

SINTESIS CaO/MCM41 DARI LUMPUR LAPINDO DENGAN METODE SONOKIMIA UNTUK KATALIS DALAM TRANSESTERIFIKASI MINYAK GORENG BEKAS

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INTISARI

Telah dilakukan sintesis katalis CaO/MCM-41 dengan sumber silika yang berasal dari lumpur Lapindo. Tujuan penelitian ini mengkaji pengaruh suhu dan rasio katalis CaO/MCM-41 pada saat proses transesterifikasi minyak goreng bekas. Ekstraksi lumpur Lapindo dilakukan dengan cara refluks menggunakan HCl dan NaOH. Lumpur hasil refluks kemudian dianalisis dengan X-ray Fluoresensi (XRF) dan digunakan sebagai sumber silika dalam sintesis MCM-41. MCM-41 disintesis dengan metode sonokimia selama 150 menit dan dikalsinasi selama 5 jam pada suhu 540 °C. MCM-41 yang telah dikalsinasi dianalisis menggunakan XRD, FT-IR, TEM, dan GSA. Jumlah Ca yang diimbangkan pada MCM-41 adalah sebesar 1,15; 1,29; 2,39; dan 3,25 (b/b) terhadap MCM-41 menggunakan metode impregnasi basah. Proses transesterifikasi minyak goreng bekas dilakukan dengan kondisi rasio mol metanol/minyak = 15 dan variasi suhu 55, 65, dan 75 °C, serta variasi rasio katalis terhadap minyak 5/100, 10/100, dan 15/100 (b/b) terhadap minyak dengan waktu reaksi selama 2 jam. Produk hasil transesterifikasi dianalisis dengan GC-MS.

Hasil analisis XRF menunjukkan kandungan silika yang diambil dari lumpur lapindo sebesar 96,7%. Hasil FT-IR dari MCM-41 menunjukkan pembentukan Si-O-Si pada panjang gelombang 1080 cm⁻¹. Analisis XRD dari MCM-41 menunjukkan puncak karakteristik 2θ antara 2°-5° dengan luas permukaan spesifik dari 1290 m²/g dan diameter pori 3,4 nm. Citra TEM menunjukkan distribusi pori yang teratur dengan bentuk heksagonal seperti sarang lebah. Konversi metil ester tertinggi didapatkan pada kondisi reaksi suhu 65 °C dan rasio katalis umpan 15/100 (b/b) yaitu sebesar 78,17% menggunakan kandungan Ca yang diimbangkan sebesar 10% (b/b). Umur katalis CaO/MCM-41d adalah 9,8 jam.

Kata kunci: lumpur Lapindo, sonokimia, MCM-41, transesterifikasi, CaO/MCM-41

SYNTHESIS OF CaO/MCM-41 FROM LAPINDO MUD WITH SONOCHEMICAL METHOD FOR CATALYST IN TRANSESTERIFICATION OF WASTE COOKING OIL

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ABSTRACT

Synthesis and characterization of MCM/41 from Lapindo mud by sonochemical method for transesterification of waste cooking oil has been carried out. The aim of this research was to synthesize MCM-41 by sonochemical method and its characterizations. The silica was separated from the mud by reflux method using 6 M of HCl and NaOH solutions. The silica was then analyzed by X-ray Fluorescence (XRF) and used as silica source in MCM-41 synthesis. The synthesis of MCM-41 was carried out by sonochemical method for 150 min. The MCM-41 was characterized by XRD, FT-IR, Surface Area Analyzer, and TEM. The Ca metals was loaded onto the MCM-41 by wet impregnation method under variation of metal content of 1.15, 1.29, 2.39, and 3.25 wt.%. Transesterification of waste cooking oil was carried out under condition of methanol/oil mole ratio of 15, temperature reaction of 55, 65 and 75 °C, and catalyst/oil weight ratio of 5/100, 10/100, and 15/100 for 2 h. The transesterification product were analyzed by GC-MS.

The XRF analysis results showed that the silica extracted from Lapindo mud was in 96.7% purity. The FT-IR data showed the formation of Si-O-Si at a wavenumber of 1080 cm⁻¹. The XRD analysis of the MCM-41 showed characteristic peak between 2 - 5°. The MCM-41 has spesific surface area of 1290 m²/g and pore diameter of 3.4 nm. The TEM images of MCM-41 showed ordered pore distribution with a hexagonal shape. The highest conversion of methyl ester was 78.17 wt.% obtained under the reaction conditions at 65 °C and catalyst/oil weight ratio of 15/100 using the CaO/MCM-41 catalyst which Ca content of 10 wt.%. The life time CaO/MCM-41d catalyst was 9.8h.

Keywords: Lapindo mud, sonochemical, MCM-41, transesterification, CaO/MCM-41