

PREPARASI KATALIS NiMo TEREDUKSI NaBH₄ TERIMPREGNASI ULTRASONIK PADA KARBON AKTIF UNTUK KONVERSI MENTEGA PUTIH MENJADI BIOAVTUR

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INTISARI

Penelitian tentang preparasi katalis NiMo/KA telah dilakukan melalui impregnasi ultrasonik menggunakan prekursor nikel (II) nitrat heksahidrat (Ni(NO₃)₂·6H₂O) dan amonium heptamolibdat tetrahidrat ((NH₄)₆Mo₇O₂₄·4H₂O) pada karbon aktif. Kalsinasi dilakukan menggunakan gas N₂ selama 3 jam dengan laju alir 20 mL menit⁻¹ pada temperatur 500 °C yang dilanjutkan perlakuan reduksi dengan variasi gas H₂ atau larutan NaBH₄. Katalis NiMo/KA hasil sintesis dikarakterisasi dengan XRD, FTIR, NH₃-TPD, XPS, dan SEM-EDX. Proses *hydrotreating* dilakukan dalam reaktor *stainless steel semi-batch* dengan pemanas ganda pada temperatur 200–600 °C dengan kenaikan 20 °C di bawah aliran gas H₂ pada tekanan 1 atm. Produk cair kemudian dianalisis menggunakan GC-MS. Uji *reusability* sebanyak tiga kali dilakukan terhadap katalis dengan selektivitas senyawa bioavtur terbaik.

Hasil penelitian menunjukkan bahwa katalis NiMo/KA yang direduksi menggunakan gas H₂ atau larutan NaBH₄ memiliki karakteristik amorf. Katalis NiMo/KA reduksi larutan NaBH₄ memiliki dispersi logam yang lebih homogen, total keasaman yang lebih tinggi (3,031 mmol g⁻¹) dibandingkan dengan katalis hasil reduksi gas H₂ (2,786 mmol g⁻¹), dan memiliki selektivitas senyawa bioavtur terbaik. Analisis XPS katalis NiMo/KA reduksi larutan NaBH₄ sebagai katalis dengan selektivitas terbaik menunjukkan bahwa logam nikel (Ni) terdeteksi dalam bentuk Ni⁰ dan Ni²⁺, sedangkan molibdenum (Mo) terdeteksi dalam bentuk Mo⁰ dan Mo⁴⁺. Selektivitas senyawa bioavtur hasil *reusability* katalis NiMo/KA reduksi NaBH₄ pertama hingga ketiga secara berturut-turut sebesar 90,09; 85,86; dan 81,97%.

Kata kunci: bioavtur, gas H₂, *hydrotreating*, larutan NaBH₄, mentega putih.

PREPARATION OF NaBH₄-REDUCED NiMo CATALYST SUPPORTED ON ACTIVATED CARBON VIA ULTRASOUND-ASSISTED-IMPREGNATION FOR THE CONVERSION OF SHORTENING INTO BIO-AVIATION FUEL

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ABSTRACT

The NiMo/AC catalysts were prepared via ultrasonic-assisted impregnation using nickel(II) nitrate hexahydrate (Ni(NO₃)₂·6H₂O) and ammonium heptamolybdate tetrahydrate ((NH₄)₆Mo₇O₂₄·4H₂O) as metal precursors loaded onto activated carbon. Calcination was carried out under N₂ gas flow at 500 °C for 3 hours with a flow rate of 20 mL min⁻¹, followed by reduction treatment using either H₂ gas or NaBH₄ solution. The synthesized NiMo/AC catalysts were characterized by XRD, FTIR, NH₃-TPD, XPS, and SEM-EDX. The hydrotreating process was carried out in a semi-batch stainless steel reactor equipped with a dual heating system at temperature range of 200–600 °C with 20 °C increments under H₂ gas flow at a pressure of 1 atm. The liquid product was then analyzed using GC-MS. Reusability tests were conducted for three cycles on the catalyst with the highest bio-aviation fuel compound selectivity.

The results showed that the NiMo/AC catalysts reduced with H₂ gas or NaBH₄ solution exhibited amorphous characteristics. The NaBH₄-reduced NiMo/AC catalyst showed a more homogeneous metal dispersion, higher total acidity (3.031 mmol g⁻¹) than the H₂-reduced catalyst (2.786 mmol g⁻¹), and the highest selectivity toward bio-aviation fuel compounds. XPS analysis of the NaBH₄-reduced NiMo/AC catalyst, which exhibited the best selectivity of bio-aviation fuel compounds, revealed that nickel (Ni) was detected as Ni⁰ and Ni²⁺, while molybdenum (Mo) was detected as Mo⁰ and Mo⁴⁺. The selectivity toward bio-aviation fuel compounds during the first, second, and third reusability cycles of the NaBH₄-reduced NiMo/AC catalyst was 90.09, 85.86, and 81.97%, respectively.

Keywords: bio-aviation fuel, hydrogen gas, hydrotreating, NaBH₄ solution, shortening.