

## PREPARASI KATALIS Co/ZSM-5 DENGAN BANTUAN GELOMBANG ULTRASONIK UNTUK KONVERSI MINYAK SAWIT OLAHAN MENJADI BIO-JET FUEL

Pangestu Arum Pratiwi  
21/473585/PA/20405

### INTISARI

Preparasi katalis Co/ZSM-5 dengan bantuan gelombang ultrasonik untuk konversi minyak sawit olahan (mentega putih) menjadi biojet-*fuel* telah dilakukan. Penelitian ini bertujuan untuk mempelajari karakteristik katalis Co/ZSM-5 menggunakan metode impregnasi dengan bantuan gelombang ultrasonik, mempelajari pengaruh susunan katalis di dalam reaktor terhadap *yield* produk cair serta menganalisis *reusability* katalis terhadap aktivitas katalitik. Katalis ZSM-5 diimpregnasi semprot dengan prekursor logam Co lalu disonikator. Kalsinasi-reduksi dilakukan dengan gas N<sub>2</sub> dan gas H<sub>2</sub> masing-masing selama 3 jam pada suhu 500 °C. Analisis katalis dilakukan dengan instrumen XRD, FT-IR, Raman, SAA, NH<sub>3</sub>-TPD, XPS, dan SEM-EDX. Variasi susunan katalis dilakukan secara tunggal dan ganda. Uji *reusability* dilakukan dengan pemakaian katalis sebanyak 3 kali. Reaktor yang digunakan adalah *semi-batch* dengan pemanas ganda dalam sistem *one-pot*. Proses *hydrotreatment* dilakukan pada rentang suhu 200–550 °C dengan laju alir H<sub>2</sub> sebesar 20 mL/menit selama 3 jam. Produk cair dianalisis dengan GC-MS dan FT-IR serta katalis *spent* dianalisis dengan SEM-EDX.

Hasil penelitian menunjukkan bahwa katalis Co/ZSM-5 memiliki derajat kristalinitas, ukuran kristal, luas permukaan, volume pori total, diameter pori, total keasamaan, kandungan logam Co, energi ikat Co<sup>2+</sup> dan Co<sup>0</sup> 2p<sub>3/2</sub> berturut-turut sebesar 74,16%; 20,94 nm; 225,1 m<sup>2</sup>/g; 0,127 cc/g; 3,29 nm; 2,335 mmol/g; 5,77%; 782,89 ; dan 778,56 eV. Uji aktivitas katalis Co/ZSM-5 susun tunggal dan susun ganda menghasilkan *yield* produk bio-jet *fuel* sebesar 48,17% dan 51,74%. Katalis Co/ZSM-5 susun tunggal dan ganda setelah dilakukan pemakaian berulang sebanyak 3 kali menghasilkan *yield* berturut-turut sebesar 48,17; 46,15; 33,73; 51,74; 47,43; dan 45,99%. Katalis Co/ZSM-5 susun tunggal dan ganda menghasilkan selektivitas yang cukup stabil.

Kata kunci: bio-jet *fuel*, gelombang ultrasonik, *hydrotreatment*, katalis Co/ZSM-5, mentega putih

## ULTRASONIC WAVE ASSISTED Co/ZSM-5 CATALYST PREPARATION FOR CONVERSION OF PROCESSED PALM OIL INTO BIO-JET FUEL

Pangestu Arum Pratiwi  
21/473585/PA/204005

### ABSTRACT

Preparation of Co/ZSM-5 catalyst with ultrasonic wave assistants for converting processed palm oil (shortening) into biojet-*fuel* has been carried out. This study aims to study the characteristics of the Co/ZSM-5 catalyst using the impregnation method with the help of ultrasonic waves, study the effect of the catalyst arrangement in the reactor on the yield of liquid products and analyze the reusability of the catalyst on catalytic activity. ZSM-5 catalysts were spray impregnated with a cobalt metal precursor and then sonicated. Calcination-reduction was performed using N<sub>2</sub> and H<sub>2</sub> gas, respectively, for 3 hours at 500 °C. The catalysts were characterized using XRD, FT-IR, Raman, SAA, NH<sub>3</sub>-TPD, XPS, and SEM-EDX. Variations in the composition of the catalyst were carried out single and double bed. Reusability tests involved three cycles of catalyst usage. A semi-batch reactor with a dual heater in a one-pot system was employed. The hydrotreatment process was conducted within a temperature range of 200–550 °C with an H<sub>2</sub> flow rate of 20 mL/minute for 3 hours. Liquid products were analyzed by GC-MS and FT-IR, while spent catalysts were analyzed by SEM-EDX.

The results showed that the Co/ZSM-5 catalyst had a degree of crystallinity, crystal size, surface area, total pore volume, pore diameter, total acidity, Co metal content, Co<sup>2+</sup> and Co<sup>0</sup> 2p<sub>3/2</sub> binding energy respectively of 74.16%; 20.94 nm; 225.1 m<sup>2</sup>/g; 0.127 cc/g; 3.29 nm; 2.335 mmol/g; 5.77%; 782.89; and 778.56 eV. Catalyst activity tests revealed bio-jet *fuel* yields of 48.17% for the single bed Co/ZSM-5 catalyst and 51.74% for the double bed arrangement. After three reusability cycles, the single double bed catalyst yield 48.17; 46.15; 33.73; 51.74; 47.43; and 45.99%, respectively. Single and double bed Co/ZSM-5 catalysts produce fairly stable selectivity.

Keywords: bio-jet *fuel*, Co/ZSM-5 catalyst, hydrotreatment, shortening, ultrasonic waves