UNIVERSITI TEKNOLOGI MARA

IN-SITU SUPERCRITICAL METHANOL TRANSESTERIFICATION FOR PRODUCTION OF BIODIESEL FROM *JATROPHA CURCAS* L. SEEDS

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CANDIDATE'S DECLARATION

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

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ABSTRACT

In-situ supercritical methanol transesterification for production of biodiesel from *Jatropha curcas* L. (JCL) seeds was successfully carried out via 1000 ml high-temperature high-pressure batch-wise reactor system in an absence of catalyst. In order to maximize the percent of crude biodiesel and FAMEs yield, four process variables were studied in this experiment, i.e. temperatures (180 to 300 °C), pressure (6 to 18 MPa), reaction time (5 to 35 min) and seeds-to-methanol ratio(1:15 to 1:45) using methanol as a solvent as well as reactant. Response Surface Methodology (RSM) was used to reduce the number of experimental runs required to generate sufficient information for a statistically acceptable results. In order to determine the best conditions of the variables in this in-situ process, Central Composite Rotatable Design (CCRD) was used for regression analysis and analysis of variance (ANOVA). Using RSM, the best conditions were chosen at temperature of 280.0 °C, pressure of 12.7 MPa, 30.0 min of reaction time and 1:40 (w/v) of seeds-to-methanol ratio. Interestingly, the qualitative Gas Chromatography (GC) analysis on the crude biodiesel showed the presence of FAMEs, indicating that the transesterification reaction had occurred during the in-situ process. The average saturated FAMEs content of the seed samples is low: 18.1% for methyl palmitate (C17:0) and 7.1% for methyl stearate (C19:0). The average content of the unsaturated FAMEs, methyl oleate (C19:1) and methyl linoleate (C19:2) is considerably higher which is 39.5 and 33.2%, respectively which are comparable to the fatty acid composition in crude JCL oil feedstock. The properties of biodiesel produced from this in-situ supercritical methanol transesterification were comparable with fuel properties of commercial No. 2 Diesel. It was found that specific gravity of JCL biodiesel was 0.87 g/cm^3 and it falls between the ASTM D6751 ranges. The kinematic viscosity is 5.27 cSt. The flash point was determined to be 100 °C while the pour point of JCL biodiesel was measured to be 0 °C which is slightly higher than that of No. 2 Diesel fuel. The cloud point was reported to be -2.06 °C. The calorific value of JCL biodiesel is 39.3 MJ/kg, which is almost 88% of the calorific value of diesel (44.8 MJ/kg). Thus, the high-temperature high-pressure batch-wise reactor system could be a promising approach in production of JCL biodiesel from in-situ supercritical methanol transesterification.

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CHAPTER THREE: MATERIALS AND METHODS