ABSTRAK

Santi Via Ningsih, 4213210027 (2026), Modifikasi dan Karakterisasi Karet Alam Siklik Berat Molekul Rendah Melalui Proses Mekanik Fisik dan Metode Pemutusan Rantai : Analisa Sifat Kimia dan Mekanik

Telah dilakukan modifikasi karet alam SIR-10 menjadi karet alam menjadi siklik berat molekul rendah (CNR) untuk meningkatkan stabilitas termal, kekakuan, kompatibilitas terhadap aditif dan kerentanan terhadap degradasi. Modifikasi diawali dengan mastikasi menggunakan *two roll mill*, kemudian dilanjutkan dengan deproteinasi melalui sokletasi menggunakan aseton selama 24 dan 48 jam. DPNR (*Deproteinized Natural Rubber*) selanjutnya disiklisasi menggunakan katalis P_2O_5 dengan variasi konsentrasi 10, 15, dan 20 phr. Tahap pemutusan rantai dilakukan menggunakan fenilhidrazin dan oksigen dalam atmosfer nitrogen, kemudian dilanjutkan dengan siklisasi untuk menghasilkan CNR berat molekul rendah. Karakterisasi dilakukan menggunakan Fourier Transform Infrared (FTIR) dan Thermogravimetric Analysis (TGA). Analisi FTIR menunjukkan bahwa deproteinasi selama 48 jam memberikan penurunan intensitas pita Amida II (1540,12 cm^{-1}), Amida I (1736 cm^{-1}), dan N–H (3278,29 cm^{-1}). Proses *chain scission* dan siklisasi berhasil menghasilkan karet alam siklis berat molekul rendah yang ditandai dengan berkurangnya intensitas pita C=C (1662 cm^{-1}), penurunan pita =C–H (3040–3020 cm^{-1}), serta munculnya pita khas pada 689 cm^{-1} (vibrasi siklik CH_2–CH_2) dan 752 cm^{-1} (non-siklik CH_2–CH_2). Analisis TGA menunjukkan penurunan massa bertahap sebesar 2% (30–100 °C), 10% (150–300 °C), dan 80% (300–500 °C), yang mengindikasikan degradasi termal cepat akibat pemutusan rantai serta karakteristik karet dengan berat molekul rendah.

Kata Kunci : Karet Alam SIR-10, DPNR (*Deproteinization of Natural Rubber*), Siklisasi, *Chain Scission*, P_2O_5, Fenilhidrazin, FTIR, TGA.

ABSTRACT

Santi Via Ningsih, 4213210027 (2026), Modification and Characterization of Low Molecular Weight Cyclic Natural Rubber Through Physical–Mechanical Processing and Chain Scission Method: Analysis of Chemical and Mechanical Properties

Modification of SIR-10 natural rubber into low molecular weight cyclic natural rubber (CNR) has been carried out to improve thermal stability, rigidity, compatibility with additives, and resistance to degradation. The modification process was initiated by mastication using a two-roll mill, followed by deproteinization through Soxhlet extraction with acetone for 24 and 48 hours. The deproteinized natural rubber (DPNR) was then cyclized using P_2O_5 catalyst with concentration variations of 10, 15, and 20 phr. Chain scission was conducted using phenylhydrazine and oxygen under a nitrogen atmosphere, followed by further cyclization to obtain low molecular weight CNR. Characterization was performed using Fourier Transform Infrared (FTIR) and Thermogravimetric Analysis (TGA). FTIR analysis showed that 48-hour deproteinization resulted in a significant decrease in the intensity of Amide II (1540.12 cm^{-1}), Amide I (1736 cm^{-1}), and N–H (3278.29 cm^{-1}) bands. The chain scission and cyclization processes successfully produced low molecular weight cyclic natural rubber, indicated by a decrease in C=C band intensity (1662 cm^{-1}), reduction of =C–H bands (3040–3020 cm^{-1}), and the appearance of characteristic peaks at 689 cm^{-1} (cyclic CH_2–CH_2 vibration) and 752 cm^{-1} (non-cyclic CH_2–CH_2 vibration). TGA analysis revealed a stepwise mass loss of 2% (30–100 °C), 10% (150–300 °C), and 80% (300–500 °C), indicating rapid thermal degradation due to chain scission and confirming the low molecular weight characteristics of the resulting rubber.

Keywords: SIR-10 Natural Rubber, DPNR (Deproteinization of Natural Rubber), Cyclization, Chain Scission, P_2O_5, Phenylhydrazine, FTIR, TGA.