

THE POTENTIAL OF CO₂ TORREFACTION AS BIOMASS PRE-TREATMENT METHOD

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Abstract

Malaysia is one of the world largest palm oil producer, where its processing is producing a large amount of biomass waste. There is a huge potential in its utilization as an energy source, as not only the amount of waste is reduced, the dependency on the fossil based fuel will also be reduced as well. However, biomass as-received is not suitable to be processed directly, as it has high moisture content and will reduce the process efficiency. Nevertheless, this may be overcome through pre-treatment processes such as torrefaction. Torrefaction of biomass aims to improve the fuel properties by lowering the moisture content and increasing the energy density at temperature between 200°C to 300°C in either inert or non-inert environment. The objective of this work is to study the effect of CO₂ concentration present during biomass torrefaction at temperature 240°C and 280°C. In this case, the empty fruit bunch (EFB), one of the main waste in the palm oil processing. In addition, the impact of torrefaction time was also evaluated at 15 and 30 minutes. The torrefaction reactor consists of a vertical stainless-steel tubular reactor equipped with an electrically heated furnace. The torrefied biomass was cooled off before analysis. It was determined that the mass yield is decreased with increased in the CO₂ concentration. This suggests the occurrence of oxidative reaction, for example the Boudouard reaction and an enhancement of volatile matter release. The heating value of the torrefied biomass shows an increasing trend, with temperature increased. This is consistent with the findings in the literature, which primarily indicates improved fuel properties. The comparable mass loss at lower temperatures improved fuel properties, makes utilization of carbon dioxide as a torrefaction medium for pretreating biomass as an attractive technology.

Keywords: Torrefaction, Carbon dioxide, Biomass pre-treatment, Biofuel.

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