MECHANICAL PROPERTIES OF GUM AND BLACK-FILLED DEPROTEINIZED NATURAL RUBBER IN COMPARISON WITH SYNTHETIC CIS-1,4-POLYISOPRENE VULCANIZATES

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Abstract

Natural rubber, when compared to synthetic cis-1,4-polyprene vulcanizates, has the advantage of being free from protein. However, it may cause allergic reactions. Therefore, deproteinized natural rubber (DPNR) is being considered for use in some applications. DPNR has lower protein content than natural rubber, but it may be reduced further to make it safer. The present work involves the preparation of deproteinized natural rubber and synthetic cis-1,4-polyprene vulcanizates with and without black filler, and the investigation of their mechanical properties.

The results show that DPNR has lower tensile strength and elongation at break than IR and WNR, but it has higher resilience and hardness than IR. The addition of black filler improves the properties of all rubbers, but DPNR still shows lower tensile strength and elongation than IR and WNR. The modulus of DPNR is higher than IR and WNR, indicating its better resistance to fatigue.

In conclusion, DPNR is a promising alternative to natural rubber in applications where protein content is a concern. It can be further improved by modifying its properties without significantly altering its mechanical performance.

ISBN 974-04-4999-9
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ABSTRACT

Since proteins existing in natural rubber were reported to cause allergy to some people using natural rubber products, synthetic cis-1,4-polyisoprene which is designed to have similar structure and properties to natural rubber is preferably chosen in some applications due to the absence of proteins. However, deproteinization of natural rubber latex can reduce extractable antigenic proteins, giving rise to less allergic reaction. In this respect, a deproteinized natural rubber is of interest as an alternative raw material for producing low allergen natural rubber products.

In this research, gum and carbon black-filled depoproteinized natural rubber and synthetic cis-1,4-polyisoprene vulcanizates having various crosslink densities were prepared by varying the curative contents. Whole natural rubber having various crosslink densities was also prepared for comparison. The mechanical properties such as tensile strength, tear strength, flex-cracking resistance, abrasion resistance and heat buildup of all vulcanizates were determined and their properties at a similar degree of crosslink density were also compared.

For both gum and carbon black systems, depoproteinized natural rubber was found to possess a lower crosslink density than both synthetic cis-1,4-polyisoprene and whole natural rubber at a specific level of curative content. Tensile and tear strengths of the vulcanizates passed through a maximum with the increase in crosslink density and then declined as crosslink density further increased. In addition, flex-cracking resistance of all vulcanizates decreased as crosslinking increased. The results indicated that depoproteinized natural rubber performed better flex-cracking resistance than synthetic cis-1,4-polyisoprene and whole natural rubber at a specific level of curative content because depoproteinized natural rubber had a lower modulus. In gum system, synthetic cis-1,4-polyisoprene exhibited an abrupt drop in tear strength at lower crosslink density and had a narrower peak than did the other two. This might be due to its lower crystallizability compared to the others. For carbon black system, it is found that tensile strength, tear strength and heat buildup of all vulcanizates were comparable at a given crosslink density. This means the reinforcement by carbon black overshadows the intrinsic properties of each rubber. At optimum crosslink density, most mechanical properties of depoproteinized natural rubber and whole natural rubber for both gum and carbon black systems were comparable to those of synthetic cis-1,4-polyisoprene except for the flex-cracking resistance of the carbon black-filled depoproteinized natural rubber and whole natural rubber was inferior to that of carbon black-filled synthetic cis-1,4-polyisoprene due to their higher modulus. However, the improved flex-cracking resistance of carbon black-filled depoproteinized natural rubber without much drop in tensile and tear strengths can be achieved by preparing it with a slightly lower modulus.

From the results, most mechanical properties of depoproteinized natural rubber were competitive with those of synthetic cis-1,4-polyisoprene. Thus, depoproteinized natural rubber might be used as an alternative raw material for producing low allergen natural rubber products.

KEY WORDS : DEPROTEINIZED NATURAL RUBBER/ SYNTHETIC CIS-1,4-POLYISOPRENE/ CROSSLINK DENSITY/ MECHANICAL PROPERTIES

123 pp. ISBN 974-04-4999-9