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DEVELOPMENT OF NR / NBR LATEX BLENDS FOR MANUFACTURE OF HIGH QUALITY GLOVES

BY

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The work described in this thesis was carried out by the undersigned at the Rubber Research Institute of Sri Lanka and Industrial Clothing Limited Prime Polymer Division, under the supervision of Mrs.Dilhara Edirisinghe .and a report on this has not been submitted to any other university for another degree. Also, I certify that this thesis does not include without acknowledgement any material previously submitted for any university and to best of my knowledge and belief it does not contain any material previously published, written or orally communicated by another person expect where due reference is in the text.

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We certify that the above statement made by the candidate is true and that this is submitable for submission to the university for the purpose of evaluation.

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LIST OF FIGURES

LIST OF TABLES

Tables **Page No**

ABBREVIATIONS

ACN	Acrylonitrile
A/O	Antioxidant
ASTM	American Society for Testing and Materials
BS	British Standards
CRI	Cure Rate Index
CV	Conventional Vulcanizing
D.R.C.	Dry Rubber Content
EV	Effective Vulcanization.
HA	High Ammonia
ISO	International Organization for Standardization
LA	Low Ammonia
MST	Mechanical Stability Time
NBR	Acrylonitrile-Butadiene(Nitrile) Rubber
NR	Natural Rubber
phr	Parts per hundred rubber
rpm	Revolutions per minute
TSC	Total Solid Content
ZDEC	Zinc Diethyl –dithiocarbamate.
ZMBT	Zinc Mercaptobenzothiazole

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ABSTRACT

In recent years nitrile latex consumption in glove manufacturing industries has remarkably increased. The main reason is to fulfill the oil and fuel resistant industrial & household glove requirement in the global market. However unlike natural rubber nitrile rubber doesn't crystallize either spontaneously or on stretching. Therefore they have low tensile strength, tear resistance which are the key physical properties the end users are expecting from a glove.

The overall objective of this research is to develop natural rubber (NR) latex /acrylonitrile butadiene rubber (NBR) latex blends having physical properties superior to NBR latex and tolerable resistance to swelling in oils and fuels, for manufacture of high quality gloves. At the same time replacement of part of the NBR latex with NR latex in the glove industry would increase consumption of NR latex which in turn will be a benefit to our country. Physical properties of the vulcanizates of NR/NBR latex blends prepared by varying the blend ratio were evaluated. For this study three different formulations were used and the main objective was to select the formulation which gives rise to best overall properties. The effect of blending method on the physical properties was also studied using three different blending methods. After evaluation of all the results glove samples of selected blends were prepared and physical properties, swelling resistance of each of these blends were studied in details.

It is concluded that blending of small percentage of a NR latex into NBR latex according to a special blending method improves physical properties remarkably while keeping the oil and fuel resistance at a tolerable level.

CONTENTS

CHAPTER ONE - INTRODUCTION

1.1 Introduction

The early work of Walters and Keyte [1] on blending of natural rubber (NR) with styrene butadiene rubber (SBR) was the beginning of an approach to elastomers blends from both technical and economical point of view. After their work the development of many new types of polymer blends as well as the usage of blends has increased remarkably during the past few decades. This is because for any application single polymers provide inadequate performance. It is significantly cheaper to produce a new material by mixing existing processes. Blends are often used to combine the desired properties of individual polymers to obtain an improved product. This is possible by careful selection and mixing of component polymers.

There are two ways of forming polymer blends.

- Chemical blends
- Physical blends.

The properties of physical blends are different from those of parent polymers. They can be unique. Physical properties are also determined by the physical structure of the blend. For many applications rubber products are manufactured from a blend of two or more dissimilar polymers. These blends are generally classified as rubber – rubber and rubber – plastic blends. [2]

Rubber – rubber blends can be prepared by a variety of methods which include latex blending, solution blending, solution and latex blending, mechanical blending and blending of powdered rubber. Latex blending is the method employed in the preparation of blends

throughout this study. Influence of blend ratio and blending method and physical properties, aging and swelling in oil and fuel of the end products, gloves were evaluated in this study.

NBR which fall in the group of specialty synthetic rubbers is regarded as the engineer's rubber as it combines excellent resistance to oil, both at normal and elevated temperature [3] NR is a very versatile material and has excellent physical properties and non polar solvent resistance. Blends of NR with NBR which combine the excellent qualities of NR with especial properties of the NBR have gained considerable important properties for the end products. Because of its strong polar properties NBR is poorly compatible with NR, which has a non polar aliphatic nature. Since the polarity of NBR increases with increasing the acrylonitrile content, the compatibility of NR becomes poorer accordingly. For this reason NBR types with relatively low amount of acrylonitrile are generally considered for blending with NR. Even with NBR containing only 28% acrylonitrile, the overall picture of physical properties shows impairment with increasing amount of NR in the blend. Therefore nitrile latex with 28% of acrylonitrile content was used as the major blend component throughout this study.

1.2 OBJECTIVES

The main objective of this project is to develop an industrial glove which has excellent physical properties such as high tensile strength, high tear strength, low modulus and excellent solvent resistance and excellent oil resistance, via latex blending. Other objectives are to increase the market opportunity for NR by development of natural rubber latex, nitrile rubber latex (NR/NBR) blends to the benefit of NR producers.