The production of rubber and rubber products is a large and diverse industry. The rubber product manufacturing industry is basically divided into two major sectors: tyre and non-tyre. The tyre sector produces all types of automotive and non-automotive tyres whereas the non-tyre sector produces high technology and sophisticated products like conveyor belts, rubber seals etc. The wide range of rubber products manufactured by the rubber industry comprises all types of heavy duty earth moving tyres, auto tyres, tubes, automobile parts, footwear, beltings etc.

The rubber industry has been growing tremendously over the years. The future of the rubber industry is tied to the global economy. Rapidly growing automotive sector in developing economies and increased demand for high-performance tyres are expected to contribute to the growth of the global industrial rubber market. The current scenario reveals that there is a tremendous scope for the development of rubber processing industries. The global market for industrial rubber products is projected to increase 5.8 % per year. Investment in rubber industry is expected to offer significant opportunities in the near future and realizing returns to investors willing to explore this sector.

This book deals with all aspects of rubber processing; mixing, milling, extrusion and molding, reclaiming and manufacturing process of rubber products. The major contents of the book are rubbers materials and processing, mixing technology of rubber, techniques of vulcanization, rubber vulcanization, rubber compounding, rubber reclaiming, manufacture of rubber products, latex and foam rubber, silicone rubber, polybutadiene and polyisoprene, styrene butadiene rubber, rubber natural etc. The book contains addresses of plant & machinery suppliers with their Photographs.

It will be a standard reference book for professionals, entrepreneurs, those studying and researching in this important area and others interested in the field of rubber processing technology.
Contents

