

**THE EFFECT OF ACETIC ACID AND SODIUM HYDROXIDE
TREATMENT TOWARDS THE CHARACTER OF WONOSARI
NATURAL ZEOLITE AS Cu, Ni AND Zn METAL SUPPORT FOR
HYDROTREATMENT CATALYST OF CASTOR OIL INTO BIOFUEL**

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ABSTRACT

The effect of acetic acid and sodium hydroxide treatment on the characters of Wonosari natural zeolite for hydrotreatment of castor oil into biofuel has been studied. The purposes of this research were to improve the properties of Wonosari natural zeolite and to prepare catalysts for hydrotreatment of castor oil into biofuel.

The natural zeolite (ZA) was treated using 6 M acetic acid for 10 h and/or treated using 0.1 M NaOH for 1 h, to produce ZAA, ZAB. Then ZAA was treated using 0.1 M NaOH for 1 h to produce ZAAB. The Cu, Ni, and Zn metals were impregnated onto the ZAA and ZAAB by wet impregnation method using a salt precursor of $\text{Cu}(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$, $\text{Ni}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, and $\text{Zn}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ respectively to produce Ni/ZAA, Cu/ZAA, Zn/ZAA, and Ni/ZAAB catalysts. The catalysts were characterized by X-Ray Diffraction (XRD), X-Ray Fluorescence (XRF), Surface Area Analyzer (SAA), Fourier transform infrared spectrophotometer (FTIR). The acidity of the catalysts was measured gravimetrically using ammonia gas adsorption. The catalysts were used in hydrotreatment of castor oil in a semi-flow reactor system under H_2 gas flow at 450°C for 2 h. The liquid product was analyzed by Gas Chromatography-Mass Spectrometer (GC-MS).

The results showed that the Si/Al ratio of ZA increased after the acid treatment and decreased after the NaOH treatment. The acidity of ZAA, ZAB, and ZAAB was lower than ZA. The specific surface area of ZA decreased after acid treatment and increased after NaOH treatment. The highest surface area ($19.14 \text{ m}^2 \text{ g}^{-1}$) was shown by the ZAB catalyst. This catalyst produced the highest liquid product of 55.10 wt% and selectivity towards hydrocarbon compounds ($\text{C}_4\text{-C}_{22}$) of 22.40 wt%. After impregnation of Cu metal onto ZAA and Ni metal onto ZAAB the specific surface area was decreased. After Ni and Zn metals impregnated onto ZAA, the specific surface area was increased. The Zn/ZAA catalyst produced the highest liquid product (52.40 wt%) and selectivity towards hydrocarbon compounds of 12.90 wt% compared to other metals support catalysts.

Keywords: Acetic acid, natural zeolite, sodium hydroxide, wet impregnation.

PENGARUH PERLAKUAN ASAM ASETAT DAN NATRIUM HIDROKSIDA TERHADAP KARAKTER ZEOLIT ALAM WONOSARI SEBAGAI PENGEMBAN LOGAM Cu, Ni DAN Zn UNTUK KATALIS HYDROTREATMENT MINYAK JARAK MENJADI BIOFUEL

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INTISARI

Pengaruh perlakuan asam asetat dan natrium hidroksida terhadap karakter zeolit alam Wonosari untuk *hydrotreatment* minyak jarak menjadi biofuel telah dipelajari. Tujuan dari penelitian ini adalah untuk meningkatkan sifat zeolit alam Wonosari dan membuat katalis yang tepat untuk *hydrotreatment* minyak jarak menjadi biofuel.

Zeolit alam (ZA) direndam dalam larutan 6 M asam asetat selama 10 jam dan direndam dalam larutan 0.1 M NaOH selama 1 jam, menghasilkan ZAA dan ZAB. ZAA kemudian direndam dalam larutan 0.1 M NaOH menghasilkan ZAAB. Logam Cu, Ni dan Zn diimpregnasi ke dalam ZA dan ZAAB dengan metode impregnasi basah menggunakan larutan prekursor garam $\text{Cu}(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$, $\text{Ni}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, $\text{Zn}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ masing-masing menghasilkan Ni/ZAA, Cu/ZAA, Zn/ZAA dan Ni /ZAAB. Katalis ZA, ZAB, ZAA, ZAAB, Ni /ZAA, Cu /ZAA, Zn /ZAA, dan Ni/ ZAAB dikarakterisasi dengan X-Ray Diffraction (XRD), *X-Ray Fluorescence* (XRF), *Surface Area Analyzer* (SAA), *Fourier-Transform Infrared Spectroscopy* (FTIR). Keasaman katalis ditentukan secara gravimetri menggunakan adsorpsi gas amonia. Katalis digunakan dalam *hydrotreatment* minyak jarak dalam sistem reaktor semi-aliran di bawah aliran gas H_2 pada 450 °C selama 2 jam. Produk cair dianalisis menggunakan *Gas Chromatography-Mass Spectrometry* (GC-MS).

Hasil penelitian menunjukkan bahwa rasio Si/Al ZA meningkat setelah perlakuan asam dan menurun setelah perlakuan NaOH. Keasaman ZAA, ZAB dan ZAAB lebih rendah dibandingkan ZA. Luas permukaan spesifik ZA setelah perlakuan asam menurun dan meningkat setelah perlakuan NaOH. Luas permukaan tertinggi ($19.14 \text{ m}^2\text{g}^{-1}$) ditunjukkan oleh katalis ZAB. Katalis ini menghasilkan produk cair tertinggi sebesar 55.10 %(b/b) dan selektivitas terhadap senyawa hidrokarbon ($\text{C}_4\text{-C}_{22}$) sebesar 22.40 %(b/b). Setelah logam Cu terimpregnasi ke ZAA dan logam Ni terimpregnasi ke ZAAB luas permukaan spesifik berkurang. Setelah logam Ni dan Zn terimpregnasi ke ZAA luas permukaan spesifik naik. Katalis Zn/ZAA menghasilkan produk cair tertinggi (52.40 %(b/b)) dan selektivitas terhadap senyawa hidrokarbon sebesar 12.90 %(b/b) dibandingkan dengan katalis terimpregnasi logam lainnya.

Kata kunci: Asam asetat, zeolit alam, natrium hidroksida, impregnasi basah.



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