UNIVERSITI TEKNOLOGI MARA

OPTIMIZATION OF ELECTRON BEAM IRRADIATION AND IONIC LIQUID PRETREATMENT OF OIL PALM FROND

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ABSTRACT

The pretreatment of oil palm frond (OPF) had been carried out using Electron Beam Irradiation (EBI) and followed with 1-ethyl-3-methylimidazolium acetate [EMIM][OAc] pretreatment. The purpose of the pretreatment are to analyse the optimal condition to get low CrI and LOI value. The lower the CrI and LOI value will lead to high effective for conversion to simple monomer sugar. The decreasing trend of crystallinity index contribute to the effectiveness is high the effectiveness with the highest speed, the longer time taken and highest value of dosage should be used. For FTIR, the result obtained are not reliable to further the optimization method. Negative effectiveness are not realiable to continue optimization of LOI. The value of LOI before undergo ionic liquid pretreatment, has achieved the rule of thumb where by, high dosage will give out high effectiveness of and lower value of LOI. The parameter need to be optimize are time, speed for Bio-shake IQ and irradiation dosage. Range of time from 1 hour to 4 hours and speed from 400 rpm to 800 rpm. For irradiation dosage, the range is 100kGy to 500kGy. The effects of EBI dosage, speed of Bioshake reactor and retention time on Crystallinity Index (CrI) were investigated by applying Box Behnken Design of Response Surface Methodology (RSM). The optimum pretreatment for CrI conditions prediction of low OPF crystallinity index are at the retention time 2.76 h, Bio-shake speed 646.46 rpm and EBI dose was 358.59 kGy. Also, the highest EBI dosage, the longer the time mixing and the highest the speed will increase the effectiveness of the pretreatment. For the parameter that analyse by XRD had successfully achieved.

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CHAPTER ONE
INTRODUCTION

1.1 RESEARCH BACKGROUND

Biomass is a renewable source of energy. It can be used indirectly and directly purpose. For directly purpose, biomass can be burn to give out heat or to generate electricity meanwhile for indirect purpose biomass can be convert into biofuel in liquid form or biogas in gaseous form. Today, biomass contribute by oil palm industry is produce in large production per year. Usually, oil palm biomass can be characterized into two which are, in 2012, dry waste with 83 millions tonnes of solid waste meanwhile, 60 million tonnes of liquid waste generated (Onoja et al, 2018). There are various type of oil palm biomass which are oil palm trunk (OPT), empty fruit bunch (EFB), oil palm frond (OPF), mesocarp fruit fibre (MF), palm kernel shells (PKS) and palm oil mill effluent (POME). In fact, 75% of the oil palm solid waste are from OPF and OPT.

Based on study by Onoja et al (2018) oil palm biomass has high composition of hydrogen and oxygen compared to carbon. It would possess low calorific value and required lower energy to break the bonds that exist between hydrogen–carbon (C-H) and oxygen–carbon (C-O) compare to the energy required to break carbon–carbon (C-C) bonds. By definition, high composition of oxygen oil palm biomass are suitable to act as fuels source. More over, oil palm biomass also has small amount composition of nitrogen and sulfur which can lead to environmentally friendly fuel.

Lignicellulose biomass (LCB) is an organic material that can be obtain from biomass which has a high content of lignin, hemicellulose and cellulose (Wu et al, 2016). LCB generally contribute to a complex matrix containing different polysaccharides, phenolic polymers and proteins. LCB has the potential to be large number of a feedstock in the production of biofuels such as bioethanol (Zafar, 2018). However, the LCB must first be pretreated by performing pretreatment to increase the pores and its surface area, to reduce the crystallinity of cellulose and to reduce of the amount of lignin content to achieved good fermented result. Then, after pretreatment step. follow by hydrolysis and fermentation process (Kristiani et al, 2015).

Therefore, for this research project, OPF is chosen due to its availability in Malaysia which is 9.6 tonnes of dry OPF per hectare (AIM, 2012). Much, the