ABSTRAK

Peningkatan jumlah limbah plastik, khususnya Polypropylene (PP) dan Low-Density Polyethylene (LDPE), menimbulkan permasalahan lingkungan yang serius sehingga diperlukan teknologi pengolahan yang mampu mengurangi limbah sekaligus menghasilkan energi alternatif. Salah satu metode yang potensial adalah pirolisis katalitik menggunakan zeolit alam sebagai katalis untuk meningkatkan efisiensi konversi dan kualitas produk cair. Penelitian ini bertujuan menganalisis pengaruh variasi persentase katalis zeolit alam terhadap yield minyak, densitas, laju pembakaran, dan nilai kalor hasil pirolisis campuran PP-LDPE. Metode yang digunakan adalah penelitian eksperimental dengan proses pirolisis pada suhu 250°C selama 120 menit menggunakan campuran plastik PP-LDPE sebanyak 3 kg. Variasi katalis yang digunakan yaitu 0%, 5%, 10%, dan 15% dari massa bahan baku. Data yang diperoleh meliputi volume minyak (yield), densitas, laju pembakaran, dan nilai kalor. Hasil penelitian menunjukkan bahwa peningkatan persentase katalis meningkatkan yield minyak dari 76 mL (0%) menjadi 576 mL (15%). Nilai densitas berkisar antara 0,8811–0,8916 g/mL, dengan densitas terendah diperoleh pada katalis 5%. Waktu pembakaran tercepat dicapai pada katalis 5% dan 15% sebesar 60 detik, sedangkan nilai kalor tertinggi diperoleh pada sampel tanpa katalis sebesar 9.808,06 cal/gram. Berdasarkan hasil penelitian, katalis 15% menghasilkan yield minyak tertinggi, sedangkan katalis 5% memberikan keseimbangan terbaik antara yield, densitas, laju pembakaran, dan nilai kalor.

Kata kunci: pirolisis katalitik, zeolit alam, PP-LDPE, yield minyak, karakteristik bahan bakar.

ABSTRACT

The increasing accumulation of plastic waste, particularly Polypropylene (PP) and Low-Density Polyethylene (LDPE), has become a significant environmental concern, highlighting the need for technologies capable of reducing waste while producing alternative energy sources. One promising approach is catalytic pyrolysis, which utilizes natural zeolite as a catalyst to improve conversion efficiency and enhance the quality of the liquid products. This study aimed to investigate the effect of varying natural zeolite catalyst concentrations on oil yield, density, burning rate, and calorific value of pyrolysis oil derived from PP-LDPE mixtures. An experimental method was employed by conducting the pyrolysis process at a temperature of 250°C for 120 minutes using 3 kg of mixed PP-LDPE plastic waste. The catalyst concentrations were varied at 0%, 5%, 10%, and 15% of the feedstock mass. The collected data included oil volume (yield), density, burning rate, and calorific value. The results showed that increasing the catalyst concentration significantly enhanced the oil yield, from 76 mL without catalyst (0%) to 576 mL with 15% catalyst. The density values ranged from 0.8811 to 0.8916 g/mL, with the lowest density obtained at the 5% catalyst concentration. The fastest burning time was achieved by the 5% and 15% catalyst samples, both requiring 60 seconds, while the highest calorific value was recorded for the non-catalytic sample at 9,808.06 cal/g. Based on the overall findings, the 15% natural zeolite catalyst produced the highest oil yield, whereas the 5% catalyst concentration provided the most balanced performance in terms of yield, density, burning rate, and calorific value.

Keywords: catalytic pyrolysis, natural zeolite, PP-LDPE, oil yield, fuel characteristics.