

ABSTRACT

SYNTHESIS OF ZEOLITE MATERIAL USING KLATEN NATURAL ZEOLITE AND Ni/ZEOLITE CATALYST FOR HYDROCRACKING OF COCONUT OIL TO PRODUCE GASOLINE AND DIESEL FRACTION

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Synthesis of zeolite material using Klaten natural zeolite as raw material and Ni/zeolite catalyst for hydrocracking of coconut oil to produce gasoline and diesel fraction has been done. The zeolite material was synthesized by destructing the Klaten natural zeolite with 9M HCl solution, then fusion with NaOH pellet (NaOH/zeolite ratio = 1.2), followed by treating with 6M NaOH solution, AlCl₃(s), CTAB(s) and distilled water. The mixture was regulated to pH of 11.5 controlled using pH universal paper. The mixture was then poured into a vessel reactor for hydrothermally process at 150 °C for 24 h. The synthesized zeolite result was analyzed using Fourier Transform Infra Red (FTIR), X-Ray Diffraction (XRD), NOVA 1200 microanalyzer Quantahrome (adsorption of nitrogen to measure the surface area and pore size), and Scanning Electron Microscope (SEM). The synthesized zeolite was impregnated by Ni using Ni(Cl)₂.6H₂O solution as a metal precursor with variation of nickel content concentration produced the Ni/zeolite samples using immersion method. The nickel contents were 2, 3.5, and 5% towards the zeolite produced ZSN1, ZSN2, and ZSN3 catalysts. Catalytic activity and selectivity on hydrocracking of coconut oil was carried out to determine the effect of nickel content, acidity, surface area, pore size, and temperature towards the hydrocracking products. The hydrocracking was carried out in the variation of temperatures of 360, 415, 450, and 500 °C. The liquid product was analyzed using Gas Chromatography Mass Spectrometer (GC-MS).

The resulted showed that the zeolite material had been successfully synthesized. The zeolite had surface area of 270.628 m²/g, pore volume of 0.339 cm³/g, and average pore radius of 4.585 nm. Impregnation of Ni onto the zeolite with Ni(Cl)₂.6H₂O solution in variation of nickel content produced varying characteristics such as total acidity, surface area, pore volume and average pore radius. The result of catalytic activity on hydrocracking of coconut oil showed that the higher nickel content resulted in the higher conversion to gasoline fraction (C₅–C₁₂). For the treatment of temperature variation, the highest conversion of gasoline fraction was 11.73 wt.% that obtained in temperature of 450 °C using ZSN2 catalyst. The highest conversion of diesel fraction was 9.15 wt.% produced by the same catalyst at temperature of 360 °C.

Keywords: zeolite, catalytic activity, hydrocracking, gasoline fraction, diesel fraction

INTISARI

SINTESIS MATERIAL ZEOLIT DAN KATALIS Ni/ZEOLIT MENGGUNAKAN ZEOLIT ALAM KLATEN UNTUK HIDRORENGKAH MINYAK KELAPA MENJADI FRAKSI BENSIN DAN DIESEL

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Telah dilakukan sintesis material zeolit dan katalis Ni/zeolit menggunakan zeolit alam Klaten untuk hidrorengkah minyak kelapa menjadi fraksi bensin dan diesel. Sintesis material zeolit dilakukan dengan destruksi zeolit alam Klaten menggunakan HCl 9M, peleburan dengan NaOH pellet (rasio NaOH/zeolit = 1,2), selanjutnya pada zeolit hasil peleburan ditambahkan larutan 6M NaOH(aq), AlCl₃(p), CTAB(p), H₂O(c), serta pHnya diatur = 11,5 menggunakan kertas pH universal. Kemudian campuran dimasukkan dalam wadah reaktor untuk proses pembentukan secara hidrotermal pada temperatur 150 °C selama 24 jam. Hasil zeolit sintetis dianalisis menggunakan *Fourier Transform Infra Red* (FTIR), *X-Ray Diffraction* (XRD), NOVA 1200 *microanalyzer Quantahrome* (adsorpsi nitrogen untuk mengukur luas permukaan dan ukuran pori), dan *Scanning Electron Microscope* (SEM). Zeolit sintetis diimpregnasi dengan logam nikel menggunakan larutan Ni(Cl)₂.6H₂O sebagai *precursor* logam dengan variasi kandungan nikel menghasilkan sampel-sampel Ni/zeolit menggunakan metode perendaman. Kandungan nikel adalah 2%, 3,5%, dan 5% terhadap zeolit menghasilkan katalis dengan kode ZSN1, ZSN2, dan ZSN3. Aktivitas dan selektivitas katalis pada hidrorengkah minyak kelapa dilakukan untuk mengetahui pengaruh kadar nikel, keasaman, luas permukaan, ukuran pori, serta temperatur terhadap hasil hidrorengkah. Hasil reaksi berupa produk cair dianalisis menggunakan *Gas Chromatography Mass Spectrometer* (GC-MS).

Hasil sintesis menunjukkan bahwa telah diperoleh material zeolit dengan luas permukaan 270,628 m²/g, volume pori 0,339 cm³/g, dan rerata jejari pori 4,585 nm. Impregnasi dengan nikel menggunakan larutan Ni(Cl)₂.6H₂O menghasilkan karakteristik katalis yang bervariasi berupa keasaman total, luas permukaan, volume pori, serta rerata jejari pori. Hasil aktivitas katalitik pada hidrorengkah minyak kelapa menunjukkan bahwa kadar nikel yang tinggi menghasilkan konversi menjadi fraksi bensin (C₅ – C₁₂) yang tinggi pula. Untuk perlakuan variasi temperatur, konversi tertinggi menjadi fraksi bensin sebesar 11,73% (b/b) dihasilkan dengan menggunakan katalis ZSN2 pada temperatur 450 °C. Konversi tertinggi menjadi fraksi diesel (C₁₃ – C₁₇) sebesar 9,15% (b/b) dihasilkan dengan menggunakan katalis yang sama pada temperatur 360 °C.

Kata kunci: zeolit, aktivitas katalitik, hidrorengkah, fraksi bensin, fraksi diesel