DEVELOPMENT OF NR/CIIR RUBBER BLENDS WITH CARBON BLACK AND SILICA FILLERS FOR TYRE INNER LINERS

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ABSTRACT

Inner liner of a tubeless tyre is currently constructed using a speciality synthetic rubber called chlorobutyl rubber (CIIR). Blending of CIIR with natural rubber (NR) will enable to achieve improvement in physico-mechanical properties with a reduced compound cost. Also, use of CIIR/NR blends for inner liners are best at retaining air pressure and minimizing the temperature dependence of air permeability. The property increase is enhanced by addition of a mix of carbon black and silica fillers, which are reinforcing fillers. One reason for carrying out this research is to enhance the market opportunities of NR by developing NR/CIIR blends to reach the end product requirements. In this study, different series of compounds were prepared, one with CIIR alone by varying the carbon black to silica ratio at 10 phr intervals, other with CIIR/NR blends by varying the CIIR to NR blend ratio at 20% intervals. Total filler loading was kept constant at 60 phr.

Melt viscosity, hardness, tensile strength, modulus at 300 % and tear strength increased with silica loading, while scorch time, abrasion volume loss and air permeability decreased above silica loading of 30 phr.. Cure time did not show any variation with type of filler. When replacing CIIR with NR, cure rate index increased significantly from 40% NR and hence the cure time decreased. Mechanical properties and air permeability varied significantly. Materials used for the inner liner mainly chlorobutyl rubber are very expensive and hence by using the above mentioned blend with the optimum filler loading, the production cost can be minimized. Results in overall showed optimum properties for the 20:80 CIIR/NR blend at 10:50 carbon black /silica filler ratio.

Key words: Chlorobutyl rubber, Natural rubber, Rubber blends, Physico-mechanical properties, Air permeability, Combined effect of carbon black and silica fillers

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LIST OF ABBREVIATIONS

Abbreviation	Description
BR	Butadiene rubber
^0C	Centigrade
CV	Conventional Vulcanization
CR	Chloroprene rubber
CB	Carbon black
CV	Conventional vulcanization
CIIR	Chloro butyl rubber
CTAB	Cetyltrimethylammonium Bromide
DEG	Diethylene Glycol
EPDM	Ethylene propylene diene ter polymer
EB	Elongation at Break
EV	Efficient Vulcanization
F	Maximum force
G	Specific gravity
IR	Isoprene rubber
IIR	Butyl rubber
IPPD	N- phenyl, N'- isopropyl paraphenylene Diammine
IRHD	International Rubber Hardness Degrees
Kg	Kilogram
M	Mass
m	Meter
mm	Milli meter
MPa	Mega Pascal
MDR	Moving Die Rheometer
MBT	Mercaptobenzthiazole
MBTS	Dibenzothiazyl di sulfide
M_H	maximum torque

M_L	Minimum torque
MOD	Modulus
100 % MOD	Modulus at 100 % elongation
300 % MOD	Modulus at 300 % elongation
500 % MOD	Modulus at 500 % elongation
NR	Natural Rubber
N	Normal cure
NBR	Acrylonitrile butadiene rubber (Nitrile Rubber)
O_2	Oxygen
O_3	Ozone
%	Percentage
phr	Parts per hundred rubber
PVI	Pre vulcanizing inhibitor
S	Sulphur
Semi EV	Semi Efficient Vulcanization
Si 69	bis-(3-triethoxysilylpropyl) tetrasulfane
SBR	Styrene butadiene rubber
VGC	Viscosity gravity constant
ZnO	Zinc Oxide

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