

Chaiyavid Wonghirunyawat 2011: Upgrading of Bio-oil from Coffee Bean Residue by Hydrodeoxygenation and Alkylation Reactions using CoMo/MCM-41 and Acid Catalyst. Master of Engineering (Chemical Engineering), Major Field: Chemical Engineering, Department of Chemical Engineering. Thesis Advisor: Associate Professor Apinya Duangchan, Ph.D. 124 pages.

Upgrading of bio-oil from coffee bean residue by hydrodeoxygenation and alkylation using CoMo/MCM-41 and $\text{SO}_4/\text{Al}_2\text{O}_3\text{-ZrO}_2$ was studied in a semi-batch reactor. Coffee bean residue was pyrolysed in a semi-batch reactor at temperatures of 450-550°C using nitrogen as a carrier gas. At 500°C, maximum bio-oil yield of 44.0% was obtained. The organic phase and aqueous phase of the bio-oil have heating values of 36.03 MJ/kg of the organic phase of bio-oil and 3.83 MJ/kg of the aqueous phase of bio-oil, respectively. Upgrading of bio-oil by hydrodeoxygenation with CoMo/MCM-41 at 500°C provided the bio-oil with a high heating value of 39.12 MJ/kg of the organic phase of bio-oil. The increase of catalyst loading from 0.02 to 0.4% weight of catalyst per weight of biomass showed no improvement on hydrodeoxygenation reaction. However, upgrading under hydrogen pressure showed a positive result. Upgrading by alkylation reaction was carried out in a stirred tank autoclave reactor at 200°C using 1% weight of catalyst per weight of biomass. The components in the bio-oil were analysed by GC-MS. Alkylation reaction increased the amount of alkylbenzene, resulting in an increase of the high heating value of the bio-oil. The oxygen and nitrogen compounds in the bio-oil were also reduced. However, hydrodeoxygenation reduced oxygenated compounds more than the alkylation.

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