

ABSTRAK

STUDI PRA-PERLAKUAN PEMANASAN TERHADAP KARAKTERISTIK *BIO CRUDE OIL* (BCO) YANG DIHASILKAN DARI PROSES PIROLISIS MINYAK KELAPA SAWIT MENGGUNAKAN ZEOLIT-P HASIL MODIFIKASI BENTONIT

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Indonesia merupakan negara dengan potensi biomassa yang melimpah yang dapat dimanfaatkan sebagai sumber energi alternatif untuk mengurangi ketergantungan terhadap energi fosil yang tidak terbarukan dan semakin menipis. Salah satu sumber biomassa yang potensial adalah minyak kelapa sawit karena ketersediaannya yang melimpah.

Penelitian ini bertujuan untuk menghasilkan *Bio Crude Oil* (BCO) melalui pirolisis minyak kelapa sawit menggunakan katalis zeolit-P termodifikasi dari bentonit. Zeolit-P disintesis dari bentonit dengan penambahan aluminium foil. Bentonit dipurifikasi menggunakan HCl 1 M kemudian dianalisis menggunakan *Diffraction Fluorescence* (XRF), *X-Ray Diffraction* (XRD), dan *Scanning Electron Microscopy* (SEM). Hasil XRF menunjukkan penurunan kadar Fe serta peningkatan Si dan Al. Analisis XRD mengidentifikasi fase kristal montmorillonit, albit, kuarsa, dan kristobalit. Hasil analisis SEM menunjukkan permukaan bentonit yang teraglomerasi dengan struktur amorf. Sintesis zeolit-P dilakukan dengan metode hidrotermal pada suhu 100°C selama 72, 96, dan 120 jam, lalu dikalsinasi pada suhu 600°C selama 8 jam. Karakterisasi zeolit-P menggunakan XRD dan SEM menunjukkan bahwa waktu kristalisasi optimal adalah 96 jam, dengan pola difraksi sesuai dengan zeolit-P standar *International Zeolite Association* (IZA) dan morfologi prisma segi empat hasil analisis SEM.

Uji aktivitas katalitik zeolit-P pada proses pirolisis minyak kelapa sawit dilakukan variasi waktu pra-perlakuan pemanasan berbeda. Hasil analisis *Gas Chromatography-Mass Spectrometry* (GC-MS) menunjukkan kandungan hidrokarbon tertinggi sebesar 79,27% diperoleh pada waktu pemanasan 30 menit.

Kata kunci: bentonit, zeolit-P, minyak kelapa sawit, pirolisis, *bio crude oil* (BCO).

ABSTRACT

HEATING PRE-TREATMENT STUDY ON THE CHARACTERISTICS OF BIO CRUDE OIL (BCO) PRODUCED FROM PALM OIL PYROLYSIS PROCESS USING ZEOLITE-P MODIFIED BENTONITE

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Indonesia is a country with abundant biomass potential that can be utilized as an alternative energy source to reduce dependence on non-renewable and increasingly scarce fossil fuels. One potential source of biomass is palm oil due to its abundant availability.

This study aims to produce Bio Crude Oil (BCO) through the pyrolysis of palm oil using a modified zeolite-P catalyst derived from bentonite. Zeolite-P was synthesized from bentonite with the addition of aluminum foil. Bentonite was purified using 1 M HCl and then analyzed using Diffraction Fluorescence (XRF), X-Ray Diffraction (XRD), dan Scanning Electron Microscopy (SEM). XRF results showed a decrease in Fe content and an increase in Si and Al. XRD analysis identified the crystalline phases of montmorillonite, albite, quartz, and cristobalite. SEM analysis showed that the bentonite surface was agglomerated with an amorphous structure. Zeolite-P synthesis was carried out using the hydrothermal method at 100°C for 72, 96, and 120 hours, then calcined at 600°C for 8 hours. Characterization of zeolite-P using XRD and SEM showed that the optimal crystallization time was 96 hours, with diffraction patterns consistent with the International Zeolite Association (IZA) standard for zeolite-P and a prismatic morphology as determined by SEM analysis.

The catalytic activity of zeolite-P in the pyrolysis process of palm oil was tested by varying the pre-treatment heating time. The results of Gas Chromatography-Mass Spectrometry (GC-MS) analysis showed that the highest hydrocarbon content of 79.27% was obtained at a heating time of 30 minutes.

Keywords: bentonite, zeolite-P, palm oil, pyrolysis, bio crude oil (BCO).