

**PREPARATION AND CHARACTERIZATION OF CoO/NATURAL ACTIVE ZEOLITE AND CoO/Y-ZEOLITE CATALYSTS FOR HYDROCRACKING OF CASHEW NUT SHELL LIQUID (*ANACARDIUM OCCIDENTALE*)**

Yustina Windrianingsih

09/291429/PPA/02930

**ABSTRACT**

Preparation and characterization of CoO/activated natural zeolite (CoO/ZAA) and CoO/Y-zeolite (CoO/ZY) catalyst for hydrocracking of cashew nut shell liquid to gasoline and diesel have been examined. The natural zeolit from Klaten was activated with HCl 3M at 90°C for 30 min (ZAA sampel). The catalysts were prepared by impregnation of Co metal onto the ZAA or Y-zeolite (ZY) sample using salt precursor of  $\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ , at 90°C for 5 h. The Samples were calcinated using microwave at 550 watt for 15 min, then oxidized using  $\text{O}_2$  at 400°C for 1 h. Catalyst characterizations were done by determining acidity using gravimetric method of amonia and pyridine base vapor adsorption, and identification of Bronsted as well as Lewis acid sites using FT-IR. Catalyst crystallinity was analyzed by X-ray diffraction (XRD), and catalyst porosity was determined using Surface Area Analyzer (SAA). Hydrocracing of the cashew nut shell liquid was carried out in a semi flow fixed-bed reactor system at 400 and 450°C, with the weight ratio of feed/catalyst was 2, 4, and 6, and  $\text{H}_2$  flow rate of 20 mL/min. The liquid product of the hydrocracking was analyzed by gas chromatography (GC).

The results showed that the Co impregnated onto the ZAA and ZY samples gravimetrically increased their acidity without defect their crystallinity. The FT-IR result indicated that the all catalysts have Lewis and Bronsted acid sites. Specific surface area, average pore radius and total pore volume, for CoO/ZAA were 148.683  $\text{m}^2/\text{g}$ , 23.028 Å, 0.156 cc/g, respectively, and those of the CoO/ZY was 553.786  $\text{m}^2/\text{g}$ , 12.574 Å, and 0.348 cc/g, respectively. The highest percentage of liquid product of the hydrocracking using the CoO/ZAA and CoO/ZY catalysts was 51.28 and 71.19% (w/w), at 450°C, sample feed/catalyst ratio of 4 (w/w). Selectivity of CoO/ZAA catalyst for gasoline, diesel and heavy oil fraction was 37.60, 20.80 and 41.59 wt.%, respectively. Selectivity of CoO/ZY catalyst for gasoline, diesel and heavy oil fraction was 52.40, 31.41 and 16.17 wt.%, respectively.

**Keywords:** activated natural zeolite, Cashew Nut Shell Liquid, Co metal, hydrocracking, Y-zeolite



## PREPARASI DAN KARAKTERISASI KATALIS CoO/ZEOLIT ALAM AKTIF DAN CoO/ZEOLIT-Y UNTUK HIDRORENGKAH MINYAK KULIT JAMBU METTE (*ANACARDIUM OCCIDENTALE*)

Yustina Windrianingsih

09/291429/PPA/02930

### INTISARI

Telah dilakukan preparasi dan karakterisasi katalis CoO/Zeolit alam aktif dan CoO/zeolit-Y untuk reaksi hidrorengkah minyak kulit jambu mette (CNSL) menjadi fraksi bensin dan *diesel*. Sampel Zeolit Alam Klaten (ZA) diaktivasi dengan HCl 3M pada suhu 90°C selama 30 menit diperoleh sampel Zeolit Alam Aktif (ZAA). Preparasi katalis dengan cara impregnasi logam Co ke dalam sampel ZAA dan sampel Zeolit-Y (ZY) menggunakan larutan garam prekursor  $\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$  selama 5 jam pada temperatur 90°C. Sampel ZAA dan ZY yang terimpregnasi logam Co kemudian dikalsinasi menggunakan *microwave*, 550 watt selama 15 menit, dan selanjutnya dioksidasi pada 400°C selama 1 jam. Karakterisasi katalis meliputi penentuan keasaman amonia dan keasaman piridin dilakukan dengan metode gravimetri dan identifikasi situs asam Bronsted dan asam Lewis dengan FT-IR, sedangkan uji kristalinitas katalis dianalisis dengan menggunakan instrumen *X-ray Diffraction* (XRD), dan pengukuran porositas katalis dengan instrumen *Surface Area Analyzer*. Proses hidrorengkah minyak kulit jambu mette dilakukan dalam reaktor *semi flow* jenis *fixed-bed*, pada temperatur 400°C dan 450°C, rasio berat umpan/katalis 2, 4, 6 (b/b), dengan laju alir gas  $\text{H}_2$  20 mL/menit. Analisis produk cair hasil hidrorengkah menggunakan Kromatografi Gas (KG).

Hasil penelitian menunjukkan bahwa pengembunan logam Co pada kedua jenis pengembunan ZAA dan ZY secara gravimetri dapat meningkatkan keasaman katalis tanpa merusak struktur katalis secara keseluruhan. Hasil analisa FT-IR untuk semua katalis menunjukkan keberadaan situs asam Lewis dan Bronsted. Luas permukaan spesifik, rerata jejari pori dan volume pori, berturut-turut untuk CoO/ZAA, yaitu 148,683  $\text{m}^2/\text{g}$ , 23,0284 Å, 0,1562 cc/g, sedangkan untuk CoO/ZY, yaitu 553,786  $\text{m}^2/\text{g}$ , 12,5740 Å, dan 0,3482 cc/g. Konversi produk cair tertinggi menggunakan katalis CoO/ZAA dan CoO/ZY masing-masing sebesar 51,28 dan 71,19% (b/b), diperoleh pada kondisi temperatur reaksi 450°C, rasio umpan/katalis 4. Selektivitas katalis CoO/ZAA terhadap fraksi bensin, diesel dan minyak berat masing-masing sebesar 37,60, 20,80, dan 41,59%. Selektivitas katalis CoO/ZY terhadap fraksi bensin, diesel dan minyak berat masing-masing sebesar 52,40, 31,41, dan 16,17%.

Kata kunci: hidrorengkah, logam Co, minyak kulit jambu mette, zeolit alam aktif, zeolit-Y