THE EFFECT OF PRE-VULCANIZATION TIME AND VULCANIZATION TEMPERATURE ON INTER-LAYER ADHESION AND PHYSICAL PROPERTIES OF MIDDLE AND TREAD LAYERS OF SOLID TIRE

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This thesis submitted in partial fulfilment of the requirements for the degree Master of Science in Polymer Technology

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February 2020

DECLARATION OF THE CANDIDATE & SUPERVISOR

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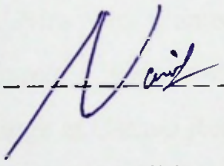

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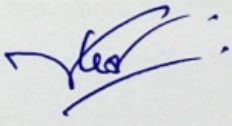
Signature of the supervisor:  Date: 10/02/2020

ACKNOWLEDGEMENT

First, I would like to extend my profound appreciation to my supervisor Prof. B. A. J. K. Premachandra for all the support and encouragement that he provides me during the master's degree program. I would also like to extend my gratitude to him for continuous support as the course coordinator; you have been an ever-present beacon of support, encouragement, and advice.

Besides my advisor, I would like to thank the rest of my thesis committee: Dr. (Mrs). Shantha Egodage, Dr. (Mrs.) D. G. Edirisingha for their encouragement and insightful comments.

Further, I would like to express my sincere gratitude to the management of Camso Loadstar (Pvt) Ltd for offering tests and laboratory facilities. My special thanks go to Mr. Anurasiri Gunasekara who provides me the support and guidance during the research. I wish to show my appreciation to all the staff who helped to conduct the testings at Camso Research & Development Center.

I would like to acknowledge professors, lecturers, and staff of chemical and process engineering, University of Moratuwa, for coaching and support during the master's degree program.

Finally, I would like to thank my wife, mother, sister, and friends for the support, devotion, and understanding throughout the research period.

Abstract

Resilient solid tires are used for industrial vehicles. Three-layer resilient tire composed of heel, middle and tread layers; the integrity of layers is empirical throughout the service life. This thesis investigated inter-layer adhesion capacity between middle and tread layer. The two compounds were pre vulcanized into 6 levels (0%,20%,40%,60%,80%, and 100%) at 100 °C, by changing the Pre-vulcanization time. Primary vulcanized sample was vulcanized secondarily at 150 °C and 170 °C; inter-facial bonding strengths were compared.
Increased secondary vulcanization temperature decreased the inter-layer adhesions. Based on adhesion strength, manufacturing limitations and physical properties, the optimum primary vulcanization level selected. To develop acceptable bonding at 0% pre vulcanization of middle layer, the tread layer could pre vulcanized up to 80% at 150 °C secondary vulcanizing temperature and up to 20% at 170 °C. At 20% pre vulcanized middle layer, tread layer could pre vulcanized up to 60% and 20% at secondary vulcanization temperature of 150 °C and 170 °C respectively. At 40% pre vulcanized middle layer, tread layer could pre vulcanized up to 40% at 150 °C secondary temperature; but at secondary temperature of 170 °C, tread layer bonded well only at 0% degree pre vulcanization.

In conclusion, 40% of middle and tread layer pre vulcanization levels are suggested as optimum pre vulcanization level at secondary vulcanization temperature of 150 °C, 20% of middle and tread layer pre vulcanization levels was the optimum for secondary vulcanization temperature of 170 °C. Out of two secondary vulcanization temperatures, 170 °C and 20% of middle and tread layer pre vulcanization levels suggested as the optimum pre vulcanization level.

Keywords: Interfacial bonding, pre cure, vulcanization temperature, rubber to rubber bonding

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LIST OF ABBREVIATIONS

6PPD	N-(1,3-Dimethylbutyl)-N'-phenyl-p-phenylenediamine
ASTM	American society for testing and materials
B.C.	Before Christ
BR	Polybutadiene rubber
CAGR	Compound annual growth rate
FEA	Finite element analysis
LCV	Light commercial vehicle
M&HCV	Medium and heavy commercial vehicle
M_H	Maximum torque
M_I	Initial torque
M_L	Minimum torque
MOR	2-(4-Morpholinothio) benzothiazole
NR	Natural rubber
ODR	Oscillating disc rheometer
OTR	Off the road
pphr	parts per hundred rubber
PVI	Pre vulcanization inhibitor
RPA	Rubber process analyzer
RSS	Ribbed smoked rubber sheet
SBR	Styrene butadiene rubber
t_{90}	Optimum cure time
ts_2	Scorch safety