A Factorial Analysis Study on Enzymatic Hydrolysis of Fiber Pressed Oil Palm Frond for Bioethanol Production

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Abstract. Different technologies have been developed to for the conversion of lignocellulosic biomass to suitable fermentation substrates for bioethanol production. The enzymatic conversion of cellulose seems to be the most promising technology as it is highly specific and does not produce substantial amounts of unwanted byproducts. The effects of agitation speed, enzyme loading, temperature, pH and reaction time on the conversion of glucose from fiber pressed oil palm frond (FPOPF) for bioethanol production were screened by statistical analysis using response surface methodology (RSM). A half fraction two-level factorial analysis with five factors was selected for the experimental design to determine the best enzymatic conditions that produce maximum amount of glucose. FPOPF was pre-treated with alkaline prior to enzymatic hydrolysis. The enzymatic hydrolysis was performed using a commercial enzyme Cellic CTec2. From this study, the highest yield of glucose concentration was 9.736 g/L at 72 hours reaction time at 35 °C, pH 5.6, and 1.5% (w/v) of enzyme loading. The model obtained was significant with p-value <0.0001. It is suggested that this model had a maximum point which is likely to be the optimum point and possible for the optimization process.

1. Introduction

According to Malaysian Innovation Agency in year 2011, the palm oil sector correspondingly generates the largest amount of biomass waste that is estimated around 80 million dry tons in 2010. It is expected to increase around 100 million dry tons by 2020 [1]. This huge amount of biomass waste may leads to serious disposal problem. Therefore, many studies have been conducted in turning this biomass waste into fermentable sugars by various methods and pretreatment and as a substitute for non-renewable energy sources. Oil palm frond (OPF) is currently been considered as one of the most sustainable lignocellulosic biomass (LCB) sources which are valuable and profitable to the agriculture industry. Presently OPF is used in local beef and dairy industry as source of fiber or as an ingredient in a complete fodder for ruminant animals in terms of pallets, silage or cubes [2]. Recent study showed

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