UNIVERSITI TEKNOLOGI MARA

SYNERGISTIC EFFECT OF CO-COMBUSTION OF EFB CHAR WITH COAL USING BET ANALYZER

NABILAH BINTI NAHARUDIN

Thesis submitted in fulfillment
of the requirements for the degree of
Bachelor of Engineering (Hons) Chemical

Faculty of Chemical Engineering

July 2019

ABSTRACT

Renewable energy is becoming more popular worldwide due to economic crisis and critical source of conventional fossil fuel such as coal, petroleum, diesel and natural gas. Empty fruit bunch (EFB) char is one of the renewable energy sources that can replace coal and act as a fuel to generate steam and electricity. In this study, microwave pyrolysed EFB char was co-combusted with coal in order to achieve high efficiency for power generation from biomass/coal blends compared to the use of biomass standalone. The aim for this study was to identify the synergistic effect during co-combustion between EFB char with Mukah Balingian (MB) coal blends by using Brunauer-Emmett-Teller (BET) analyser. The surface area of EFB char and MB coal blends were investigated over a range of different weight ratio and temperature. In this research, the weight ratio of EFB char/MB coal blends were from 100:0, 60:40, 20:80, and 0:100 and the temperature for co-combustion will be conducted at 400, 600, and 700°C. Raw EFB was pyrolyzed in microwave pyrolysis condition at 300 W exposed for 35 minutes. The resulting solid char was mixed with MB coal at different blending ratio prior to undergoing co-combustion in furnace. The results revealed that the surface area is inversely proportional to temperature of combustion. The higher the combustion temperature, the lower the BET surface area. Besides that, as the mass fraction of EFB char increases, the surface area of pores decreases. The synergistic effect was analyzed by comparing the actual and predicted BET surface area generated by linear equation. From the comparison, the actual BET surface area obtained experimentally does not synchronize with the predicted BET surface area due to interaction occur between the blends. This can be concluded that there is a synergistic effect occur on the co-combustion of EFB char with MB coal.

Keywords – BET analysis; Coal; Empty Fruit Bunch Char; Synergistic effect.

ACKNOWLEDGEMENT

First, I would like to thank to the Almighty Allah for giving me the strength and His blessing upon finishing my research project as to fulfil the requirement for finishing my study. I am gratefully thanking my supervisors, Normadyzah Ahmad, and Siti Shawalliah Idris for helping me throughout the whole two semester in conducting this research project.

Besides that, I would like to thank to Fazni Susila Abd Ghani for assistance in conducting the BET analyser and Johan for helping me conducting the microwave pyrolysis. Without them, I might not complete my research project as they keep on providing more knowledge and encourage me to keep on strong in doing this research project. Not to forget to my beloved family and friends who always gives support and help me a lot on finishing my research project.

Finally, I would like to acknowledge Faculty of Chemical Engineering, Universiti Teknologi MARA, Shah Alam for their support and facilities provided in conducting the experiment for my research project. May Allah bless all of them who makes my life easier and help me along my journey in finishing research project.

TABLE OF CONTENTS

CHAPTER 1 : INTRODUCTION

In this chapter, detailed information about research background and scope of study are explained for this research work. This will also include the objectives of this research and discussion on the problem statement.

1.1 RESEARCH BACKGROUND

Nowadays, renewable energy is becoming more popular worldwide due to critical source of current fuel and economic crisis. About 34 countries in the world are attempting to reduce the agricultural waste by converting them into biomass as the major source for renewable energy. In 2014, United States of America (USA) has generated the highest electricity from renewable municipal waste (8,461 GWh) followed by Japan (6,574 GWh), Germany (6,069 GWh), and Italy (2,370 GWh) (Council, 2016). Biomass can be used widely such as cooking, heating buildings and homes, and even become an electricity source. It can be in a form of solid biomass such as wood and garbage or it could also be a biogas and liquid biofuels such as biodiesel and ethanol. These fuels are then burnt to convert into energy (Philip, 2018). Day after day, biomass is becoming the most common raw material for renewable energy sources. Biomass waste such as animal waste, aquatic plant, energy crops, wood and wood waste, agricultural crops and their waste by-product