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**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

Department of Chemical and Process Engineering

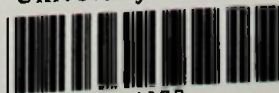
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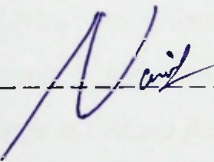
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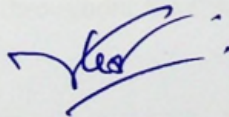


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Abstract

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

TABLE OF CONTENT

Declaration of the candidate & supervisor	i
Acknowledgement	ii
Abstract.....	iii
Table of Content.....	iv
List of Figures.....	vii
List of Tables	viii
List of Abbreviations	ix
1. Introduction.....	1
1.1 History of the tire	1
1.2 Global tire market	1
1.3 Types of tires.....	2
1.4 Solid tire.....	2
1.4.1 Resilient tire components and their functions.....	3
1.5 The resilient tire manufacturing process.....	4
1.6 Research objectives.....	6
2. Literature review	7
2.1 Compounding of rubber	7
2.1.1 Rubbers	7
2.1.2 Fillers	7
2.1.3 Anti-degradants.....	8
2.1.4 Curatives	8
2.2 Compound mixing	8
2.3 Rubber to rubber interface bonding strength	9
2.4 Vulcanization of rubber	11
2.4.1 Effects of vulcanization on vulcanizate properties	12

2.4.2	Characterization of the vulcanization process	13
2.4.3	Effect of vulcanization temperature.....	16
2.5	Problem statement.....	17
3.	Materials & experimental techniques	18
3.1	Materials and compounding.....	19
3.1.1	Compound batch variation.....	21
3.1.2	Vulcanization system.....	22
3.2	Vulcanization	22
3.2.1	Evaluation of vulcanization time	22
3.2.2	Compression moulding	23
3.3	Sample preparation	23
3.3.1	Compound preparation for primary vulcanization.....	23
3.3.2	Primary vulcanization of samples.....	24
3.3.3	Vulcanization of adhesion samples.....	27
3.4	Determination of properties	29
3.4.1	Rheological analysis	29
3.4.2	Adhesion test.....	30
3.4.3	Microscopic investigations	31
3.4.4	Tensile properties.....	31
3.4.5	Tear strength	32
3.4.6	Hardness test	32
4.	Results and discussion	33
4.1	Microscopic investigations of the bonded surface.....	33
4.1.1	Binocular microscopic images of failure surfaces	34
4.2	Rheometer results of primary vulcanizates.....	36



4.2.1 Rheometer results at 150 °C and 170 °C for different primary vulcanization levels of the middle compound	36
4.2.2 Rheometer results at 150 °C and 170 °C for different primary vulcanization levels of the tread compound	38
4.3 Influence of middle and tread layer primary vulcanization level on their interlayer adhesion	39
4.3.1 Influence of middle and tread layer primary vulcanization level on their interlayer adhesion at low secondary vulcanization temperature	39
4.3.2 The influence of middle and tread layer primary vulcanization level on their interlayer adhesion at high secondary vulcanization temperature	45
4.3.3 Effect of secondary vulcanization temperature on M0 with different primary vulcanization level of tread layer	49
4.3.4 Effect of secondary vulcanization temperature on M20 with different primary vulcanization level of tread layer	50
4.3.5 Effect of secondary vulcanization temperature on M40 with different primary vulcanization level of tread layer	51
4.3.6 Effect of secondary vulcanization temperature on M60 with different primary vulcanization level of tread layer	52
4.3.7 Effect of secondary vulcanization temperature on M80 with different primary vulcanization level of tread layer	52
4.3.8 Effect of secondary vulcanization temperature on M100 with different primary vulcanization level of tread layer	53
4.4 Physical property evaluation of optimum vulcanizate samples	54
4.4.1 Selecting an optimum vulcanizate sample	54
4.4.2 Physical properties of optimum primary vulcanizate samples	55
4.4.3 Influence of optimum primary vulcanizates on solid tire performance	56
5. Conclusion and recommendation	60
References List	62

