

ABSTRAK

MODIFIKASI BENTONIT MENJADI ZEOLIT-Y DAN UJI APLIKASINYA SEBAGAI KATALIS PADA PROSES PIROLISIS MINYAK KELAPA SAWIT MENJADI *BIO CRUDE OIL* (BCO)

Oleh

NURUL NATASHA BERLIANI

Minyak kelapa sawit merupakan salah satu sumber biomassa terbarukan yang berpotensi menghasilkan hidrokarbon melalui metode pirolisis. Kualitas hidrokarbon dalam *bio crude oil* (BCO) sangat dipengaruhi oleh jenis katalis yang digunakan. Penelitian ini bertujuan untuk memodifikasi bentonit menjadi zeolit-Y melalui metode hidrotermal dan mengkaji efektivitasnya sebagai katalis dalam proses pirolisis minyak kelapa sawit dengan variasi waktu pra-perlakuan pemanasan (0, 10, 20, 30, dan 40 menit).

Penelitian ini dilaksanakan pada Oktober 2024–Maret 2025 di Laboratorium Kimia Anorganik–Fisik FMIPA Universitas Lampung. Tahapan penelitian meliputi; (1) purifikasi bentonit menggunakan HCl 1M dan karakterisasinya, (2) sintesis zeolit-Y secara hidrotermal menggunakan bentonit hasil purifikasi dan aluminium foil *food grade* dengan variasi waktu kristalisasi 72, 96, dan 120 jam, (3) karakterisasi zeolit-Y menggunakan *X-Ray Diffraction* (XRD) dan *Scanning Electron Microscope* (SEM), (4) aplikasi zeolit-Y sebagai katalis dalam proses pirolisis minyak kelapa sawit, dan (5) analisis produk BCO menggunakan *Gas Chromatography-Mass Spectrometry* (GC-MS).

Hasil penelitian menunjukkan bahwa bentonit berhasil di purifikasi dengan HCl 1M. Karakterisasi XRD menunjukkan bahwa kristalisasi zeolit-Y terbaik diperoleh pada waktu 96 jam, meskipun fasa kristalnya belum murni zeolit-Y. Mikrograf SEM memperlihatkan bahwa kristal kubik oktahedral khas zeolit-Y mulai terbentuk, namun masih didominasi oleh fasa sodalit dan amorf. Hasil analisis GC-MS terhadap BCO menunjukkan bahwa pra-perlakuan pemanasan selama 30 menit menghasilkan kandungan hidrokarbon tertinggi sebesar 64,87%.

Kata kunci: bentonit, zeolit-Y, minyak kelapa sawit, pirolisis, BCO.

ABSTRACT

MODIFICATION OF BENTONITE INTO ZEOLITE-Y AND ITS APPLICATION TEST AS CATALYST IN THE PYROLYSIS PROCESS OF PALM OIL INTO BIO CRUDE OIL (BCO)

By

NURUL NATASHA BERLIANI

Palm oil is one of the renewable biomass sources that has the potential to produce hydrocarbons through pyrolysis method. The quality of hydrocarbons in bio crude oil (BCO) is strongly influenced by the type of catalyst used. This study aims to modify bentonite into zeolite-Y through hydrothermal method and assess its effectiveness as a catalyst in the pyrolysis process of palm oil with variation of heating pre-treatment time (0, 10, 20, 30, and 40 minutes). This research was conducted in October 2024-March 2025 at the Laboratory of Inorganic-Physical Chemistry FMIPA, University of Lampung. The research stages included; (1) bentonite purification using 1M HCl and its characterization, (2) hydrothermal synthesis of zeolite-Y using purified bentonite and food grade aluminium foil with crystallization time variation of 72, 96, and 120 hours, (3) characterization of zeolite-Y using X-Ray Diffraction (XRD) and Scanning Electron Microscope (SEM), (4) application of zeolite-Y as catalyst in palm oil pyrolysis process, and (5) analysis of BCO products using Gas Chromatography-Mass Spectrometry (GC-MS). The results showed that bentonite was successfully purified with 1M HCl. XRD characterization showed that the best zeolite-Y crystallization was obtained at 96 hours, although the crystal phase was not pure zeolite-Y. SEM micrographs showed that cubic octahedral crystals typical of zeolite-Y began to form, but were still dominated by sodalite and amorphous phases. GC-MS analysis of the BCO showed that the 30-minute heating pre-treatment resulted in the highest hydrocarbon content of 64.87%.

Keywords: bentonite, zeolite-Y, palm oil, pyrolysis, BCO.