1 RUBBERS: MATERIALS AND PROCESSING TECHNOLOGY
   Natural Rubber Plantation
   Tapping of Rubber Latex
   Preservation and Coagulation of Latex
   Chemical Nature of Natural Rubber Hydrocarbon
   Hydrogenated Rubber
   Cyclized Rubber
   Chlorinated Rubber
   Rubbers from Stereo-regular Polymerization of Isoprene and Butadiene
   Styrene-Butadiene Rubber (SBR)
   Polychloroprene Rubber (CR)
   Nitrile Rubber (NBR)
   Butyl Rubber (IIR)
   Ethylene-Propylene-Diene Terpolymer (EPDM)
   Polysulphide Rubber (PSR)
   Polymethylacrylic Rubber or Acrylate Rubber (ACR)
   Fluorocarbon Rubber (FKM)
   Introduction
   Mastication and Mixing
   Open Mill
   Internal Mixers
   Reclaimed Rubber
   Fillers
   Antidegradants
   Accelerators
   Retarders
   Activators
   Tyres
   Belting and Hoses
   Cellular Rubber Products
   Miscellaneous Applications of Rubber
   Passenger Tyre
   Tube Compound for Car tyres
   Conveyor Belts
   Insulation Compound for Cables
   Shoe Soles
2 MIXING TECHNOLOGY OF RUBBER
   Two-roll Mills
   Internal Batch Mixers
   Continuous Mixers
   Advantages of continuous mixing
   Disadvantages of continuous mixing
   Development of the Banbury Mixer
   Operating Variables
   Ram Pressure
   Rotor Speed
   Batch Size
   Coolant Temperature
   Unit Operations in Mixing
   Single-Pass Versus Multiple-Pass Mixing
Types of Mix Cycle
Late Oil Addition
Upside-down Mixing
Sandwich Mixes
Analysis of Changes to the Mix Procedure
Acceleration of First-pass Compound
Mill Mixing of Speciality Compounds
Acceleration in Line with Internal Mixing
Testing of Raw Materials
Elastomers as Raw Materials
Fillers
Plasticisers and Process Oils
Small Ingredients
Control of Composition
Tracking the Mix Cycle
Compound Testing
Basic SPC Charting
Rheometer Data and its Meaning
Mixing Control Software
Peptisers in Natural Rubber
Effects of Temperature
Effects of Time
Effects of Use Level
Effects of Other Additives
Peptisers in SBR
Peptisers in Sulphur-containing Polymers
Additives to Increase Viscosity
Preventing Unwanted Chemical Reactions
Filler Treatments
Bin Storage Problems
Inspection of Banbury Mixers
Inspection at the Mezzanine Level
Side Cooling
Rotor Cooling
Rotors and Bearings
Rotor Bearing Lubrication
Dust Stops
Drop Door and Latch
Hydraulic System
Grease System
Dust Stop Lubrication
Drive Gears
Couplings
Inspection of the Banbury Platform
Ram and Cylinder
Heating Weight
Piston Rod
Weight Pin Assembly
Hopper Door
Air Line Filter
Hopper Operation
Mixer Maintenance and Lubrication
Each time the mixer is started
Once per shift
Once per day
Once per week
Once per month
Every six months
Anticipating Required Service
Dust Stop Maintenance
SSA Dust Stops
Assembly
Lapping
Running
Banbury Mixer â€“ Hydraulic Dust Stops
Assembly
Run-in
Lapping
Production
Flushing
EPDM Expansion Joint Cover
Expansion Joint Intermediate Layer
Traffic Counter Treadle Cover
SBR/IR Belt Cover
EPDM Low Voltage Electrical Connector
Peroxide-cured Black-filled EPDM Compounds
EPDM Concrete Pipe Gasket
Injection-moulded NBR Gasket
CR/SBR Blend
Low Durometer CR/SBR Blend
Non-black CR for Injection Moulding
Hard Rubber Industrial Wheel
High Durometer NBR Masterbatch
NBR/PVC Cable Jacket
NBR/PVC/SBR Blend
Butyl Masterbatch
Butyl Masterbatch, Heat Interacted
Chlorobutyl/NR Blend
CSM CORD Jacket
Non-black Millable Urethane
Some Major Changes
Tempered Water
Power-controlled Mixing
Energy Conservation
Composition of EPDM Elastomers
Variables in EPM and EPDM Elastomers
Average Molecular Weight
Molecular Weight Distribution
Ethylene/Propylene Ratio
Type of Diene
Diene Level
How Processing Relates to Structure and Rheology
Practical Guidelines for Mixing EP Elastomers
Using Internal Mixers
Polymer Composition and Form
Filler/Oil Levels and Types
Cure Systems
Processing Aids
Mixing Process
Mixing Instructions
Fill Factor
Mixing Temperature
Machine Parameters
Ram Pressure
Coolant Temperature
Automation
Machine Condition
Downstream Processing Equipment
Using Two-roll Mills
Summary
Rework
Phase Mixing
Natural Rubber Viscosity Reduction
Measurement of Mixing Efficiency
Special Considerations
Raw Materials
Typical Formulations
Internal Mixing
Mill Mixing
Summary
Accounting Methods
Farrel Continuous Mixer
Operating Principles of the FCM
Commercial Applications for the FCM
Farrel Mixing Venting Extruder (MVX)
Designing the Rotor
Analysis of Dispersive Mixing
3 TECHNIQUES OF VULCANIZATION
Pressureless Vulcanization
Rubber Moulding
Factors of Moulding
Mouldin
Compression Moulding
Transfer Moulding
Injection Moulding
Helicure
Buffed Tread Crumb
Incineration and Pyrolysis of Tyres
Reclaimed Rubber
4 RUBBER VULCANIZATION
Physical Property Tests
Free Sulphur Determination
Solvent-swell Method
Mooney-Rivlin Equilibrium Modulus
Differential Scanning Calorimetry
Determination of Spring Constant
Sulphur Vulcanization
Peroxide Crosslinking
Resin Vulcanization
Electron Beam Vulcanization
Nitroso Compounds
Metal Oxides
5 RUBBER COMPOUNDING
General Compounding Principles
Tensile Strength
Tear Resistance
The Crescent Tear Test
The Hardness of Rubber
Set
Abrasion Resistance
Flex Cracking Resistance
Resilience
Heat Build-up
Temperature Resistance
Tyres
Retreading Materials
Conveyor Belting, Transmission Belting and Hose
Footwear
Rubber Roller
Medical Applications
‘O’ rings and Seals
Rubber Blends
Master Batches
Choice of Rubber
Fillers
Vulcanizing Agents
Peptizers
Accelerators
Activators
Anti-oxidants
Retarders
Softeners and Plasticizers
Rubber Crumb
Factive
Processing Aids
Special Purpose Additives
Unvulcanized compound properties
Vulcanized compound properties
6 RUBBER RECLAIMING
7 MANUFACTURE OF RUBBER PRODUCTS
Classification
Components
Tyre Building
Parts of a Conveyor Belt
Cover rubber
Manufacturing Process
Finished belt testing
PVC Belting
Steel Cord Belting
Design of Hoses
Hose Manufacture
Braided/spiralled hoses
Testing of Hose Constructions
V-Belt Manufacture
Main Types of Power Transmission Belts
Preparation of Ingredients
Stability of Latex Compounds
Manufacture of Latex Products
Foaming and Gelling
Vulcanization
Classification and Terminology
Fabric Lined Water-proof Shoes
Canvas Shoes
Micro-cellular Soling
Manufacturing procedure
Types of Mountings
8 LATEX AND FOAM RUBBER
Selection of Raw Materials
Preparation of Raw Materials
Compounding and Design
Maturation
Processing and shaping
Dipped Goods
Latex Thread
Vulcanisation
Hot Air Cure
Hot Water Vulcanisation
Autoclave Vulcanisation
Radiation Vulcanisation
Ultrasonic Wave Curing
Testing of Rubber Products
Packing and Marketing
Conclusions and Recommendations

