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GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP



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Transforming the skill landscape



Participant Handbook

Sector
Rubber Industry

Sub-Sector
Tyre & Non-Tyre

Occupation
Mixing

Reference ID: **RSC/Q0112, Version 1.0**
NSQF Level 4



**Rubber Internal Mixer
Operator**

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Shri Narendra Modi
Prime Minister of India

“ Skilling is building a better India.
If we have to move India towards
development then Skill Development
should be our mission. ”



Certificate

COMPLIANCE TO QUALIFICATION PACK – NATIONAL OCCUPATIONAL STANDARDS

is hereby issued by the
RUBBER SKILL DEVELOPMENT COUNCIL

for

SKILLING CONTENT : PARTICIPANT HANDBOOK

Complying to National Occupational Standards of
Job Role/ Qualification Pack: **'Rubber Internal Mixer Operator'** QP No. **'RSC/Q0112 NSQF Level 4'**

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We are also grateful to the partner organizations for their efforts in reviewing and endorsing this participant handbook.

About this book

The participant handbook for 'Rubber Internal Mixer Operator' is designed for participants to enable them to get trained and upgraded for the knowledge and basic skills of 'Rubber Internal Mixer Operator' in 'Rubber Industry' sector. All the aspects of skills required by the participant, are covered in this handbook. This participant handbook is designed to enable training for the specific Qualification Pack (QP) drafted by Rubber Skill Development Council (RSDC) and ratified by National Skill Development Corporation (NSDC). It covers following National Occupational Standard (NOS) across Unit/s:

- RSC/N0133 - Prepare internal mixer and accessories
- RSC/N0134 - Mix in internal mixer to prepare rubber compound
- RSC/N0135 - Undertake post internal mixing activities
- RSC/N5001 - Carry out housekeeping in rubber product manufacturing
- RSC/N5002 - Carry out reporting and documentation
- RSC/N5003 - Carry out quality checks
- RSC/N5004 - Carry out problem identification and escalation
- RSC/N5007 - Carry out health and safety

This handbook is designed to provide the necessary knowledge and skill to the participants to carry out their duties in an organized and disciplined manner by following safe working practices.

Key Learning Objectives for the specific NOS mark the beginning of the Unit/s for that NOS. The symbols used in this book are described below.

Symbols Used



Key Learning
Outcomes



Steps



Time



Tips



Notes



Unit
Objectives



Activity



Exercise



Summary

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1. Introduction to Rubber

Unit 1.1 – Introduction to Rubber Industry

Unit 1.2 – Types of Rubber Internal Mixing

Unit 1.3 – Rubber Internal Mixing Basics

Unit 1.4 – Equipment used in Rubber Internal Mixing

Unit 1.5 – Job Role of a Rubber Internal Mixer Operator



Key Learning Outcomes

At the end of this module, you will be able to:

1. Discuss about rubber industry.
2. Explain different sources of rubber.
3. Discuss about major Indian rubber associations.
4. Explain the rubber internal mixing terminology.
5. Explain the basics of rubber internal mixing process.
6. Define material used in rubber internal mixing.
7. Explain equipment used for rubber internal mixing.
8. Define roles and responsibilities for rubber internal mixing operator.

UNIT 1.1: Introduction to Rubber Industry

Unit Objectives

At the end of this unit, you will be able to:

1. Identify types of rubber commonly used in rubber industry.
2. Classify different types of rubber manufacturing processes.
3. Name different uses of rubber.
4. Illustrate the purpose of various rubber bodies and associations in India.

1.1.1 The Rubber

Rubber is a polymer material, which has elastic properties. It is also called as 'caoutchouc'. It normally has long chain molecules known as "polymers". Rubber being elastic, is also called "elastomers". Products made from rubber have a flexible and stable – three-dimensional chemical structure and are able to withstand higher force and large deformations. For example: the material can be stretched repeatedly to at least twice of its original length and upon immediate release of the stress, will return with force, approximately to its original length. Under load, the product should not show creep or relaxation. Besides these properties, the modulus of rubber ranges from hundred to ten thousand times lower, as compared to other solid materials like steel, plastics and ceramics. This combination of unique properties, gives rubber its specific applications like seals, shock absorbers and tyres.

