UNIVERSITI TEKNOLOGI MARA

BIOCHAR FROM FIXED BED BIOMASS CARBONIZATION IN VARIOUS PYROLIZING ENVIRONMENTS

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Thesis submitted in fulfilment
of the requirement for the degree of
Master of Science

Faculty of Mechanical Engineering

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of University Teknologi MARA. It is original and is the result of my work, unless otherwise indicated or acknowledge as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and regulation for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Slow pyrolysis process has been known as the competitive ways for the production of biochar. There are several factors effecting the production of biochar yield in terms of their quality and also quantity of biochar produced such as heating rate, temperature, particle size, residence time, originality of feedstock, etc. Slow pyrolysis occurs in the absence of oxygen or significantly less oxygen is present than required for complete combustion or gasification to take place. However, in industrial scale process, it is difficult to avoid oxygen infiltration during the process. In this thesis, a diameter of 52 mm and total length of 500 mm fixed bed pyrolysis system was used to study the effects of oxygen composition and various pyrolizing environments such as bed temperature and residence time on the quantity and quality of palm shell and mangrove wood char yield. The design and fabrication of the reactor was also part of this study. Oxygen ratio was set from 0% to 11% and nitrogen gas was used to balance oxygen ratio. The pyrolysis runs at 345°C to 615°C, residence time was between 2.00 hours to 5.00 hours. Nitrogen gas was let to be continuously flow in the reactor for 10 min to outflow oxygen before run. Oxygen ratio was set by adjusting flow speed of oxygen and nitrogen. Heating rate was set at 10°C/min for each run. Response surface methodology was used as a design of experimental method to minimize the number of experiment run. Only the char yield from char container was collected and weighed for further analysis while others were not collected. The characterisation of biomass solid waste and the char yield was also conducted. From the experimental results, it was shown that the highest char yield percentages of both palm shell and mangrove wood was 38.35% and 22.39% respectively under temperature of 480 °C, 0% of oxygen and 3.13 hours of residence time. The results shows that lower oxygen ratio, lower residence time and higher temperature increased the biochar yield percentages. It was shown that oxygen composition generally influenced the quantity and quality of biochar.

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