ABSTRAK

PENGARUH VARIASI TEMPERATUR DAN WAKTU TINGGAL TERHADAP PROSES TOREFAKSI LIMBAH KAYU KARET (*HEVEA BRASILIENSIS*)

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Limbah kayu karet (*hevea brasiliensis*) merupakan salah satu jenis biomassa yang memiliki potensi besar sebagai sumber energi alternatif karena ketersediaannya yang melimpah dari kegiatan peremajaan tanaman karet di perkebunan, namun pemanfaatannya masih belum optimal. Limbah kayu karet (*hevea brasiliensis*) memiliki potensi besar sebagai bahan bakar padat karena ketersediaannya yang melimpah di Indonesia, namun karakteristik awalnya masih memiliki kadar air dan zat volatil yang cukup tinggi sehingga memerlukan peningkatan kualitas melalui proses torefaksi. Penelitian ini bertujuan untuk menganalisis pengaruh variasi temperatur 250°C, 275°C, dan 300°C serta waktu tinggal 10, 20, dan 30 menit terhadap karakteristik bahan bakar padat limbah kayu karet melalui pengujian nilai kalor, analisis proksimat, hidrofobisitas, *mass yield*, dan *energy yield*. Proses torefaksi dilakukan menggunakan reaktor torefaksi kontinu tipe tubular dengan sistem pemanas *oil jacket*, sementara pengujian nilai kalor menggunakan *oxygen bomb calorimeter* dan analisis proksimat dilakukan di laboratorium energi. Hasil penelitian menunjukkan bahwa peningkatan temperatur dan waktu tinggal secara signifikan meningkatkan kualitas bahan bakar. Nilai kalor tertinggi diperoleh pada temperatur 300°C selama 30 menit sebesar 5395,31 kkal/kg. Analisis proksimat pada 300°C menunjukkan penurunan kadar air dari 10,12% menjadi 6,04%, penurunan *volatile matter* dari 84,30% menjadi 78,31%, serta peningkatan *fixed carbon* dari 4,89% menjadi 14,07%. Selain itu, sifat hidrofobisitas meningkat, dengan penurunan penyerapan air hingga 4,82%. Dengan demikian, proses torefaksi efektif meningkatkan kualitas energi biomassa limbah kayu karet sebagai bahan bakar padat alternatif.

Kata kunci: torefaksi, kayu karet, nilai kalor, analisis proksimat, hidrofobisitas

ABSTRACT

EFFECT OF TEMPERATURE AND RESIDENCE TIME VARIATIONS ON THE TORREFACTION PROCESS OF RUBBER WOOD WASTE (*HEVEA BRASILIENSIS*)

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Rubber wood waste (*hevea brasiliensis*) is a type of biomass that has significant potential as an alternative energy source due to its abundant availability from rubber plantation replanting activities; however, its utilization remains limited. This biomass has the potential to be used as a solid fuel, but its initial characteristics include relatively high moisture and volatile matter contents, requiring an upgrading process through torrefaction. This study aims to analyze the effect of temperature variations of 250°C, 275°C, and 300°C and residence times of 10, 20, and 30 minutes on the characteristics of rubber wood waste solid fuel through calorific value testing, proximate analysis, hydrophobicity testing, mass yield, and energy yield. The torrefaction process was conducted using a tubular continuous torrefaction reactor with an oil jacket heating system, while the calorific value was measured using an oxygen bomb calorimeter and proximate analysis was performed in an energy laboratory. The results show that increasing temperature and residence time significantly improves the fuel quality. The highest calorific value was obtained at 300°C for 30 minutes, reaching 5395.31 kcal/kg. Proximate analysis at 300°C showed a decrease in moisture content from 10.12% to 6.04%, a decrease in volatile matter from 84.30% to 78.31%, and an increase in fixed carbon from 4.89% to 14.07%. In addition, hydrophobicity increased as indicated by a reduction in water absorption to 4.82%. Therefore, the torrefaction process effectively improves the energy quality of rubber wood waste biomass as an alternative solid fuel.

Keywords: torrefaction, rubber wood, calorific value, proximate analysis, hydrophobicity