Based on the source of raw material, there are two kinds of rubber, natural rubber (NR) and synthetic rubber (SR). However, there is third type of rubber - reclaimed rubber, which is produced by recycling scrap rubber.



Fig. 1.1.1. Rubber

Natural rubber

Natural rubber is mainly harvested from rubber plants. There are many plant species that generate natural rubber and there are many other plants that contain rubber latex. For quality and economic considerations, rubber plant is a major source of natural rubber. 'Latex' is a sticky, milky white, liquid material. The process used for extracting latex is called 'tapping'.



Fig. 1.1.2. Rubber Plant



Fig. 1.1.3. Collection of rubber by tapping process

This latex is further processed for making rubber, which can be used for making some useable products. Latex is processed in following ways –

1. Sheets
2. Creps
3. Block rubber
4. Preserved latex concentrates

Most of the natural rubber is sold in the form of sheets, creps and block rubber.

Sheets

This form is most easy to produce; hence it is the most saleable form of natural rubber. There are 2 types of sheets –

1. Ribbed Smoked Sheets (RSS)
2. Air Dried Sheets (ADS)

Out of above types, Ribbed Smoked Sheets are more common in market. There are five grades of Ribbed Smoked Sheets based on quality. These grades are established by International Rubber quality and packing conference. Only completely dried sheets are allowed to be sold in this category. Based on different conditions, these ratings are called as RSS1, RSS2, RSS3, RSS4 and RSS5



Fig. 1.1.4. Rubber sheets

Crepe

Crepe are derived from coagulated latex / field coagulam after getting rolled many times between rollers and then dried in Air. There are many types of crepe, namely – pale latex crepe, Estae brown crepe, Thin brown crepe, Thick blanket crepe, Flat blanket crepe, standard flat bark crepe and pure smoked blanket crepe.

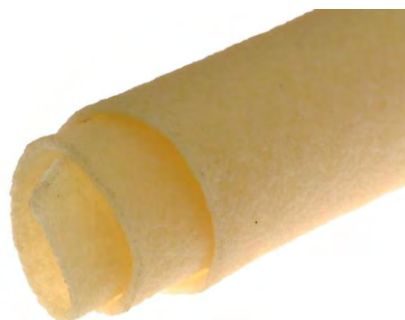


Fig. 1.1.5. Rubber crepe

Technically specialized Natural Rubber

Natural dried rubber is graded based on technical specification. It was initially proposed by ISO (International Standard Organization) and then Malaysia adopted it in 1965. Later on all natural rubber producing countries adopted the system. In this system, two letters of the countries name used for making code. For ex - Indian natural rubber is coded as ISNR (Indian Standard Natural Rubber)



Fig. 1.1.6. TSR rubber

Synthetic Rubber

As the name suggest, it is man made Rubber, which is derived from petroleum, coal, oil, natural gas and acetylene. It has more than 10 major classes, many of these are copolymers i.e. polymers consisting more than one monomer. Initially, Styrene-butadiene copolymers (SBR) synthetic rubbers were invented. Which is one of the widely used elastomer. Synthetic Rubber is used as a replacement for natural rubber in many cases, especially when improved material properties are needed. Common used Synthetic Rubber are –

1. Emulsion Styrene Butadiene (ESBR)
2. Butadiene Rubber (BR)
3. Solution Styrene Butadiene (SSBR)
4. Isobutylene Isoprene Butyl (IIR)
5. Acrylonitrile Butadiene (NBR)
6. Ethylene Propylene Diene Monomer (EPDM)



Fig. 1.1.7. Synthetic rubber

Used or Reclaimed Rubber

Used or reclaimed rubber is the product, which is recovered from the processing of vulcanized scrap rubber tyres, tubes and miscellaneous waste rubber goods. The Process includes use of heat and chemical agents. The process also includes heavy mechanical working. This reclaimed rubber has plasticity which is near to the original plasticity. This rubber can be compounded, processed and re-vulcanized as fresh rubber. During the process of reclamation the molecular weight of the elastomeric component is substantially reduced.



