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Properties of Natural Rubber/Recycled Chloroprene Rubber Blend: Effects of Blend Ratio and Matrix

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Abstract

The present study investigated the effects of two types of natural rubber and different blend ratios on the cure, tensile properties and morphology of natural rubber/recycled chloroprene rubber blends. The blends of natural rubber/recycled chloroprene rubber were prepared by using laboratory two-roll mill. The result showed that the cure time prolonged with the addition of recycled chloroprene rubber (rCR). Comparability, natural rubber/recycled chloroprene rubber (SMR L/rCR) blendcured rapidly than epoxidized natural rubber/recycled chloroprene rubber (ENR 50/rCR) blend. The addition of rCRalso caused a decrement in the tensile strength and elongation at break for both rubber blends. The SMR L/rCR blendsshowed higher tensile strength and elongation at break compared to those of ENR 50/rCR blends at any blend ratios.

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*Keywords:*Recycled chloroprene rubber; Rubber blends; Mechanical properties

1. Introduction

In the glove manufacturing, common problems such as the formation of blisters, pinholes, thin patch, and gel latex between the gloves fingers are the main reason for great amount of glove rejected due to poor in quality. Hence, due

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to these common problems in glove manufacturing, the idea to reuse the rejected gloves in blending with virgin rubber is developed.

In this work, the blending of recycled chloroprene rubber (rCR) gloves with two different types of natural rubber is investigated. It is well known that chloroprene rubber (CR) has demonstrated resistance to hydraulic fluids, gasoline, alcohols, organic acids, alkalis, oils and fats and may also provide enhanced chemical and wear resistance compared to natural or other synthetic rubbers in some situations[1]. These properties indicate CR is stable and high resistance towards common degrading agencies. Hence, the recycling of CR is necessary as a solution for disposal problem.

Two types of natural rubber with different in polarity were used namely Standard Malaysian Rubber (SMR L) and modified natural rubber known as Epoxidized Natural Rubber (ENR). The epoxidation of NR to produce ENR involves the random introduction of epoxide groups onto the double bond of the NR polymer chain[2] where ENR properties resembling those of synthetic rubbers rather than natural rubber[3]. ENR 50 is a chemically modified natural rubber which contains 50 mol% of epoxidation[4] . It is reported that the blends of NR/CR are immiscible [5, 6] and the ENR 50/CR blends are miscible up to certain degree depended on several factors[7-9]. However, the works mentioned are based on the CR and only a few studies work on blending with recycled chloroprene rubber was reported to the best knowledge of the authors. This study will be reported and compared the effects of various blend ratios on the cure characteristics, tensile properties, and morphology of SMR L/rCR and ENR 50/rCR blends.

2. Experimental

2.1. Material and formulation

NR from Standard Malaysian Natural Rubber grade L (SMR L) and epoxidized natural rubber (ENR 50) were supplied by Rubber Research Institute Malaysia (RRIM), whereas Juara Resources (M) Sdn. Bhd. was the supplier for the recycled gloves. At first, the recycled gloves were grounded into powder form using a table-type pulverizing machine from RongTsong Precision Technology Co., Ltd. The average size of ground rCR was 600 μm. CB of high abrasion furnace (N330) was purchased from EXCELKOS Sdn. Bhd. All other reagents, such as zinc oxide (ZnO), sulfur (S_8), *N*-cyclohexyl-2-benzothiazole sulfonamide (CBS), tetramethylthiurammonosulfide (TMTM), magnesium oxide (MgO), and stearic acid, were purchased from Bayer (M) Sdn. Bhd. The detailed of five different formulations of the rubber blends are shown in Table 1.

Table 1.The experimental formulations.

Materials	Loadings (phr)				
	1	2	3	4	5
NR*	95	85	75	65	50
rCR	5	15	25	35	50
ZnO	5.0	5.0	5.0	5.0	5.0
Stearic acid	3.0	3.0	3.0	3.0	3.0
CBS	0.5	0.5	0.5	0.5	0.5
TMTM	1.0	1.0	1.0	1.0	1.0
MgO	2.0	2.0	2.0	2.0	2.0
S_8	2.5	2.5	2.5	2.5	2.5
N330	30.0	30.0	30.0	30.0	30.0

*Two different types of NR were used; SMR L and ENR 50

2.2. Blending preparation

Blending of rCR with SMR L or ENR 50 and all the ingredients listed in the Table 1 were carried out on a laboratory two roll mill model XK-160 with the size of 160 mm x 320 mm. These procedures were based on ASTM D 3184-89.