PRODUCTION OF BIO-COAL FROM DUCKWEED BY DRY TORREFACTION

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I declare that the work in the thesis was carried out in accordance with the regulation of Universiti Teknologi MARA. It is original and is the results of my own, unless otherwise indicated or acknowledge as reference work.

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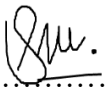
Signed : 

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We declared that we read this thesis and in our point of view this thesis is qualified in terms of scope and quality for the purpose of awarding the Bachelor of Chemical Engineering (Environment) with Honours.

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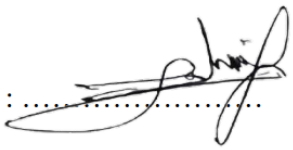
Signed : 

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ABSTRACT

Dry torrefaction is a thermal process that convert biomass into a coal-like material. It is a process of heating of biomass in the absence of oxygen and water at temperature of typically 200 to 300 °C. This process does not only used to improve the structure of biomass, but increases its calorific value and energy density. Since the torrefaction process is still new, the scientific features of feedstock and chemical reaction kinetics, including physico-chemical changes, are not fully understood and the effects of reaction parameters are still being examined. Besides, duckweed and other aquatic plants has becoming a popular prospective source of biomass because it has high proportion of cellulose and starch and low lignin content. It becomes an ultimate choice because it requires minimum pretreatment compared with other biofuels feedstocks such as pine woods, bamboo and corn cob. This study is focused on determining the optimum operating condition for dry torrefaction of duckweed in order to transform into bio-coal and reviewing the fuel properties such as moisture content, higher heating value (HHV), O/C ratio, H/ C ratio and solid yield of bio-coal derived from duckweed. The series of experimental work of torrefaction process was conducted with constant residence time which is 60 minutes. The effect of temperature and flowrate of nitrogen as carrier gas was studied. The torrefied duckweed is analyzed using high heating value (HHV), proximate analysis and ultimate analysis. From the experimental result, severe torrefaction (400 °C) is not suitable for biomass due to very low solid and energy yield. Thus, 300 °C is chosen as the most suitable dry torrefaction temperature. Although the impact of nitrogen flow rate as carrier gas is uncertain, nitrogen supply of 90 ml/min was chosen as the optimum carrier gas used in duckweed torrefaction because it records the highest HHV at all temperature variations.