LIST OF FIGURES

Figure 1.1 Components of a three-layer resilient tire	3
Figure 1.2 Basic steps of the resilient tire manufacturing process	4
Figure 2.1 Network formation during vulcanization	11
Figure 2.2 Vulcanizate properties as a function of the crosslinking density	12
Figure 2.3 Typical rheometer graph for rubber vulcanization.....	13
Figure 2.4 Primary, secondary and total vulcanization.....	15
Figure 2.5 Resilient tire middle to tread premature failure.....	17
Figure 3.1 Basic steps of the experiment.....	18
Figure 3.2 Primary vulcanizate.....	27
Figure 3.3 Adhesion sample with dimensions	28
Figure 3.4 Adhesion test sample and forces	30
Figure 4.1 Middle-tread interface failure.....	33
Figure 4.2 Middle tearing failure	33
Figure 4.3 The surface finish of "middle teared" surface nature.....	34
Figure 4.4 The surface finish of "rough teared" surface nature	34
Figure 4.5 The Surface finish of "rough" surface nature	35
Figure 4.6 The Surface finish of "matt" surface nature	35
Figure 4.7 The Surface finish of "glossy" surface nature	35
Figure 4.8 Adhesion results and acceptable level for samples that secondary vulcanized at 150 °C	41
Figure 4.9 Adhesion results and acceptable level for samples that secondary vulcanized at 170 °C	46
Figure 4.10 Adhesion results between M0 with different tread pre vulcanizates.....	49
Figure 4.11 Adhesion results between M20 vs different tread pre vulcanizates	50
Figure 4.12 Adhesion results between M40 vs different tread pre vulcanizates	51
Figure 4.13 Adhesion results between M60 vs different tread pre vulcanizates	52
Figure 4.14 Adhesion results between M80 vs different tread pre vulcanizates	52
Figure 4.15 Adhesion results between M100 vs different tread pre vulcanizates	53

LIST OF TABLES

Table 3.1 Formulation of middle layer compound	19
Table 3.2 Formulation of tread layer compound	20
Table 3.3 First stage middle compound mixing cycle	21
Table 3.4 Second stage middle compound mixing cycle.....	21
Table 3.5 First stage tread compound mixing cycle	21
Table 3.6 Second stage tread compound mixing cycle.....	21
Table 3.7 Primary vulcanization time of middle pre-vulcanizates	26
Table 3.8 Primary vulcanization time of tread pre-vulcanizates	26
Table 3.9 Low secondary vulcanization temperature sample names and primary vulcanization percentages	28
Table 3.10 High secondary vulcanization temperature sample names and primary vulcanization percentages of composition layers	29
Table 4.1 Cure characteristics of middle vulcanizates tested at 150 °C	36
Table 4.2 Cure characteristics of middle vulcanizates tested at 170 °C	36
Table 4.3 Cure characteristics of tread vulcanizates tested at 150 °C	38
Table 4.4 Cure characteristics of tread vulcanizates tested at 170 °C	38
Table 4.5 Adhesion results of samples that secondary vulcanized at 150 °C.....	40
Table 4.6 Middle vulcanizate self-adhesion results, secondary vulcanized at 150 °C	42
Table 4.7 Tread vulcanizate self-adhesion results, secondary vulcanized at 150 °C	42
Table 4.8 Adhesion results of samples that secondary vulcanized at 150 °C.....	45
Table 4.9 Middle vulcanizate self-adhesion results, secondary vulcanized at 170 °C	47
Table 4.10 Tread vulcanizate self-adhesion results, secondary vulcanized at 170 °C	47
Table 4.11 Optimum vulcanization levels	54
Table 4.12 Physical properties of optimum primary vulcanizate configuration 1.....	55
Table 4.13 Physical properties of optimum primary vulcanizate configuration 2.....	55
Table 4.14 Physical properties of optimum primary vulcanizate configuration 3.....	55
Table 4.15 Pre vulcanization time of optimum pre vulcanizates.....	58

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-Morpholiniothio) 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