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FRACTIONATION OF BIO-OIL USING FRACTIONAL DISTILLATION COLUMN FOR TRANSPORTATION LIQUID FUELS

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ABSTRACT

The advancement of technology in transportation industries has been booming and the demands of fossil fuels is at its peak and need to be fulfilled. But conventional fuels such as petroleum and diesel will eventually be depleted in time and an immediate alternative solution is needed to meet the demands for fossil fuels. Introduction of bio-oil will serve as a new substitute for conventional fuels where it emits less pollution emission and act as renewable resources. Thus, the aim of this research is to produce bio-oil from Palm Kernel Shell (PKS) and Empty Fruit Bunch (EFB) by Fast Pyrolysis. The resulting crude bio-oil produced is cooled and collected before being sent for separation process (Fractionation Distillation). A total of 10 fractions of liquid bio-oil from the column is examined and analysed through physical and chemical analysis. Through physical analysis, the water content especially in the upper fraction of the column for EFB is higher than that in PKS bio-oil samples, and both PKS and EFB bio-oil pH values behaviour shows high degree of acidity level. In chemical analysis method, Fourier Transform Infrared Spectroscopy (FTIR) is used to detect functional groups in PKS and EFB bio-oil samples. Unlike EFB bio-oil analysis, PKS shows higher margin of deviation due to its temperature sensitive difference but still both produces rather similar trend of analysis. Lastly, Gas Chromatography-Mass Spectrometer (GC-MS) is used to identify numerous chemical composition of PKS and EFB bio-oil constituents.

Keywords— Fast Pyrolysis, Palm Kernel Shell (PKS), Empty Fruit Bunch (EFB), Fractional Distillation (DC), Fourier Transform Infrared Spectroscopy (FTIR), Gas Chromatography-Mass Spectrometer (GC-MS).

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INTRODUCTION

1.1 BACKGROUND STUDY

The introduction of bio-oil fuels from biomass feedstock as raw material has been a turning point and an immediate solution to replace existing conventional fossil fuels such as gasoline, and diesel used as transportation fuels. Since conventional fossil fuels is non-renewable resources, then bio-oil fuels served as an immediate solution for generating more than approximately 1.5 billion vehicles running currently in worldwide (S. Edelstein, 2017). Fast Pyrolysis is a process without the presence of oxygen used to convert biomass such as Palm Kernel Shell (PKS) and Empty Fruit Bunch (EFB) into crude bio-oil after a condensation process, leaving solid biochar and non-condensable gases (Carbon Monoxide, Hydrogen and methane). But direct use of crude bio-oil is not recommended yet since there are several properties of bio-oil that are not suitable for transportation fuels. According to A. Majhi, et al. (2013), high water and oxygen content, high acidity and low heating values has been a drawback for the direct application of crude bio-oils and an upgrading method is introduced further in this report such as Fractional Distillation Column. This is mainly to heat crude bio-oils into certain fractions in the column and identify which fraction is bio-oil rich suitable as Second-Generation transportation fuels.

A detailed analysis process of identify the types of component present in upgraded bio-oils is done using powerful analytical equipment such as Gas Chromatography-Mass Spectrometer (GC-MS) and Fourier Transform Infrared (FTIR). This will provide great accuracy of component profiling in terms of peaks as data and directly matched the component with existing databases, which is also extensively used in pharmaceutical industry and medicine manufacturer (Elliott, et al., 2013).