

SINTESIS KATALIS BASA BERBASIS γ - Al_2O_3 TERMODIFIKASI TEMBAGA DAN AMINO SILAN UNTUK KONVERSI MINYAK KELAPA SAWIT BEKAS MENJADI BIODIESEL

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INTISARI

Pada penelitian ini telah dilakukan sintesis dan karakterisasi katalis γ - Al_2O_3 terimpregnasi tembaga dan tergrafting amino silan yang diaplikasikan untuk reaksi transesterifikasi minyak kelapa bekas menjadi biodiesel. Tujuan penelitian ini mempelajari sintesis dan penentuan kebasaaan katalis $\text{CuO}/\gamma\text{-Al}_2\text{O}_3$, $\text{NH}_2/\gamma\text{-Al}_2\text{O}_3$, dan $\text{CuO}/\gamma\text{-Al}_2\text{O}_3\text{-NH}_2$, mempelajari morfologi dan porositas katalis dengan kebasaaan tertinggi, serta mempelajari kondisi reaksi optimumnya dalam konversi minyak kelapa bekas menjadi biodiesel menggunakan katalis dengan kebasaaan tertinggi. Modifikasi CuO dilakukan menggunakan metode impregnasi kering dengan garam $\text{Cu}(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$ dan modifikasi amino silan dilakukan menggunakan metode grafting dengan (3-aminopropil)trimetoksisilan (3-APTMS). Katalis dianalisis dengan XRD, FT-IR, uji kebasaaan, SEM-EDX Mapping, dan SAA. Uji aktivitas katalis dilakukan melalui reaksi transesterifikasi dengan variasi temperatur (40, 50, 60, dan 70 °C), waktu (1, 2, 3, dan 4 jam), rasio berat katalis : minyak (1, 3, dan 5%), dan rasio molar minyak:metanol (1:6, 1:9, dan 1:12). Produk biodiesel dianalisis menggunakan GC-MS. Kestabilan aktivitas katalis diuji dengan penggunaan satu katalis untuk tiga kali reaksi pada kondisi optimum.

Berdasarkan hasil karakterisasi, terkonfirmasi bahwa logam CuO telah terimpregnasi dan amino silan telah tergrafting pada $\gamma\text{-Al}_2\text{O}_3$. Katalis $\text{CuO}/\gamma\text{-Al}_2\text{O}_3\text{-NH}_2$ memiliki angka kebasaaan tinggi yaitu 1,8 mmol/g, morfologi permukaan berbentuk kubus dan luas permukaan spesifik sebesar 81,037 m^2/g dengan volume pori 0,158 cm^3/g , diameter pori 3,107 nm. Penggunaan katalis pada reaksi transesterifikasi menghasilkan yield metil ester optimum 86,34% dengan kondisi reaksi temperatur 50 °C selama 3 jam dengan katalis 3% dan rasio mol minyak:metanol 1:9. Hasil penggunaan berulang pada reaksi kedua dan ketiga berturut-turut menghasilkan metil ester sebesar 73,68% dan 58,77%.

Kata kunci: biodiesel, grafting, impregnasi, transesterifikasi

SYNTHESIS OF A BASE CATALYST ON γ - Al_2O_3 MODIFIED WITH COPPER AND AMINO SILANE FOR CONVERSION OF USED PALM OIL INTO BIODIESEL

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ABSTRACT

In this research, the synthesis and characterization of the γ - Al_2O_3 catalyst impregnated with chopper and grafted amino silane have been conducted, which was applied for the transesterification reaction of used coconut oil into biodiesel. The aim of this research is to study the synthesis and characteristics of the $\text{CuO}/\gamma\text{-Al}_2\text{O}_3$, $\text{NH}_2/\gamma\text{-Al}_2\text{O}_3$, dan $\text{CuO}/\gamma\text{-Al}_2\text{O}_3\text{-NH}_2$ catalyst, study the morphology and porosity of the catalyst with the highest basicity, and study the optimum reaction conditions for the conversion of used coconut oil into biodiesel uses a catalyst with the highest basicity. CuO modification was conducted using the dry impregnation method with $\text{Cu}(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$ salt and amino silane modification was conducted using the grafting method with (3-aminopropyl)trimethoxysilane (3-APTMS). The catalyst was analyzed by XRD, FT-IR, basicity test, SEM-EDX Mapping, and SAA. The catalyst activity test was conducted through a transesterification process with temperature variations (40, 50, 60, and 70 °C), time (1, 2, 3, and 4 hours), catalyst weight ratio: oil (1, 3, and 5), and oil: methanol molar ratio (1:6, 1:9, and 1:12). Biodiesel products were analyzed using GC-MS. Catalyst reusability was tested by using one catalyst for three reactions at optimum conditions.

Based on characterization, it was confirmed that CuO metal had been impregnated and amino silane had been grafted onto $\gamma\text{-Al}_2\text{O}_3$. The $\text{CuO}/\gamma\text{-Al}_2\text{O}_3\text{-NH}_2$ catalyst is amorphous with a high basicity number of 1.8 mmol/g, a cubic surface morphology and a specific surface area of 81.037 m^2/g with a pore volume of 0,158 cm^3/g , a pore diameter of 3,1077 nm. The use of a catalyst in the transesterification reaction resulted in an optimum methyl ester conversion of 86.34% under reaction condition temperature of 50 °C for 3 hours with 3% catalyst and mol ratio oil:methanol 1:9. The results of repeated use in the second and third reactions respectively produced methyl ester of 73.68% and 58.77%.

Keywords: biodiesel, grafting, impregnation, transesterification