Fig. 1.1.8. Reclaimed rubber

1.1.2 Uses of rubber

Rubber is a widely used product now a days. It is used in automobiles, household and industrial applications. Some of the most common uses are as following -

- Tyres and Tubes - Automobile and agriculture tyres and tubes are the largest consumers of rubber. This category consume around three fourth of total rubber consumption.
- 'Under the bonnet' products for automobile - It includes, Door and window profiles, noses, bells, matting, flooring and dampeners (anti-vibration mounts).
- Conveyor Belt – for various industrial use.
- Hoses and pipes – for air and water circulation.
- Medical equipment - Gloves (medical, household and industrial), toy balloons, rubber bands, etc.
- Adhesives – Many manufacturing industries and products also use rubber product as adhesives. It is mostly used in paper and the carpet industry.
- Textile industry – Rubber is also widely used in textile industry.
- Shock absorbers – Impact absorbing property of rubber is very useful in shock absorber application.
- Machine mounting pads – it is widely used as a machine mounting mount, which helps in reducing vibration transfer to floor from machine.



Fig. 1.1.9. Rubber products

1.1.3 Rubber industry

Initially rubber industry started in South America during 19th century. Where it was restricted for a long time from export. In 1876, English brought it to India, Sri Lanka and other parts of Asian countries. Initially rubber trees were planted in Kolkata and then later it was grown in coastal areas of Kerala, Tamil Nadu and Karnataka.

Rubber products manufacturing started in India, in the year 1920. Now, rubber industry is one of the key industries of the Indian economy.

Following are some of the facts on rubber industries –

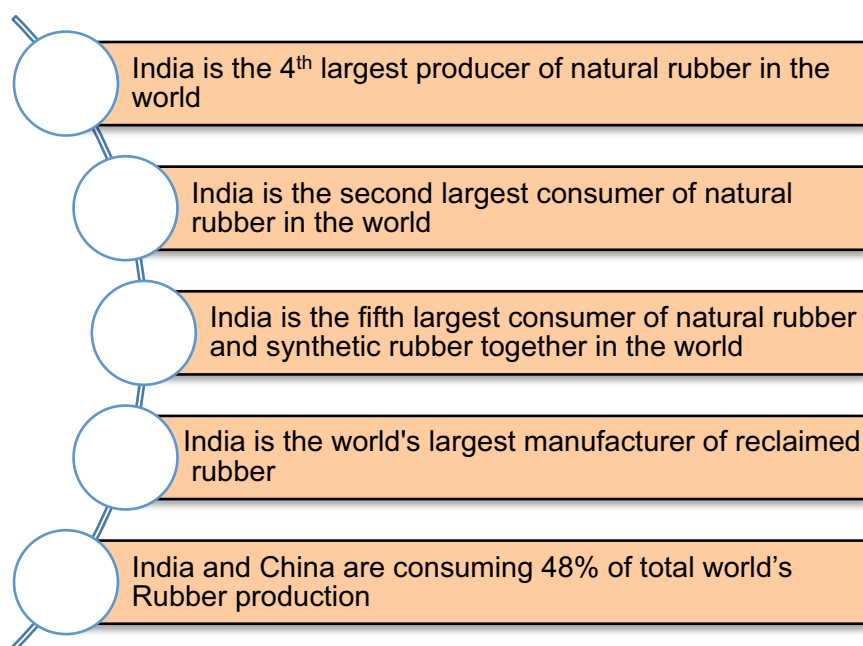


Fig. 1.1.10. Rubber industry facts

Overview of India Rubber Industry

India produces approx. 7 Lakh tons of rubber, annually . In India there are approximately 6000 Rubber product companies. Out of these some 35 large scale companies, 320 medium scale and more than 5000 small scale industries. These companies do total turnover of around Rs. 12,000 Crore. These units are manufacturing more than 35000 rubber products, employing four Crore people, which also includes 22000 technically qualified support personnel. India's rubber industry has growth rate of 8-9% per annum.

