

## INTISARI

Peningkatan jumlah sampah plastik menuntut suatu metode penanggulangan sampah yang ramah lingkungan dan memiliki prospek jangka panjang, misalnya dengan proses pirolisis. Salah satu keuntungan dari pirolisis limbah plastik adalah memperoleh minyak berbasis minyak bumi dengan produk tambahan berupa aluminium. Penelitian ini bertujuan untuk mempelajari pengaruh suhu dan laju pemanasan terhadap *yield* dan karakteristik minyak, terhadap *yield* padatan dan aluminium juga karakteristik kimia aluminium serta mendapatkan parameter kinetika yang menggambarkan pengaruh suhu dan laju pemanasan terhadap laju proses pirolisis. Proses pirolisis sampah plastik ini diharapkan dapat memberikan kontribusi dalam penanganan sampah non-organik dan produksi bahan bakar alternatif serta berkontribusi dalam pengembangan teknologi pemungutan logam aluminium dari sampah plastik.

Bahan baku berupa sampah plastik jenis *polyethylene* dan *polypropylene* dibersihkan dari pengotor tanah dan dijemur. Selanjutnya plastik dipotong dengan ukuran seragam 4x4 cm dan ditimbang sebanyak 100 gram. Proses pirolisis berlangsung sejak suhu ruangan hingga 2 jam setelah suhu pirolisis tercapai, yaitu 550°C dengan laju pemanasan 0,1°C/s. Asap yang terbentuk dari proses pirolisis dikondensasikan sebagai *plastic oil* dan ditimbang setiap 10 menit sejak tetesan pertama hingga waktu pirolisis selesai. Padatan (aluminium dan karbon) yang tersisa di dalam reaktor diambil setelah proses pirolisis selesai dan suhu reaktor mencapai suhu ruangan. Aluminium kotor hasil pirolisis selanjutnya melewati proses *founndry* untuk dileburkan, dicetak dan didinginkan. Percobaan diulang untuk berbagai variasi suhu pirolisis (450°C, 500°C, 600°C, 650°C) pada laju pemanasan 0,3°C/s dan berbagai laju pemanasan (0,15°C/s; 0,2°C/s; 0,25°C/s; 0,3°C/s) pada suhu 550°C.

Hasil penelitian menunjukkan bahwa kenaikan suhu pirolisis akan menurunkan *yield* minyak, sedangkan kenaikan laju pemanasan akan meningkatkan *yield* minyak dengan karakteristik minyak berada di antara karakter minyak jenis solar dan kerosin. Kenaikan suhu dan laju pemanasan proses pirolisis akan menurunkan *yield* padatan, sedangkan *yield* aluminium tetap. Logam aluminium yang diperoleh sebesar 5,3% terhadap massa plastik dengan kemurnian 96,79%. Kenaikan suhu dan laju pemanasan akan meningkatkan laju proses pirolisis. Model kinetika yang mewakili proses pirolisis plastik *polyethylene* dan *polypropylene* adalah model reaksi tunggal dengan nilai parameter kinetika *pre-exponential factor* (A) sebesar 18,2689 menit<sup>-1</sup> dan nilai energi aktivasi (E) sebesar 40,231 kJ/mol, nilai  $\alpha$  sebesar 0,0039 menit<sup>-1</sup> dan nilai  $\beta$  sebesar 8,6883 s/°C.

Kata kunci: pirolisis, plastik, suhu, laju pemanasan, aluminium

## ABSTRACT

Increasing the number of plastic waste require a waste reduction methods which are environmentally friendly and have long-term prospects, for example, by pyrolysis. One of the advantages of pyrolysis of waste plastics are gained petroleum-based oil with additional products such as aluminium. This study aimed to study the effect of temperature and heating rate on the the yield and characteristics of oil, the yield of solids and aluminium also chemical characteristics of aluminium and getting kinetic parameters that describe the effects of temperature and heating rate on the rate of pyrolysis process. Plastic waste pyrolysis process is expected to contribute in the handling of non-organic waste and the production of alternative fuels and contribute to the technological development of aluminium metal collection from plastic waste.

Raw materials such as polyethylene and polypropylene plastic wastes was cleaned of soil impurities and was dried. Furthermore, the plastic is cut with a uniform size 4x4 cm and weighed as much as 100 grams. Pyrolysis process started from room temperature up to 2 hours after the pyrolysis temperature is reached, i.e 550°C at a heating rate 0,1°C/s. The smoke that is formed from the pyrolysis process was condensed as plastic oil and weighed every 10 minutes since the first drop until the time pyrolysis is completed. Solids (aluminium and carbon) remaining in the reactor was taken after the pyrolysis process is complete and the reactor temperature reaches room temperature. Further, gross aluminium proceeds through the process of foundry to be melted, molded and cooled. The experiment was repeated for a wide variety of pyrolysis temperatures (450°C, 500°C, 600°C, 650°C) at the heating rate of 0,3°C/s and various of heating rates (0,15°C/s; 0,2°C/s; 0,25°C/s; 0,3°C/s) at a temperature of 550°C.

The results showed that the rise of temperature will decrease the yields of oil, while the increase in the heating rate will increase the yield of oil with the characteristics of pyrolysis oil was located between character types of diesel and kerosene. The increase of temperature and heating rate of pyrolysis process will decrease the yield of solids, while the yield on fixed aluminium. Aluminium metal was gained 5.3% of the mass of plastic with a purity of 96.79%. The rise in temperature and heating rate will increase the rate process of pyrolysis. Kinetics model that representing plastic pyrolysis process of polyethylene and polypropylene was single reaction model with kinetics parameter values pre-exponential factor (A) is 18.2689 min<sup>-1</sup> and the value of activation energy (E) is 40.231 kJ/mol,  $\alpha$  value is 0.0039 min<sup>-1</sup> and the value of  $\beta$  is 8.6883 s/°C.

Keywords: pyrolysis, plastic, temperature, heating rate, aluminium