

# Perengkahan Katalitik Minyak Nyamplung (*Calophyllum inophyllum*) Menjadi Senyawa Biohidrokarbon Menggunakan Katalis Zeolit Berbasis Material Fly Ash Dengan CaO dan NiO = Catalytic Cracking of Tamanu Oil (*Calophyllum inophyllum*) into Biohydrocarbon Compounds Using Fly Ash-Based Zeolite Catalyst Materials with CaO and NiO

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## Abstrak

Permintaan energi global yang semakin tinggi, ditambah dengan dampak emisi gas rumah kaca yang berbahaya dari bahan bakar fosil, telah memicu pencarian sumber energi alternatif yang tidak bersaing dengan pasokan makanan. Penelitian ini melakukan perengkahan katalitik minyak nyamplung menjadi senyawa biohidrokarbon menggunakan katalis zeolit berbasis fly ash yang dimodifikasi. Katalis zeolite didapatkan dari preparasi fly-ash dengan metode pencucian asam (HCl) dan peleburan alkali (NaOH) yang diimpergnasi dengan kalsium oksida (CaO) dan nikel oksida (NiO) untuk meningkatkan kinerjanya. Variasi rasio campuran katalis 5% dan 10% CaO, serta 1-3% NiO, suhu 450-550C, dan rasio minyak terhadap katalis 0-20% wt. Hasil reaksi perengkahan berupa bio-oil dikarakterisasi dengan Gas Chromatography-Mass Spectroscopy (GCMS) dan Fourier Transform Infra-Red (FT-IR). Hasil preparasi katalis dikarakterisasi dengan X-ray diffraction (XRD), X-ray fluorescence (XRF), Scanning Electron Microscopy (SEM), dan Brunauer–Emmett–Teller (BET). Berdasarkan hasil penelitian, minyak nyamplung berhasil dikonversi menjadi senyawa biohidrokarbon dengan variasi katalis zeolite fly ash (ZFA) yang dimodifikasi dengan CaO dan NiO. Jenis katalis ZFA terimpregnasi 3% NiO (3%NiO/ZFA) pada suhu 550C dan rasio massa katalis terhadap minyak umpan 10% wt menghasilkan konversi terbesar 81,89%. Berdasarkan hasil GCMS, hasil selektivitas fraksi rantai gasoline (C5-C11) sebesar 27,14%. Karakteristik sifat fisik dari biohidrokarbonnya mendekati standar biodiesel dengan nilai densitas (717 kg/m<sup>3</sup>), viskositas kinematic (2,69 cSt.), dan angka RON (94).

.....Increasing global energy demand and the harmful effects of greenhouse gas emissions from fossil fuels, has fuelled the search for alternative energy sources that don't compete with food supplies. This study conducted the catalytic cracking of nyamplung oil into bio-hydrocarbon compounds using a modified fly ash-based zeolite catalyst. The zeolite catalyst was obtained from fly-ash preparation by acid washing (HCl) and alkali melting (NaOH) impregnated with calcium oxide (CaO) and nickel oxide (NiO) to improve its performance. Variation of catalyst mixture of 5% and 10% CaO, with 1-3% NiO, temperature 450-550C, and ratio of oil to catalyst 0-20% wt. The results of the cracking reaction in the form of bio-oil were characterized by Gas Chromatography-Mass Spectroscopy (GCMS) and Fourier Transform Infra-Red (FT-IR). The catalyst preparation results were characterized by X-ray diffraction (XRD), X-ray fluorescence (XRF), Scanning Electron Microscopy (SEM), and Brunauer–Emmett–Teller (BET). Based on the results of the research, nyamplung oil was successfully converted into bio-hydrocarbon compounds using a variety of zeolite fly ash (ZFA) catalysts modified with CaO and NiO. Catalyst type ZFA impregnated with 3% NiO (3%NiO/ZFA) at 550C and mass ratio of catalyst to feed oil of 10% wt produced the biggest conversion of 81,89%. Based on the GCMS results, the selectivity of the gasoline chain fraction (C5-C11) was 27,14%.

The physical properties of the bio-hydrocarbons are close to those of biodiesel with a density value (717 kg/m<sup>3</sup>), kinematic viscosity (2,69 cSt.), and RON number (94).