ABSTRAK

Hana Ria Wong, NIM 4182210006 (2018). Konversi Limbah Pelepah Kelapa Sawit Menjadi Bio-Oil Sebagai Biofuel Alternatif Melalui Reaksi Hidrodeoksigenasi Menggunakan Katalis Logam Co dan Fe yang Diembankan pada Zeolit Mordenit

Bio-oil hasil pirolisis limbah pelepah kelapa sawit potensial untuk dijadikan sebagai sumber bahan bakar biohidrokarbon. Pada penelitian ini dilakukan proses pirolisis limbah pelepah sawit ukuran 60 mesh pada suhu 500 °C selama 2 jam, dilanjutkan proses *upgrading* untuk meningkatkan sifat fisikokimia produk *bio-oil*, melalui reaksi esterifikasi dan hidrodeoksigenasi (HDO) menggunakan katalis oksida logam Fe dan Co yang diembankan pada zeolit mordenit (Mor). Proses HDO dilakukan pada reaktor sistem *fixed-bed* dengan variasi suhu (250, 300, 350 °C), dialiri gas H_2 dengan waktu selama 2 jam. Produk *bio-oil* dianalisis dengan *Gas Chromatography Mass Spectrometry* (GC-MS), analisis elementer (C,H,N,O) dan sifat fisikokimia lainnya. Hasil yang didapat menunjukan bahwa produk *bio-oil* mengandung senyawa potensial yang lebih dominan seperti golongan furan dan penol. Katalis bimetal Fe_2O_3-CoO/Mor memiliki karakteristik (luas permukaan; 415.305 m^2/g, volume pori; 0.048 cc/g, diameter pori; 1.557 nm) yang lebih baik dibandingkan dengan katalis monometal (Fe_2O_3/Mor dan CoO/Mor). Pada suhu 300 °C menunjukan kondisi optimum dalam proses hidrodeoksigenasi, hal ini terlihat dari tingginya *yield* produk fase liquid yang dihasilkan pada masing-masing katalis (Mor; 89,85%, dan Fe_2O_3-CoO/Mor; 93%). Sifat fisikokimia dari produk cair *upgraded bio-oil* pada kondisi optimum menunjukan terjadi peningkatan kualitas *bio-oil* dengan berkurangnya kadar air (mencapai 39%), peningkatan HHV (Fe_2O_3-CoO/Mor; 15.97%) dan kenaikan derajat deoksigenasi (Fe_2O_3-CoO/Mor; 59.80%). Katalis bimetal Fe_2O_3-CoO/Mor juga memiliki selektivitas yang lebih tinggi jika dibandingkan katalis Mor dalam mengkonversi senyawa hidrokarbon sikloalkana dan alkana rantai terbuka seperti heksana.

Kata kunci : *Bio-oil*, Esterifikasi-Hidrodeoksigenasi, katalis, Fe_2O_3, CoO, Mordenit

ABSTRACT

Hana Ria Wong, NIM 4182210006 (2018). Conversion of Palm Oil Frond Waste into Bio-Oil as An Alternative Biofuel Through Hydrodeoxygenation Reaction Using Co and Fe Metal Catalysts Carried on Mordenite Zeolite

Bio-oil from pyrolysis of palm frond waste has the potential to be used as a source of bio-hydrocarbon fuel. In this study, a pyrolysis process of 60 mesh palm frond waste was carried out at a temperature of 500 °C for 2 hours, followed by an upgrading process to improve the physicochemical properties of bio-oil products, through an esterification and hydrodeoxygenation (HDO) reaction using an oxide catalyst Fe and Co metal carried out on mordenite (Mor) zeolite. The HDO process is carried out on a fixed-bed system reactor with temperature variations (250, 300, 350 °C), flowed with H_2 gas for 2 hours. Bio-oil products was analyzed by Gas Chromatography Mass Spectrometry (GC-MS), elementary analysis (C,H,N,O) and other physicochemical properties. The results obtained showed that the bio-oil products contain dominant potential compound content such as the furan and penol groups. The bimetallic catalyst Fe_2O_3-CoO/Mor has characteristics surface area: 415,305 m^2/g, pore volume: 0.048 cc/g, pore diameter: 1,557 nm which is better compared to monometallic catalysts (Fe_2O_3/Mor and CoO/Mor). At a temperature of 300 °C showing optimum conditions in the hydrodeoxygenation process, this can be seen from the high yield of liquid phase products produced in each catalyst (Mor: 89.85% and Fe_2O_3-CoO/Mor: 93%). The physicochemical properties of liquid products upgraded bio-oil under optimum conditions showed an improvement in the quality of bio-oil with reduced water content (up to 39%), increased HHV (Fe_2O_3-CoO/Mor 15.97%) and increased degree of deoxygenation (Fe_2O_3-CoO/Mor 59.80%). Fe_2O_3-CoO/Mor bimetallic catalysts also have a higher selectivity when compared to Mor catalysts in converting cycloalkane hydrocarbon compounds and open-chain alkanes such as hexane.

Keywords : Bio-oil, Esterification-Hydrodeoxygenation, catalyst, Fe_2O_3, CoO, Mordenite