Manufacture of Latex Foam
Dunlop Process
Mechanism of Gelling
Compounding
Foaming and Gelling
Construction of Moulds
Curing
Washing
Drying
Finishing
Common Defects in Foam Making
Shrinkage
Foam Collapse
Setting
Complete Distortion of the Foam
Protein estimation protocol
Conclusion
9 SILICONE RUBBER
Electronics and Electrical Industries
Silicone Rubbers to Mimic Flesh
Silicone Polymers
Silicone Rubber Elastomers
Reinforcing Fillers
Semireinforcing or Extending Fillers
Additives
Curing Agents
Mixing
Freshening
Moulding
Extrusion
Calendering
Dispersion Coating of Fabric
Heavy-duty Hose
Bonding
Bonding Unvulcanised Silicone Rubber
Bonding Vulcanised Silicone Rubber
Post-baking
Condensation Cure—One-component
Condensation Cure—Two-component
Addition Cure
10 POLYBUTADIENE AND POLYISOPRENE
Polyisoprene
Cyclopolyisoprene
Gel and Branching
Polybutadiene
Isoprene
Butadiene
11 STYRENE BUTADIENE RUBBER (SBR)
Raw Materials
Production of Hydrocarbon Rubber
Manufacture of Emulsion SBR
Vinyl Content and Blockiness
Molecular Weight and Branching
Manufacture of Solution SBR
Property Control
Branching
Blending
Properties
Tg Measurement
Molecular-weight Measurement
Dynamic Mechanical Measurements
Applications of SBR
12 RECLAIMED RUBBER
Whole Tyre Reclaim
Drab and Coloured Reclaims
Butyl Reclaim
Scrap-rubber Preparation
Reclaimed Rubber
Digester Process
Reclaimer Process
Pan Process
Engelke Process
Testing and Evaluations of Reclaimed Rubber
Millroom Operations
Special Strengths Through Reclaiming
Further Advantages of Reclaiming - Applications
Major Uses of Reclaimed Rubber
Automobile floor mat
Semi-pneumatic tyre
Butyl inner tube
Innerliner
Carcass
Applications
Process
Characterisation of Reclaimed Waste Latex Rubber (WLR)
13 NITRILE AND POLYACRYLIC RUBBER
Uses of Nitrile Rubber
Mixing and Processing
Latest Developments
Composition
Raw Polymer Characteristics
Physical Characteristics
Heat, Fluid, Low-temperature Resistance
Applications
Cure Systems
Reinforcing Agents
Plasticisers
Process Aids
Antioxidants
Mixing
Extrusion/Calendering
Compound Storage Stability
Vulcanisation
Bonding Characteristics
Solution Characteristics
Blends
Future Developments
14 RUBBER NATURAL
Agriculture
Exploitation
Latex Composition
Types and Grades
Production
Latex Concentrate
Processing
Chemistry
Physical Properties
Economic Aspects
Applications
15. Addresses of Plant & Machinery Suppliers
16. Plant & Machinery Photographs

About NIIR
NIIR PROJECT CONSULTANCY SERVICES (NPCS) is a reliable name in the industrial world for offering integrated technical consultancy services. NPCS is manned by engineers, planners, specialists, financial experts, economic analysts and design specialists with extensive experience in the related industries.


NPCS also publishes varies process technology, technical, reference, self employment and startup books, directory, business and industry database, bankable detailed project report, market research report on various industries, small scale industry and profit making business. Besides being used by manufacturers, industrialists and entrepreneurs, our publications are also used by professionals including project engineers, information services bureau, consultants and project consultancy firms as one of the input in their research.

Our Detailed Project report aims at providing all the critical data required by any entrepreneur vying to venture into Project. While expanding a current business or while venturing into new business, entrepreneurs are often faced with the dilemma of zeroing in on a suitable product/line.