Sintesis dan aplikasi nanokomposit selulosa/-fe2o3/zro2 sebagai katalis biodiesel dari asam laurat = Synthesis and nanocomposit application cellulose/-fe2o3/zro2 as biodiesel catalyst from lauric acid

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Abstrak

Nanokomposit berbasis polimer yang didukung oleh oksida logam, menarik untuk dikembangkan sebagai katalis untuk produksi biodiesel. Dalam penelitian ini, nanokomposit selulosa/-Fe2O3/ZrO2 telah berhasil disintesis dengan memanfaatkan limbah jerami padi sebagai sumber isolasi nanoselulosa, Zirkonium Oksida (ZrO2) disintesis melalui kopresipitasi, Hematite (-Fe2O3) disintesis melalui kopresipitasi yang didukung oleh karakterisasi FTIR, XRD, SEM dan TEM. Hasil pengujian dengan SEM dan TEM menunjukkan morfologi isolasi nanoselulosa berupa fibril panjang dengan ukuran panjang sekitar 171 nm dan diameter 43 nm.
Hasil pengujian XRD menunjukkan struktur Hematite (-Fe2O3) dan Zirkonium Oksida (ZrO2) berupa fasa kristalin. Aktivitas katalitik diuji melalui reaksi esterifikasi metil laurat (biodiesel) dari asam laurat. Kondisi optimum reaksi esterifikasi diperoleh dengan jumlah katalis 2% terhadap asam laurat dan waktu reaksi 3 jam. Hasil persen konversi biodiesel menggunakan nanokomposit selulosa/-Fe2O3/ZrO2 menunjukkan nilai terbaik sebesar 62,85%. Energi aktivasi konversi asam laurat menjadi produk pada penambahan nanokomposit selulosa/-Fe2O3/ZrO2 sekitar 31,24 kJ.mol-1. Parameter kinetika dari reaksi dievaluasi mengikuti pseudo-orde pertama. Komposisi FAME ditentukan dengan GC-MS.
<hr>Nanocomposites of metal oxide supported by biopolymer are interesting to be developed as catalyst for biodiesel production. In this study, cellulose/-Fe2O3/ZrO2 nanocomposite was successfully synthesized by utilizing rice straw waste as a source of nanocellulose biopolymer, Zirconium Oxide (ZrO2) was synthesized via coprecipitation, Hematite (-Fe2O3) was synthesized via coprecipitation in which their characterizations were conducted by FTIR, XRD, SEM, and TEM. The composition of fatty acid methyl ester was determined using gas chromatography-mass spectroscopy. The results of testing with SEM and TEM show the morphology of nanocellulose isolation in the form of long fibrils with a length of about 171 nm and a diameter of 43 nm.
The XRD test results showed Hematite (-Fe2O3) and Zirconium Oxide (ZrO2) structures in the form of crystalline phase. Catalytic activity was tested by esterification of methyl laurate (biodiesel) from lauric acid. The optimum conditions for the esterification reaction were obtained by the amount of catalyst 2% against lauric acid and reaction time of 3 hours. The results of percent biodiesel conversion using cellulose/-Fe2O3/ZrO2 nanocomposite showed the best value of 62.85%. The activation energy of lauric acid conversion into a product at the addition of cellulose/-Fe2O3/ZrO2 nanocomposite is around 31.24 kJ.mol-1. The kinetic parameter of the reaction was also evaluated following the pseudo-first order equation.