

## **MODIFIKASI MORDENIT DENGAN PERLAKUAN HNO<sub>3</sub> DAN/ATAU NaOH SEBAGAI KATALIS PADA *HYDROTREATING* $\alpha$ -SELULOSA TERPIROLISIS**

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### **INTISARI**

Telah dilakukan modifikasi mordenit dengan perlakuan HNO<sub>3</sub> dan/atau NaOH digunakan sebagai katalis pada *hydrotreating*  $\alpha$ -selulosa terpirolisis. Pada penelitian ini digunakan mordenit komersial (HSZ-642NAA) yang digunakan sebagai mordenit kontrol (HM), kemudian mordenit direfluks dengan HNO<sub>3</sub> 0,1 dan 0,5 M pada temperatur 70 °C selama 3 jam dan dihasilkan mordenit AM<sub>0,1</sub> dan AM<sub>0,5</sub>. Mordenit HM, AM<sub>0,1</sub> dan AM<sub>0,5</sub> diaduk dalam larutan NaOH 0,1 M selama 15 menit pada temperatur 27 °C, selanjutnya direfluks dengan NH<sub>4</sub>Cl 1 M pada temperatur 70 °C selama 2 jam dan diperoleh mordenit BHM, BAM<sub>0,1</sub> dan BAM<sub>0,5</sub>. Karakterisasi rasio Si/Al mordenit dianalisis dengan *Inductively Coupled Plasma* (ICP), keasamannya menggunakan adsorpsi uap NH<sub>3</sub> secara gravimetri, kristalinitasnya dengan *X-ray Diffraction* (XRD), serta analisis karakter pori mordenit BHM, BAM<sub>0,1</sub> dan BAM<sub>0,5</sub> dengan *Gas Sorption Analyzer* (GSA). Aktivitas serta selektivitas katalitik mordenit diuji melalui proses *hydrotreating*  $\alpha$ -selulosa terpirolisis dengan aliran gas H<sub>2</sub> 20 mL menit<sup>-1</sup> pada temperatur 450 °C selama 2 jam dengan rasio berat katalis dan umpan sebesar 1:60, produk cair yang dihasilkan dianalisis menggunakan *Chromatography-Mass Spectrometer* (GC-MS).

Hasil penelitian menunjukkan terdapat kenaikan rasio Si/Al dari mordenit seiring dengan penurunan kristalinitas setelah diberi perlakuan HNO<sub>3</sub> dan/atau NaOH. Keasaman mordenit mengalami penurunan seiring dengan kenaikan rasio Si/Al, kecuali AM<sub>0,1</sub>. Diameter pori rata-rata mordenit BHM, BAM<sub>0,1</sub> dan BAM<sub>0,5</sub> berturut-turut sebesar 2,96; 3,34 dan 4,53 nm. Mordenit BAM<sub>0,1</sub> menunjukkan aktivitas katalitik tertinggi dalam menghasilkan fraksi cair sebesar 64,04 % (b/b). Mordenit BAM<sub>0,5</sub> menunjukkan selektivitas katalitik terbaik karena menghasilkan 1-pentena 0,44% (b/b); 2-heptena 2,75% (b/b) serta 1-propanol 3,05% (b/b) dari proses *hydrotreating*  $\alpha$ -selulosa terpirolisis.

Kata kunci: *hydrotreating*, mordenit, perlakuan HNO<sub>3</sub>, perlakuan NaOH, struktur mesopori.

## **MODIFICATION OF MORDENITE WITH HNO<sub>3</sub> AND/OR NaOH TREATMENTS AS A CATALYST IN HYDROTREATING OF PYROLYZED $\alpha$ -CELLULOSE**

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### **ABSTRACT**

Modification of mordenite had been performed with HNO<sub>3</sub> and/or NaOH used for a catalyst in the hydrotreating of pyrolyzed  $\alpha$ -cellulose. In this research, commercial mordenite (HSZ-642NAA) was used as mordenite control (HM), then the mordenite was refluxed in 0.1 and 0.5 M of HNO<sub>3</sub> at 70 °C for 3 h and AM<sub>0,1</sub> and AM<sub>0,5</sub> were produced. The HM, AM<sub>0,1</sub> and AM<sub>0,5</sub> mordenites were stirred in 0.1 M of NaOH for 15 minutes at temperature 27 °C, then refluxed in 1 M NH<sub>4</sub>Cl at 70 °C for 2 h and BHM, BAM<sub>0,1</sub> and BAM<sub>0,5</sub> mordenites were obtained. The characterization of Si/Al ratio of mordenites was analyzed by using Inductively Coupled Plasma (ICP), the acidity were by using ammonium vapour adsorption by gravimetry, the crystallinity by using X-ray Diffraction (XRD), and the analysis of mordenite pore character of BHM, BAM<sub>0,1</sub>, and BAM<sub>0,5</sub> were analyzed by using Gas Sorption Analyzed (GSA). Catalytic activity and selectivity of the mordenites were evaluated in the hydrotreating of pyrolyzed  $\alpha$ -cellulose with 20 mL minute<sup>-1</sup> H<sub>2</sub> gas flow at 450 °C for 2 h with the weight ratio of catalyst and feed was 1:60. The liquid products were analyzed using Chromatography-Mass Spectrometer (GC-MS).

The results of the study showed that there was an increase in the Si/Al ratio of mordenite along with the decrease in crystallinity after being treated with HNO<sub>3</sub> and/or NaOH. The acidity of mordenites decreased along with the increase of Si/Al ratio, except for the AM<sub>0,1</sub> mordenite. The average pore diameter of BHM, BAM<sub>0,1</sub> and BAM<sub>0,5</sub> mordenites were 2.96; 3.34 and 4.53 nm, respectively. The BAM<sub>0,1</sub> mordenite showed the highest catalytic activity in generating liquid fraction (64.04 wt%). The BAM<sub>0,5</sub> mordenite showed the best catalytic selectivity because it produces 1-pentene 0.44 (wt%); 2-heptene 2.75 (wt%) and 1-propanol 3.05 (wt%) from the hydrotreating process of pyrolyzed  $\alpha$ -cellulose.

**Keywords:** hydrotreating, mordenite, HNO<sub>3</sub> treatment, NaOH treatment, mesoporous structure.