UNIVERSITI TEKNOLOGI MARA

THE EFFECTS OF CROSSLINK CONCENTRATION AND CARBOXYLATED NITRILE RUBBER (XNBR) CONTENT ON THE SWELLING RESISTANCE AND THE MECHANICAL PROPERTIES OF NATURAL RUBBER (NR) LATEX FILM AND NR: XNBR LATEX BLENDS

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Abstract

Natural rubber (NR) is non-polar that has excellent mechanical properties but relatively poor swelling resistance towards hydrocarbon oil. As a result, this deficiency limits its applications particularly in fast food industry. In contrast, carboxylated nitrile rubber (XNBR) is polar and has very good swelling resistance towards hydrocarbon oil. However, XNBR is more expensive than NR. For this reason, XNBR latex was blended with NR in order to get well balance in term of swelling resistance and strength. The effect of crosslink concentrations and blend ratio NR: XNBR on swelling resistance, tensile and tear strength of NR latex films was investigated. The amount of sulphur was varied from 0.2 part per hundred rubber (pphr) to 3.0 pphr in order to get different crosslink concentrations of the NR latex film. The ratios of NR: XNBR were varied at three different levels, namely 20:80, 50:50 and 80:20 in order to vary the level of polarity. The crosslink concentration of NR latex film was measured by using the equilibrium volume swelling method. The swelling resistance of the latex film was assessed in terms of mass uptake and diffusion coefficient where the latex film was immersed in cooking oil until the equilibrium oil uptake was achieved. The tensile strength and tearing energy of the latex film before and after swollen in cooking oil were also determined by using tensile machine. The results showed that increasing the crosslink concentration reduced the mass uptake of the oil and decreased the diffusion coefficient, thus improves the swelling resistance. Increasing the XNBR level decreased the mass uptake of oil markedly due to increase in the polarity. The tensile and tear strengths of the swollen latex films were substantially lower than the unswollen latex films. The swollen latex film produced steady tear with low tearing energy. In contrast, unswollen latex film produced knotty tear with high tearing energy.

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CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Natural rubber latex is an intracellular milky fluid produced by the laticifer cells of the tropical rubber tree *H.brasiliensis* [1]. Natural rubber (NR) latex finds very wide applications in the gloves industry since 1920s [2]. This is attributed to an excellent tear and puncture resistance of NR latex films. Besides that NR latex film exhibits very high extensibility (600-1000%) before its breaking point. These properties make NR latex film as an excellent barrier protection against infectious liquids and gases. Most of the NR latex gloves are used in hospitals and clinics as examination and surgical gloves. However, recently NR latex gloves have entered the fast food industry where good swelling resistance is an essential requirement. Being a non-polar rubber, NR latex glove has poor swelling resistance [3] and thus limits its applications in the fast-food industry. When the rubber is swollen it will lose its tensile strength and tear strength. The decrease in these strengths is associated with the loosening of cohesive bonds and low intermolecular forces between rubber molecular chains since the rubber molecular chains are pushed apart by oil molecules. In order to improve the swelling resistance towards hydrocarbon oil so that the mechanical strengths are not much affected, one can use nitrile rubber (NBR), since it is polar in nature. The nitrile butadiene rubber (NBR) latex gloves give lower tear strength as compared to NR latex gloves since the former is a non strain-crystallizing rubber and the latter is a strain-crystallizing rubber. The crystals formed during straining act as self-reinforcing filler which enhance the tear resistance of NR latex film [4]. Preliminary work by Vivayganathan and Amir showed that carboxylated nitrile rubber (XNBR) latex film gave higher tear resistance than ordinary NBR latex film since the former has better colloidal stability than the latter [5,6] . Besides that,