PENGEMBANGAN KATALIS SILIKA/KARBON TERSULFONASI UNTUK SINTESIS BIODIESEL BERBAHAN DASAR MINYAK JELANTAH

SKRIPSI

diajukan untuk memenuhi Sebagian syarat memperoleh gelar Sarjana Sains

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Sebuah skripsi yang diajukan untuk memenuhi salah satu syarat memperoleh gelar Sarjana Sains pada Program Studi Kimia Fakultas Pendidikan Matematika dan Ilmu Pengetahuan Alam

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Menyatakan bahwa skripsi yang berjudul "**PENGEMBANGAN KATALIS SILIKA/KARBON TERSULFONASI UNTUK SINTESIS BIODIESEL BERBAHAN DASAR MINYAK JELANTAH**" ini beserta seluruh isinya adalah benar-benar karya saya sendiri. Saya tidak melakukan penjiplakan atau pengutipan dengan cara-cara yang tidak sesuai dengan etika ilmu pengetahuan yang berlaku di masyarakat. Atas pernyataan ini, saya siap menanggung risiko/sanksi apabila dikemudian hari ditemukan adanya pelanggaran etika keilmuan atau ada klaim dari pihak lain terhadap keaslian karya saya ini.

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ABSTRAK

Biodiesel sebagai sumber energi terbarukan diperlukan dalam penyediaan bahan bakar alternatif. Bahan baku biodiesel dapat bersumber dari minyak nabati berbagai biomassa termasuk minyak jelantah. Katalis berperan penting dalam reaksi transesterifikasi pada sintesis biodiesel. Penelitian ini bertujuan untuk mensintesis dan mengkarakterisasi katalis $SiO_2/C-SO_3H$, serta menguji kinerjanya sebagai katalis dalam sintesis biodiesel berbahan dasar minyak jelantah. Optimasi kondisi sintesis katalis dilakukan melalui *Response Surface Methodology* (RSM) meliputi suhu sulfonasi, waktu sulfonasi, dan rasio $H_2SO_4:SiO_2/C$. Katalis hasil sintesis dikarakterisasi menggunakan FTIR, XRD, BET N_2 sorption pada 77 K, dan SEM-EDX. Biodiesel hasil sintesis dikarakterisasi dengan GC-MS, pengujian densitas, viskositas, dan titik nyala untuk mengevaluasi kesesuaiannya terhadap standar kualitas bahan bakar. Hasil penelitian menunjukkan bahwa kondisi optimum sintesis Silika/Karbon tersulfonasi diperoleh pada suhu 80°C, waktu 300 menit, dan rasio $H_2SO_4:SiO_2/C$ (6:1 wt/wt). Spektra IR mengonfirmasi keberhasilan proses sulfonasi, ditandai munculnya puncak serapan pada panjang gelombang 882,5 cm^{-1} yang merupakan gugus fungsi sulfonat ($-SO_3H$). Proses sulfonasi pada SiO_2/C menyebabkan penurunan intensitas dan pelebaran puncak, sehingga material semakin bersifat amorf**.** Analisis BET menunjukkan luas permukaan spesifik sebesar 254,82 m^2/g dengan karakteristik mesopori, didukung oleh hasil SEM berupa morfologi berpori dan tidak teratur. Katalis $SiO_2/C-SO_3H$ memiliki kinerja yang baik dalam mengonversi minyak jelantah (komposisi FAME dominan berupa metil oleat dan metil eikosanoat). Biodiesel hasil sintesis memiliki densitas sebesar 879 kg/m^3, viskositas 2,3 mm^2/s, dan titik nyala 176°C, bersesuaian dengan standar SNI 7182-2015.

Kata Kunci: Katalis, Silika/Karbon Tersulfonasi, Minyak Jelantah, Transesterifikasi, Biodiesel.

ABSTRACT

Biodiesel as a renewable energy source is needed in the provision of alternative fuels. Biodiesel feedstock can be sourced from various vegetable oils, including used cooking oil. Catalysts play an important role in the transesterification reaction in biodiesel synthesis. This study aims to synthesize and characterize the SiO_2/C-SO_3H catalyst, as well as test its performance as a catalyst in the synthesis of biodiesel from used cooking oil. Optimization of catalyst synthesis conditions was performed using Response Surface Methodology (RSM), including sulfonation temperature, sulfonation time, and H_2SO_4:SiO_2/C ratio. The synthesized catalyst was characterized using FTIR, XRD, BET N_2 sorption at 77 K, and SEM-EDX. The synthesized biodiesel was characterized using GC-MS, density testing, viscosity testing, and flash point testing to evaluate its compliance with fuel quality standards. The results of the study showed that the optimal synthesis conditions for sulfonated silica/carbon were obtained at a temperature of 80°C, a time of 300 minutes, and an H_2SO_4:SiO_2/C ratio of 6:1 wt/wt. IR spectra confirmed the success of the sulfonation process, marked by the appearance of an absorption peak at a wavelength of 882.5 cm^{-1}, which is the sulfonate functional group (-SO_3H). The sulfonation process on SiO_2/C caused a decrease in intensity and broadening of the peak, making the material more amorphous. BET analysis showed a specific surface area of 254.82 m^2/g with mesoporous characteristics, supported by SEM results showing a porous and irregular morphology. The SiO_2/C-SO_3H catalyst demonstrated good performance in converting waste cooking oil (with a dominant FAME composition of methyl oleate and methyl eicosanoate). The synthesized biodiesel has a density of 879 kg/m^3, viscosity of 2.3 mm^2/s, and flash point of 176°C, in accordance with SNI 7182-2015 standards.

Keywords: *Catalyst, Sulfonated Silica/Carbon, Waste Cooking Oil, Transesterification, Biodiesel.*

DAFTAR ISI

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DAFTAR LAMPIRAN

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