

PENGARUH PERLAKUAN ASAM KLORIDA DAN/ATAU NATRIUM HIDROKSIDA TERHADAP KARAKTER ZEOLIT HY DAN UJI AKTIVITASNYA DALAM HIDRORENGKAH α -SELULOSA TERPIROLISIS

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INTISARI

Telah dipelajari pengaruh perlakuan HCl dan/atau NaOH terhadap karakter zeolit Y terprotonasi (HY). Zeolit HY direndam dengan HCl 0,1 dan 0,5 M pada temperatur 70 °C selama 3 jam sehingga dihasilkan zeolit DY_{0,1} dan DY_{0,5}. Zeolit HY, DY_{0,1} dan DY_{0,5} direndam dalam larutan NaOH 0,1 M selama 15 menit pada temperatur ruang (29 °C), selanjutnya direndam dalam NH₄Cl 1 M pada temperatur 70 °C selama 2 jam sehingga diperoleh zeolit AHY, ADY_{0,1} dan ADY_{0,5}. Zeolit HY, AHY, DY_{0,1}, ADY_{0,1}, DY_{0,5} dan ADY_{0,5} dikarakterisasi keasamannya menggunakan adsorpsi uap NH₃ secara gravimetri, kristalinitasnya dengan difraksi sinar X (XRD), rasio Si/Al-nya dengan *Inductively Coupled Plasma* (ICP). Zeolit AHY, ADY_{0,1} dan ADY_{0,5} dianalisis karakter porinya dengan *Surface Area Analyzer* (SAA). Aktivitas katalitik zeolit HY, AHY, ADY_{0,1} dan ADY_{0,5} diuji dalam proses hidrorengkah α -selulosa terpirolisis dengan reaktor *stainless steel* dengan laju alir gas H₂ sebesar 20 mL menit⁻¹ pada temperatur 450 °C selama 2 jam serta rasio berat katalis:umpan sebesar 1:30.

Hasil penelitian menunjukkan adanya kenaikan rasio Si/Al dari zeolit HY seiring dengan penurunan kristalinitas setelah diberi perlakuan HCl dan/atau NaOH. Keasaman zeolit HY mengalami penurunan seiring dengan kenaikan rasio Si/Al, kecuali zeolit AHY. Struktur mesopori zeolit HY terbentuk setelah diberi perlakuan NaOH. Diameter pori rata-rata zeolit AHY, ADY_{0,1} dan ADY_{0,5} berturut-turut adalah 2,6246; 3,6192 dan 5,9716 nm. Zeolit ADY_{0,1} menunjukkan aktivitas katalitik tertinggi dalam menghasilkan produk cair sebesar 74,10% (b/b). Zeolit ADY_{0,5} menunjukkan selektivitas katalitik terbaik karena menghasilkan 1-isopropil-2,4-dimetilbenzena yang termasuk fraksi bensin sebanyak 4,17% (b/b) dari proses hidrorengkah α -selulosa terpirolisis.

Kata kunci: Hidrorengkah α -selulosa, perlakuan HCl, perlakuan NaOH, struktur mesopori, zeolit HY

EFFECT OF HYDROCHLORIC ACID AND/OR SODIUM HYDROXIDE TREATMENT TOWARDS HY-ZEOLITE CHARACTERS AND ITS ACTIVITY IN HYDROCRACKING OF PYROLYZED α -CELLULOSE

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ABSTRACT

Effect of HCl and/or NaOH treatment towards protonated Y-zeolite (HY) has been evaluated. The HY zeolite was immersed in 0.1 and 0.5 M HCl at 70 °C for three hours resulting DY_{0,1} and DY_{0,5} zeolites. The HY, DY_{0,1} and DY_{0,5} zeolites were immersed in 0.1 M NaOH for 15 minutes at room temperature (29 °C), then immersed in 1 M NH₄Cl at 70 °C for two hours resulting AHY, ADY_{0,1} and ADY_{0,5} zeolites. The HY, AHY, DY_{0,1}, ADY_{0,1}, DY_{0,5} and ADY_{0,5} zeolites were characterized by means of acidity using ammonia vapour adsorption (gravimetric method), crystallinity using X-ray Diffraction (XRD), Si/Al ratio using Inductively Coupled Plasma (ICP). The AHY, ADY_{0,1} and ADY_{0,5} zeolites were analyzed their pore characters by Surface Area Analyzer (SAA). Catalytic activity of HY, AHY, ADY_{0,1} and ADY_{0,5} zeolites was evaluated in hydrocracking of pyrolyzed α -cellulose using stainless steel reactor with H₂ gas flow rate of 20 mL min⁻¹ at 450 °C for two hours with catalyst:feed weight ratio of 1:30.

The results showed that the HCl and/or NaOH treatment towards the HY-zeolite increased Si/Al ratio and decreased crystallinity. The acidity of HY-zeolites decreased along with the increase of Si/Al ratio, except for the AHY zeolites. The HY-zeolite mesopore structure was generated after the NaOH treatment. The average pore diameter of AHY, ADY_{0,1} dan ADY_{0,5} zeolites were 2.6246, 3.6192 and 5.9716 nm. The ADY_{0,1} zeolite showed the highest catalytic activity in generating liquid product (74.10 wt.%). The ADY_{0,5} zeolite showed the best catalytic selectivity because ADY_{0,5} produced 1-isopropyl-2,4-dimethylbenzene (4.17 wt.%) which is the fraction of gasoline from pyrolyzed α -cellulose hydrocracking process.

Keywords: HCl treatment, mesoporous structure, NaOH treatment, pyrolyzed α -cellulose hydrocracking, HY-zeolite