biomass (LCB), oil palm frond (OPF) was pretreated with an ionic liquid (IL), 1-Ethyl-3-methylimidazolium acetate EMIM Ac. The pretreatment combines physical and physicochemical pretreatment for dissolving the biomass cellulose. The sample was first pretreated by electron beam irradiation (EBI) at Agensi Nuklear Malaysia which the irradiation dose of 100, 200, 400, 600, 800 and 1000 kGy with 2 MeV of voltage accelerator and 5 mA current flow. Ionic liquid pretreatment was then carried out using Bioshake at temperature 70 - 99°C for 4 hours with the speed of 800 rpm. Until the supernatant was achieved, the sample was being dried in the oven and analyzed by using Fourier Transform Infrared (FTIR) spectroscopy. FTIR spectroscopy allows the composition of the biomass to be examined, qualitatively and quantitatively based on the absorbance of infrared radiation. TAPPI method was used to determine cellulose, hemicellulose and lignin degradation. The resulting FTIR spectra of the EBI and IL pretreated oil palm frond and cellulose show that the lignocellulosic biomass components degradation increases as the EBI doses increases, yet the spectra reading trend got a fluctuation due to error that possibly caused by contamination and particle size of LCB. The resulting TAPPI method shows that the cellulose composition and lignin degradation increase as the EBI doses increases, nevertheless the reading instability present in the middle of the doses range which probably due to excessive water presence in the ionic liquid and inhibitory factor that prevents the cellulose to be soluble and lignin to be degraded, respectively.

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# 1.0 INTRODUCTION

## 1.1 Research Background

At the present time, the world are facing energy resources complications due to the documented issues of fossil fuels, i.e rising cost and unpredicted instabilities, releases of greenhouse gases, global warming and limited source. Thus, various alternatives have been strategized to overcome these difficulties. Fortunately, the awareness of these issue has been increasing, as can be seen from the developed field of renewable resources, sustainable energy which economically practical, for instance, bioethanol. Bioethanol can be formed by various raw materials which are biological. It gives cleaner releases compared to other fuel resources (Haghighi Mood *et al.*, 2013). Until now, numerous researches has been done regarding bioethanol production from biomass wastes.

Nowadays, trend of potential of biomass as one of alternate source of energy has been rising. Therefore, palm oil frond has been an attention to produce fuel which is biomass based (Hassan, Kee and Al-Kayiem, 2013). Palm oil mill manufacturing has developed to be a favored medium for continuous and large biomass resource. In Malaysia, contribution of the industry of oil palm affects the nation's economic growth a lot. Therefore, it is worth to have them as the feedstock to convert them into energy, not only because of widely plantation but also due to their renewable characteristic and hence being long lasting source of fuel (Qiu, Aita and Walker, 2012).

The biomass source which contains lignocellulosic materials has been attraction of scientist to integrate them in the fuel production. Lignocellulose which consists of hemicellulose, cellulose and lignin can be extracted into sugar for energy conversion. Lignocellulosic materials abundance causing it to be non-affecting to human food chain supply, strengthen the researcher purpose to have them as their study (Kristiani *et al.*, 2013).

Pretreatment is one of the way to ensure the biomass structure includes lignocellulose to be hydrolyzed. Pretreatment has many types, for example, physical, biological, chemical and physiochemical (Poornejad, Karimi and Behzad, 2014). This method allowing hydrogen bond to be disturbed and broken down besides increasing the area of the surface and the permeability. Pretreatment using dilute acid solution can contribute to lignocellulose breaking down structure thus increasing catalyst or even enzyme digestibility (Kristiani *et al.*, 2013).

Due to pretreatment methods, ionic liquid is used to increase the efficiency of the method. Ionic liquid is organic salts that are liquid in room temperature. It is also called as green solvents (Qiu, Aita and Walker, 2012). Ionic liquid display outstanding physical characteristic, e.g. dissolving organic, non-polar and