

PREPARASI KATALIS NiMo-SO₄/SiO₂ MESOPORI DENGAN METODE HIDROTERMAL SERTA APLIKASINYA DALAM HIDRORENGKAH *USED COOKING OIL* MENJADI BIOGASOLIN

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INTISARI

Preparasi katalis NiMo-SO₄/SiO₂ mesopori dengan metode hidrotermal serta aplikasinya dalam hidrorengkah *used cooking oil* telah dilakukan. Penelitian ini bertujuan untuk mempelajari preparasi, karakterisasi, aktivitas, selektivitas, dan *reusability* dari katalis NiMo-SO₄/SiO₂ mesopori terhadap proses hidrorengkah minyak goreng bekas menjadi biogasolin serta mempelajari pengaruh konsentrasi sulfat dan logam terhadap aktivitas katalis tersebut. Preparasi katalis dilakukan melalui prekursor TEOS dengan metode *sol-gel* dengan variasi konsentrasi H₂SO₄ 1,5; 2; dan 2,5 M. Impregnasi logam Ni dan Mo dilakukan secara hidrotermal dengan konsentrasi logam 1, 2, dan 3% (b/b). Karakterisasi katalis dilakukan dengan uji keasaman gravimetri amonia, instrumen *Fourier Transform Infrared* (FTIR), *X-Ray Diffraction* (XRD), *Field Emission Scanning Electron Microscope* (FESEM EDX Mapping), *X-Ray Fluorescence* (XRF), *Surface Area Analyzer* (SAA), *Transmission Electron Microscopy* (TEM), *Thermo Gravimetric Analysis/Differential Thermo Analysis* (TGA/DTA), dan *X-Ray Photoelectron Spectroscopy* (XPS). Aktivitas dan selektivitas katalis diuji melalui proses perengkahan minyak goreng bekas dengan rasio katalis:umpan 1%.

Berdasarkan hasil penelitian, diperoleh katalis dengan morfologi berupa granul nanosilika. Katalis dengan keasaman tertinggi adalah katalis yang diimbangkan asam sulfat 2 M dan logam NiMo sebanyak 1% dengan keasaman 13,15 mmol/g. Katalis yang diperoleh memiliki struktur amorf dengan luas permukaan 403,77 m²/g dan diameter pori 4,79 nm. Persentase penurunan massa dari katalis sebesar 1,61% menandakan kemurnian tinggi pada katalis. Penggunaan katalis NiMo 1/SMS-2 menghasilkan konversi produk cair sebesar 55,9% dengan selektivitas terhadap fraksi gasolin sebesar 52,37%. Hasil uji *reusability* terhadap katalis NiMo 1/SMS-2 menunjukkan terjadinya penurunan terhadap konversi produk cair yakni menjadi 54,90% dan 52,00% pada penggunaan ke-2 dan ke-3. Terjadi pula penurunan selektivitas terhadap fraksi gasolin menjadi 28,17% dan 21,05%.

Kata kunci: biogasolin, hidrorengkah, minyak goreng bekas, NiMo, silika mesopori tersulfatasi

***HYDROTHERMAL ASSISTED PREPARATION OF MESOPOROUS
NiMo-SO₄/SiO₂ CATALYST AND ITS APPLICATIONS IN
HYDROCRACKING OF USED COOKING OIL INTO BIOGASOLINE***

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ABSTRACT

The preparation of NiMo-SO₄/SiO₂ mesoporous catalyst via hydrothermal method and its application in the hydrocracking of used cooking oil has been conducted. This research aims to investigate the preparation, characterization, activity, selectivity, and reusability of NiMo-SO₄/SiO₂ mesoporous catalyst towards the process of converting used cooking oil into biogasoline, as well as to study the influence of sulfate and metal impregnation on the catalyst activity. The catalyst preparation was carried out using TEOS precursor via the sol-gel method with varying concentrations of H₂SO₄ at 1.5, 2, and 2.5 M. Ni and Mo metal impregnation was performed hydrothermally with metal concentrations of 1, 2, and 3% (w/w). Catalyst characterization was conducted through ammonia gravimetric acidity test, Fourier Transform Infrared (FTIR) spectroscopy, X-Ray Diffraction (XRD) analysis, Field Emission Scanning Electron Microscope (FESEM) with Energy Dispersive X-ray Spectroscopy (EDX) mapping, X-Ray Fluorescence (XRF) analysis, Surface Area Analyzer (SAA) measurement, Transmission Electron Microscopy (TEM) imaging, Thermo Gravimetric Analysis/Differential Thermo Analysis (TGA/DTA), and X-Ray Photoelectron Spectroscopy (XPS). Catalyst activity and selectivity were evaluated through the hydrocracking process of used cooking oil with a catalyst-to-feed ratio of 1%.

Based on the research results, a catalyst with nanosilica granule morphology was obtained. The catalyst with the highest acidity was the one impregnated with 2 M sulfuric acid and 1% NiMo metal with an acidity of 13.15 mmol/g. The obtained catalyst exhibited an amorphous structure with a surface area of 403.77 m²/g and a pore diameter of 4.79 nm. The percentage of mass loss from the catalyst was 1.61%, indicating high purity of the catalyst. The use of NiMo 1/SMS-2 catalyst resulted in a liquid product conversion of 55.9% with a selectivity towards the gasoline fraction of 52.37%. The reusability test results of NiMo 1/SMS-2 catalyst showed a decrease in liquid product conversion to 54.90% and 52.00% on the 2nd and 3rd uses, respectively. There was also a decrease in selectivity towards gasoline to 28.17% and 21.05%.

Keywords: biogasoline, hydrocracking, NiMo, sulphated mesoporous silica, used cooking oil