

**CHEMICAL MODIFICATION OF RUBBER WASTE  
AND CHARACTERIZATION OF THEIR BLENDS  
WITH NATURAL RUBBER**

Dilhara Githanjali Edirisinghe

(8018)



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## ABSTRACT

Ground rubber tyre (GRT) produced by recycling of tyre waste or rejects is used as a filler in the manufacture of tyre components, mainly to reduce the cost. Rubber matrix-GRT compositions generally exhibit poor mechanical properties due to poor matrix-filler adhesion and lack of reactive sites on GRT particle surfaces. Therefore, GRT is modified by employing various types of reclamation processes to enhance mechanical properties. The modified GRT known as reclaimed rubber is widely used as a component in rubber blends in many applications, especially in tyre manufacturing.

This study is focused on developing a cost effective, environmental friendly mechano-chemical reclamation process for GRT to produce reclaim rubber using a readily available amino compound. Initially, influence of the amino compound on rubber compound properties was evaluated and results indicate that it acts as an activator for sulphur vulcanization. Properties of GRT modified with the amino compound indicate that the amino compound acts as a reclaiming agent as well. Comparison of properties of natural rubber (NR) / novel reclaimed rubber blend compounds and revulcanisates with those of the controls reveal that the former can be used as alternatives to the latter in the manufacture of tyre treads. Replacement of 30% of virgin NR in the vulcanisates with the novel reclaimed rubber retains about 65-85% of strength properties, elongation at break and resilience. Abrasion volume loss is at an acceptable level and ageing properties are comparable to those of the 100% virgin NR vulcanisate.

Further, most of the properties of the virgin NR & novel reclaimed rubber composites are comparable to those of the corresponding composites prepared by blending NR with commercially available reclaimed rubbers. Accordingly, the novel reclaimed rubber could be a suitable component to blend with virgin NR in the manufacture of tyre treads with required properties.

**Keywords:** Ground rubber tyre, reclaiming, mechano-chemical reclamation, natural rubber, rubber blends, physico-mechanical properties

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## LIST OF ABBREVIATIONS

<b>Abbreviation</b>	<b>Description</b>
NR	Natural Rubber
MT	Metric Tons
BR	Polybutadiene Rubber
SBR	Styrene-Butadiene Rubber
TDF	Tyre Derived Fuel
GRT	Ground Rubber Tyre
GTR	Ground Tyre Rubber
ASTM	American Society for Testing and Materials
ARDL	Akron Rubber Development Laboratory
NBR	Acrylonitrile-Butadiene (Nitrile) Rubber
EPDM	Ethylene-Propylene-Diene Terpolymer
CR	Polychloroprene (Neoprene) Rubber
CSIRO	Commonwealth Scientific and Industrial Research Organization
TMTD	Tetramethylthiuram Disulphide
TETD	Tetraethylthiuram Disulphide
ZDC	Zinc Diethyl Dithiocarbamate
MBT	2-Mercaptobenzothiazole
TCR	Trelleborg Cold Reclaiming
DMSO	Dimethyl Sulfoxide
SKS	Sekhar-Kormer-Sotnikova
IIR	Isobutylene-Isoprene (Butyl) Rubber
DPG	Diphenyl Guanidine
DVR	Devulcanised Rubber
RH	Rubber Hydrocarbon
TEM	Transmission Electron Microscopy
SEM	Scanning Electron Microscopy



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RSS	Ribbed Smoked Sheet Rubber
ISO	International Standards Organisation
M <sub>L</sub>	Minimum Torque
M <sub>H</sub>	Maximum torque
T <sub>S1</sub> or T <sub>S2</sub>	Scorch Time
T <sub>90</sub> or T <sub>C90</sub>	90% Cure Time
N 330	High Abrasion Furnace Black
CRI	Cure Rate Index
M100	Modulus at 100% Elongation
M300	Modulus at 300% Elongation
IRHD	International Rubber Hardness Degrees
IR	Infra-Red
FTIR	Fourier Transform Infra-Red
ATR	Attenuated Total Reflectance
MDR	Moving Die Rheometer
RR	Reclaimed Rubber
IPPD	N-Isopropyl, N'-Phenyl Paraphenylene Diamine
TMQ	2,2,4-Trimethyl-1,2-Dihydroquinoline
ZnO	Zinc Oxide
CRT	Cathode Ray Tube
BSE	Back Scattered Electrons
TSR	Technically Specified Rubber
TBTD	Tetrabenzylthiuram disulphide
Ts	Tensile strength
Eb	Elongation at break
CB	Carbon Black
MW	Microwave
CT	Conventional Thermal
CV	Conventional Sulphur
EV	Efficient Sulphur
MPI	Ministry of Plantation Industries



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