

ABSTRAK

Salaisa, NIM 4213510015 (2025). Sintesis Katalis Bimetal Ni-Fe Yang Diembangkan Dalam Biochar Untuk Reaksi Hidrogenasi Hasil Pirolisis Limbah Plastik LDPE Sebagai Bahan Bakar Alternatif

Peningkatan konsumsi bahan bakar fosil dan tingginya volume limbah plastik, khususnya Low Density Polyethylene (LDPE), menimbulkan permasalahan lingkungan sekaligus krisis energi. Penelitian ini bertujuan untuk mengonversi limbah plastik LDPE menjadi bahan bakar alternatif melalui proses pirolisis dan peningkatan kualitas produk oil dengan reaksi hidrogenasi menggunakan katalis bimetal Ni-Fe/Biochar. Biochar disintesis dari cangkang kelapa sawit melalui proses karbonisasi pada suhu 550°C, kemudian diaktivasi dengan KOH dan HCl, lalu dikarakterisasi dengan FTIR, XRD dan BET. Biochar aktif dikembangkan logam Ni dan Fe melalui metode impregnasi dengan konsentrasi 1% (b/b) menggunakan metode impregnasi basah sehingga diperoleh katalis Ni-Fe/Biochar dan dikarakterisasi dengan BET. Proses hidrogenasi Bio oil LDPE dilakukan pada suhu 450°C selama 2 jam. Produk oil hasil pirolisis dan hidrogenasi dikarakterisasi menggunakan FTIR, serta diuji sifat fisikokimianya meliputi viskositas, densitas, dan bilangan iodin. Data karakterisasi katalis menunjukkan Biochar bersifat amorfus dengan luas permukaan 218.964 m²/g dan setelah masuk logam luas permukaan menjadi 189.19m²/g. Proses hidrogenasi menggunakan katalis Ni-Fe/Biochar mampu menurunkan bilangan iodin oil LDPE dari 79,91g menjadi 42,61g dalam 100g sampel, hasil karakterisasi FTIR menunjukkan serapan yang tetap intens dari C=C. Pengujian densitas dan viskositas menghasilkan nilai yang sesuai dengan standar SNI. Secara keseluruhan katalis Ni-Fe/Biochar menunjukkan aktivitas yang baik dalam proses hidrogenasi untuk meningkatkan kualitas oil hasil pirolisis LDPE sehingga berpotensi digunakan sebagai bahan bakar alternatif yang ramah lingkungan.

Kata kunci: LDPE, pirolisis, hidrogenasi, biochar, katalis Ni-Fe

ABSTRACT

Salaisa, NIM 4213510015 (2025). Synthesis of Bimetal Catalyst Ni-Fe Carried Out in Biochar for Hydrogenation Reaction From Pyrolysis of Plastic Waste LDPE as an Alternative Fuel

The increase in fossil fuel consumption and the high volume of plastic waste, especially Low Density Polyethylene (LDPE), cause environmental problems as well as an energy crisis. This study aims to convert LDPE plastic waste into alternative fuels through the pyrolysis process and improve the quality of oil products by hydrogenation reaction using Ni-Fe/Biochar bimetal catalysts. Biochar is synthesized from palm oil shells through a carbonization process at 550°C, then activated with KOH and HCl, then characterized by FTIR, XRD and BET. Active biochar is carried out with Ni and Fe metals through an impregnation method with a concentration of 1% (w/w) using the wet impregnation method so that a Ni-Fe/Biochar catalyst is obtained and characterized with BET. The hydrogenation process of LDPE Bio oil is carried out at a temperature of 4500C for 2 hours. Pyrolysis and hydrogenated oil products were characterized using FTIR, and their physicochemical properties were tested including viscosity, density, and iodine number. Catalyst characterization data showed that Biochar was amorphous with a surface area of 218,964 m²/g and after entering the metal the surface area became 189.19 m²/g. The hydrogenation process using Ni-Fe/Biochar catalyst was able to reduce the number of iodine oil LDPE from 79.91g to 42.61g in 100g of samples, the results of FTIR characterization showed a still intense absorption of C=C. Density and viscosity testing produced values that were in accordance with SNI standards. Overall, Ni-Fe/Biochar catalysts show good activity in the hydrogenation process to improve the quality of LDPE pyrolysis oil so that it has the potential to be used as an environmentally friendly alternative fuel

Keywords: LDPE, pyrolysis, hydrogenation, biochar, Ni-Fe catalyst