

# Pengaruh tekanan gas hidrogen pada hidredeoksigenasi trigliserida dengan pelarut pirolisat polipropilena dan katalis Ni-Cu/ZrO<sub>2</sub> terhadap komposisi biofuel = Effect of hydrogen gas pressure on triglyceride hydrodeoxygenation with polypropylene pyrolyzate solvent and Ni-Cu/ZrO<sub>2</sub> catalyst on biofuel composition

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## Abstrak

Crude Palm Oil (CPO) dapat diproses melalui pirolisis menghasilkan bio-oil yang membutuhkan upgrading untuk mengubah bio-oil menjadi biofuel salah satunya melalui hidredeoksigenasi (HDO). Penelitian lanjut mengenai pengaruh tekanan gas hidrogen (H<sub>2</sub>) terhadap reaksi HDO dengan komponen umpan olahan CPO serta pirolisat Polypropylene (PP) termal dilakukan untuk meningkatkan pemahaman komprehensif terhadap variabel reaksi HDO pada produksi biofuel dengan metode umpan gas H<sub>2</sub> dan pelarut yang berbeda. HDO katalitik campuran 50% Refined Bleached Deodorized Palm Oil (RBDPO) dan 50% pirolisat PP termal- juga berperan sebagai pelarut- dengan katalis Ni-Cu/ZrO<sub>2</sub> dilakukan pada variasi tekanan 8-14 bar gas H<sub>2</sub> menggunakan reaktor hidrogenasi self-induced impeller. Katalis Ni-Cu/ZrO<sub>2</sub> hasil preparasi penelitian berukuran mesopori dengan ukuran kristal 33,95 nm, luas permukaan spesifik 8,04 m<sup>2</sup>/g, dan konsentrasi situs basa sebesar 0,38 mmol/g memiliki stabilitas termal yang rendah serta interaksi Ni dengan metal-oxide lemah karena keberadaan pengotor dan Ni-Cu yang kurang terimpregnasi pada penganban ZrO<sub>2</sub>. Tekanan gas H<sub>2</sub> memengaruhi perubahan komposisi ke arah biodiesel dengan peningkatan komposisi alkana dan olefin serta penurunan komposisi sikloalkana, alkohol, asam karboksilat, dan keton sepanjang 10 - 14 bar gas H<sub>2</sub> di samping keberadaan data outlier pada 8 bar gas H<sub>2</sub>. Yield fraksi cair maksimal 55-65% dengan peningkatan yield solid campuran wax dan sludge dari komponen umpan serta penurunan yield NCG seiring peningkatan tekanan gas H<sub>2</sub> didapatkan. Rasio komponen PP dan RBDPO sebagai umpan pada reaksi HDO menghasilkan yield biofuel tertinggi pada 50% PP dan 50% RBDPO. Keuntungan kemampuan dispersi partikel gas H<sub>2</sub> pada self-inducing impeller reaktor HDO tidak dapat menanggulangi rendahnya solubilitas gas H<sub>2</sub> pada pelarut pirolisat PP termal.

.....Crude Palm Oil (CPO) can be processed through pyrolysis to produce bio-oil which requires upgrading to convert bio-oil into biofuel, one of which is through hydrodeoxygenation (HDO). Further research on the effect of hydrogen gas pressure (H<sub>2</sub>) on HDO reactions with processed CPO feed components and thermal Polypropylene (PP) pyrolyzate was carried out to improve a comprehensive understanding of HDO reaction variables in biofuel production with H<sub>2</sub> gas feed methods and different solvents. The catalytic HDO mixture of 50% Refined Bleached Deodorized Palm Oil (RBDPO) and 50% thermal PP pyrolyzate- also acts as a solvent- with a Ni-Cu/ZrO<sub>2</sub> catalyst carried out at a pressure variation of 8-14 bar H<sub>2</sub> gas using a self-induced impeller hydrogenation reactor. The Ni-Cu/ZrO<sub>2</sub> catalyst as a result of the research preparation is mesoporous with a crystal size of 33.95 nm, a specific surface area of 8.04 m<sup>2</sup>/g, and a base site concentration of 0.38 mmol/g. It has low thermal stability and the interaction of Ni with metal-oxide is weak due to the presence of impurities and poorly impregnated Ni-Cu on the support. The pressure of H<sub>2</sub> gas affects the composition change towards biodiesel by increasing the composition of alkanes and olefins and decreasing the composition of cycloalkanes, alcohols, carboxylic acids, and ketones along 10 - 14 bar of

H<sub>2</sub> gas in addition to the presence of outlier data at 8 bar of H<sub>2</sub> gas. Maximum liquid fraction yield is 55-65% with an increase in yield of solid mixture of wax and sludge from the feed component and a decrease in NCG yield as H<sub>2</sub> gas pressure increases. The ratio of PP and RBDPO components as feed in the HDO reaction resulted in the highest biofuel yields at 50% PP and 50% RBDPO. The advantage of H<sub>2</sub> gas particle dispersion ability in the self-inducing impeller of the HDO reactor cannot overcome the low solubility of H<sub>2</sub> gas in the thermal PP pyrolyzate solvent.