ABSTRAK

PENGARUH RASIO CAMPURAN LIMBAH PLASTIK HDPE DAN LDPE TERHADAP KARAKTERISTIK BAHAN BAKAR CAIR HASIL PIROLISIS KATALITIK MENGGUNAKAN ZEOLIT ALAM TERAKTIVASI

(Inggit Amania Salsabilla, 2026, 78 Halaman, 16 Tabel, 12 Gambar, dan 4 Lampiran)

Limbah plastik *High-Density Polyethylene* (HDPE) dan *Low-Density Polyethylene* (LDPE) memiliki potensi untuk dikonversi menjadi bahan bakar cair melalui proses pirolisis katalitik. Penelitian ini bertujuan menganalisis pengaruh rasio campuran HDPE dan LDPE terhadap jumlah produk cair dan karakteristik fisikokimianya serta mengidentifikasi kecenderungan fraksi hidrokarbon yang dihasilkan. Penelitian dilakukan secara eksperimental menggunakan unit pirolisis dua tahap, yaitu *thermal cracking* dan *catalytic cracking*, dengan zeolit alam teraktivasi sebanyak 3% dari massa bahan baku. Massa bahan baku pada setiap percobaan adalah 2 kg dengan variasi rasio HDPE sebesar 100:0, 75:25, 50:50, 25:75, dan 0:100. Produk yang dihasilkan dianalisis berdasarkan *yield*, densitas, viskositas, nilai kalor estimasi, titik nyala, dan komposisi senyawa menggunakan *Gas Chromatography–Mass Spectrometry* (GC–MS). Hasil penelitian menunjukkan bahwa rasio HDPE sebesar 25:75 menghasilkan produk cair tertinggi, yaitu 196 mL dengan *yield* sebesar 8,53%. Produk pada rasio tersebut memiliki densitas 0,8708 g/mL, viskositas dinamik 3,97 cP atau viskositas kinematik 4,56 cSt, nilai kalor estimasi 10.829,50 cal/g, dan titik nyala 35°C. Analisis GC–MS menghasilkan 200 puncak dengan total area terintegrasi sebesar 99,95%. Berdasarkan distribusi rantai karbon, produk cair tersusun atas fraksi *gasoline* sebesar 23,592%, kerosin 2,121%, diesel 58,339%, dan fraksi berat 15,948%. Dominasi fraksi diesel menunjukkan bahwa produk cair cenderung memiliki karakteristik hidrokarbon rantai menengah. Rasio HDPE sebesar 25:75 memberikan keseimbangan terbaik antara kuantitas dan karakteristik produk cair, tetapi rendahnya titik nyala menunjukkan bahwa produk masih memerlukan pemisahan dan peningkatan mutu sebelum digunakan sebagai bahan bakar komersial.

Kata Kunci: *High-Density Polyethylene* (HDPE), *Low-Density Polyethylene* (LDPE), pirolisis katalitik, zeolit alam teraktivasi.

ABSTRACT

EFFECT OF HDPE AND LDPE PLASTIC WASTE BLEND RATIOS ON THE CHARACTERISTICS OF LIQUID FUEL PRODUCED BY CATALYTIC PYROLYSIS USING ACTIVATED NATURAL ZEOLITE

(Inggit Amania Salsabilla, 2026, 78 Pages, 16 Tables, 12 Figures, and 4 Appendices)

High-Density Polyethylene (HDPE) and Low-Density Polyethylene (LDPE) plastic waste have the potential to be converted into liquid fuel through catalytic pyrolysis. This study aimed to analyze the effect of HDPE and LDPE blend ratios on the quantity and physicochemical characteristics of the liquid product and to identify the tendency of the resulting hydrocarbon fractions. The research was conducted experimentally using a two-stage pyrolysis unit consisting of thermal cracking and catalytic cracking, with activated natural zeolite added at 3% of the feedstock mass. The feedstock mass used in each experiment was 2 kg, with HDPE ratios of 100:0, 75:25, 50:50, 25:75, and 0:100. The products were analyzed based on yield, density, viscosity, estimated calorific value, flash point, and compound composition using Gas Chromatography–Mass Spectrometry (GC–MS). The results showed that the HDPE ratio of 25:75 produced the highest liquid product, namely 196 mL with a yield of 8.53%. The product obtained at this ratio had a density of 0.8708 g/mL, a dynamic viscosity of 3.97 cP or a kinematic viscosity of 4.56 cSt, an estimated calorific value of 10,829.50 cal/g, and a flash point of 35°C. GC–MS analysis identified 200 peaks with a total integrated area of 99.95%. Based on the carbon-chain distribution, the liquid product consisted of 23.592% gasoline fraction, 2.121% kerosene fraction, 58.339% diesel fraction, and 15.948% heavy fraction. The predominance of the diesel fraction indicated that the liquid product tended to contain medium-chain hydrocarbons. The HDPE ratio of 25:75 provided the best balance between the quantity and characteristics of the liquid product. However, the relatively low flash point indicated that further separation and upgrading processes are required before the product can be used as a commercial fuel.

Keywords**:** *High-Density Polyethylene* (HDPE), *Low-Density Polyethylene* (LDPE), *catalytic pyrolysis*, *actived natural zeolite*.