

KATALIS BIFUNGSIONAL DARI CANGKANG UDANG VANAME UNTUK ESTERIFIKASI-TRANSESTERIFIKASI MINYAK SAWIT BEKAS MENJADI BIODIESEL

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INTISARI

Pada penelitian ini telah dilakukan preparasi dan karakterisasi katalis bifungsional dari abu cangkang udang vaname tersulfatasi ($CUVK_{(x)}/SO_4$) untuk esterifikasi-transesterifikasi minyak sawit bekas (MSB) menjadi biodiesel. Penelitian ini bertujuan untuk mempelajari sintesis dan karakterisasi material katalis bifungsional ($CUVK_{(x)}/SO_4$) termasuk aplikasinya dalam esterifikasi-transesterifikasi minyak sawit bekas. Cangkang udang vaname dikalsinasi pada temperatur 800 °C selama 5 jam kemudian diimpregnasi dengan asam sulfat variasi konsentrasi 7, 5, 3, 2, dan 1 M. Uji esterifikasi-transesterifikasi dengan metode refluks konvensional dilakukan pada semua katalis tersulfatasi untuk memperoleh katalis terbaik berdasarkan bahan baku MSB yang digunakan pada penelitian ini. $CUVK$ dan $CUVK_{(x)}/SO_4$ terbaik dikarakterisasi dengan instrumen XRF, XRD, FTIR, SEM, SAA, serta uji total keasaman dan kebasaaan. Produk FAME dikarakterisasi dengan GC-MS.

Hasil penelitian menunjukkan esterifikasi-transesterifikasi MSB telah berhasil dilakukan dengan katalis bifungsional $CUVK_{(1)}/SO_4$ menghasilkan pembentukan FAME dan gliserol pada akhir reaksi. $CUVK$ memiliki kandungan utama CaO dengan pembentukan fasa kristal CaO, $Ca(OH)_2$, dan hidroksiapatit ($Ca_{10}(PO_4)_6(OH)_2$), serta nilai total kebasaaan sebesar 22,86 mmol HCl/g. Proses sulfatasi menghasilkan pembentukan fasa kristal kalsium sulfat anhidrat dan terhidrat. Impregnasi asam sulfat meningkatkan keasaman katalis dengan nilai total keasaman sebesar 2,24 mmol NaOH/g dan total kebasaaan turun menjadi 14,58 mmol HCl/g. Kedua katalis termasuk material tipe mesopori dengan luas permukaan spesifik yang lebih besar pada katalis $CUVK_{(1)}/SO_4$. Konversi FAME tertinggi menggunakan katalis $CUVK_{(1)}/SO_4$ diperoleh sebesar 82,39% pada kondisi reaksi optimum: berat katalis terhadap umpan 4%, rasio mol minyak:metanol 1:15, temperatur reaksi 65 °C, dan waktu reaksi 150 menit.

Kata kunci: biodiesel, cangkang udang vaname, CaO, minyak sawit bekas, sulfatasi

***BIFUNCTIONAL CATALYST FROM VANAME SHRIMP SHELL
FOR ESTERIFICATION-TRANSESTERIFICATION
OF USED PALM OIL INTO BIODIESEL***

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ABSTRACT

In this study, the preparation and characterization of a bifunctional catalyst from sulfated vaname shrimp shell ash (CUVK_(x)/SO₄) were carried out for the esterification-transesterification of used palm oil (UPO) into biodiesel. This research aims to study the synthesis and characterization of the bifunctional catalyst material (CUVK_(x)/SO₄) including its application in the esterification-transesterification of used palm oil. Vaname shrimp shell was calcined at 800 °C for 5 hours and then impregnated with sulfuric acid with varying concentrations of 7, 5, 3, 2, and 1 M. Esterification-transesterification tests using the conventional reflux method were carried out for all sulfated catalysts to determine the best catalyst based on the UPO raw material used in this research. CUVK and the best CUVK_(x)/SO₄ were characterized by XRF, XRD, FTIR, SEM, SAA instruments, and tested for total acidity and basicity. FAME products were characterized by GC-MS.

The results showed that the esterification-transesterification of UPO has been successfully carried out with the bifunctional catalyst CUVK₍₁₎/SO₄, resulting in the formation of FAME and glycerol at the end of the reaction. CUVK has a major content of CaO with the formation of CaO, Ca(OH)₂, and hydroxyapatite (Ca₁₀(PO₄)₆(OH)₂) crystal phases which the total basicity was 22.86 mmol HCl/g. The sulfation process resulted in the formation of anhydrous and hydrated calcium sulfate crystal phases. Sulfate acid impregnation increased the acidity of the catalyst with a total acidity of 2.24 mmol NaOH/g and the total basicity decreased to 14.58 mmol HCl/g. Both catalysts exhibited a mesoporous type of material with a larger specific surface area in the CUVK₍₁₎/SO₄ catalyst. The highest FAME conversion using CUVK₍₁₎/SO₄ catalyst was 82.39% under optimum reaction conditions: catalyst to feed weight ratio of 4%, oil to methanol mole ratio of 1:15, reaction temperature of 65 °C, and reaction time of 150 minutes.

Keywords: biodiesel, CaO, sulfation, used palm oil, vaname shrimp shell