

SYNTHESIS AND CHARACTERIZATION OF Ni/MESOPOROUS SILICA CATALYSTS FROM LAPINDO MUD FOR HYDROCRACKING OF WASTE COOKING OIL INTO BIOFUEL

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ABSTRACT

The synthesis and characterization of mesoporous silica (SM) and Ni/mesoporous silica (Ni/SM) catalysts from Lapindo mud for the hydrocracking of waste cooking oil into biofuel has been conducted. Extraction of silica from Lapindo mud and CTAB used a combined method of acids and bases. The SM was synthesized by hydrothermal method using CTAB as a template. The SM material was calcinated in the temperature of 540°C for 5 h to remove the template. The SM material was then characterized by X-Ray Powder Diffraction (XRD), Fourier-Transform Infrared Spectroscopy (FT-IR), Scanning Electron Microscopy (SEM), and Brunauer-Emmett-Teller (BET). The nickel metal of 4, 6, and 8 wt.% was loaded into the SM by wet impregnation method using salt precursors of $\text{Ni}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, produced the Ni(4)/SM, Ni(6)/SM, and Ni(8)/SM catalysts, respectively. The catalysts were analyzed by X-Ray Powder Diffraction (XRD), Fourier-Transform Infrared Spectroscopy (FT-IR), Brunauer-Emmett-Teller (BET), and Atomic Absorption Spectroscopy (AAS). The catalytic activity test was carried out for hydrocracking of waste cooking oil by using the SM, Ni(4)/SM, Ni(6)/SM and Ni(8)/SM catalysts. The results of liquid product of the hydrocracking was analyzed by gravimetric method and Gas Chromatography-Mass Spectrometry (GC-MS).

The experimental result showed that the mesoporous silica (SM) has structure characteristic as a porous material with pore diameter, specific surface area, and pore volume of 3.59368 nm, 874.284 m^2/g and 0.81409 cm^3/g , respectively. The liquid products of the hydrocracking using SM, Ni(4)/SM, Ni(6)/SM, and Ni(8)/SM catalysts were 63.95, 80.57, 74.63 and 75.77 wt.%. The highest selectivity of the gasoline fraction (54.22 wt.%) was produced by Ni(4)/SM catalyst and the highest diesel oil fraction (8.37 wt.%) was produced by Ni(8)/SM catalyst.

Keywords: Lapindo mud, silica, mesoporous, catalyst, biofuel.

SINTESIS DAN KARAKTERISASI KATALIS Ni/SILIKA MESOPORI DARI LUMPUR LAPINDO UNTUK HIDRORENGKAH MINYAK GORENG BEKAS MENJADI *BIOFUEL*

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INTISARI

Telah dilakukan sintesis dan karakterisasi katalis silika mesopori (SM) dan Ni/silika mesopori (Ni/SM) dari silika lumpur untuk hidrorengkah minyak goreng bekas menjadi *biofuel*. Ekstraksi silika dari lumpur Lapindo dan CTAB menggunakan metode gabungan asam-basa. SM disintesis dengan metode hidrotermal dengan menggunakan CTAB sebagai cetakan. Material SM dikalsinasi pada suhu 540°C selama 5 jam untuk menghilangkan cetakan. Material SM dikarakterisasi dengan *X-Ray Powder Diffraction* (XRD), *Fourier-Transform Infrared Spectroscopy* (FT-IR), *Scanning Electron Microscopy* (SEM), dan *Brunauer-Emmett-Teller* (BET). Logam nikel sebesar 4, 6, dan 8% (b/b) diimbangkan pada SM dengan metode impregnasi basah menggunakan garam prekursor $\text{Ni}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, menghasilkan katalis Ni(4)/SM, Ni(6)/SM, dan Ni(8)/SM. Katalis dikarakterisasi menggunakan *X-Ray Powder Diffraction* (XRD), *Fourier-Transform Infrared Spectroscopy* (FT-IR), *Brunauer-Emmett-Teller* (BET), dan *Atomic Absorption Spectroscopy* (AAS). Uji aktivitas katalis dilakukan pada hidrorengkah minyak goreng bekas menggunakan katalis SM, Ni(4)/SM, Ni(6)/SM dan Ni(8)/SM. Produk cair hasil hidrorengkah minyak goreng bekas dianalisis dengan metode gravimetri dan *Gas Chromatography-Mass Spectrometry* (GC-MS).

Hasil penelitian menunjukkan bahwa SM memiliki struktur karakteristik material berpori (*porous material*) dengan diameter pori, luas permukaan dan volume pori berturut-turut 3.59368 nm, 874.284 m²/g dan 0.81409 cm³/g. Hidrorengkah minyak goreng bekas dengan katalis SM, Ni(4)/SM, Ni(6)/SM, dan Ni(8)/SM menghasilkan produk cair berturut-turut 63.95, 80.57, 74.63 dan 75.77% (b/b). Selektivitas fraksi bensin tertinggi (54.22% b/b) dihasilkan oleh katalis Ni(4)/SM dan fraksi solar tertinggi (8.37% b/b) dihasilkan oleh katalis Ni(8)/SM.

Kata kunci: Lumpur Lapindo, silika, mesopori, katalis, dan biofuel.