India consumes nearly 20 lakh tones of rubber (including natural, synthetic and reclaim) annually (as per the data of 2018-19) for producing a wide range of rubber products. Tamil Nadu (3.7 lakh tones), Maharashtra (2.09 lakh tones) and Kerala (2.02 lakh tones) are the top three rubber consuming states in the country (as per the data of 2018-19).

Trend of Rubber Consumption in India

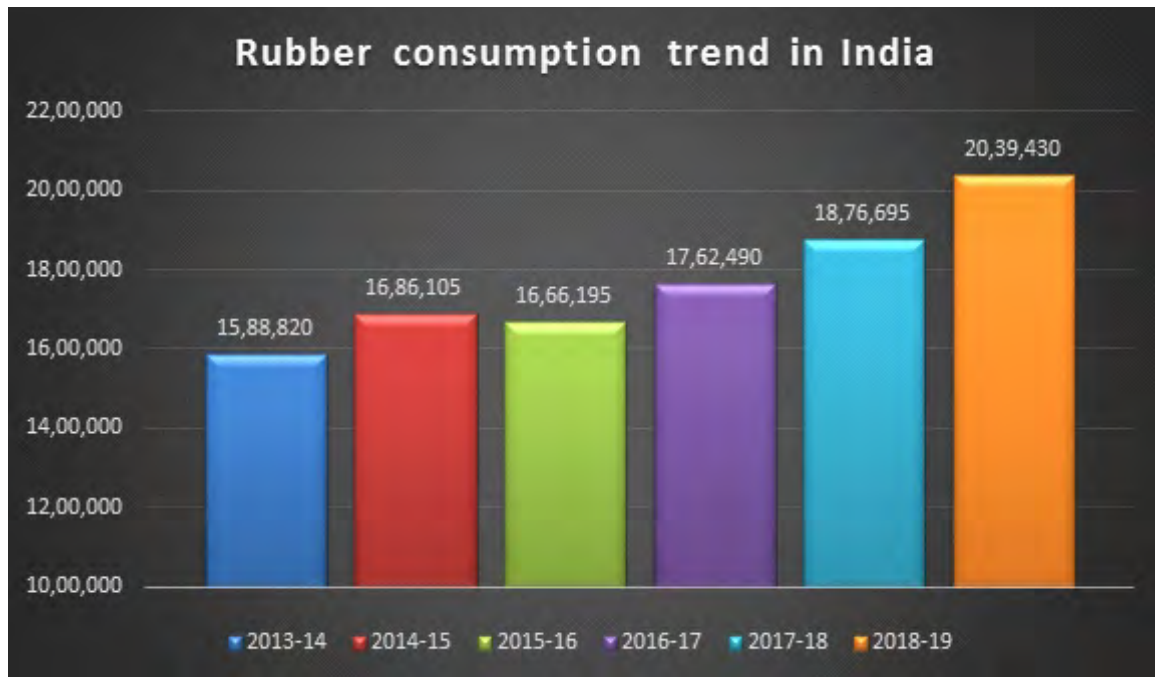


Fig. 1.1.11. Trend of rubber consumption

Rubber Consumption in India

The major rubber consuming sectors in India are as follows:

- 1 Automotive tyre sector
- 2 Bicycles tyres and tubes
- 3 Footwear
- 4 Camelback and latex products
- 5 Belts and hoses
- 6 Rest of products

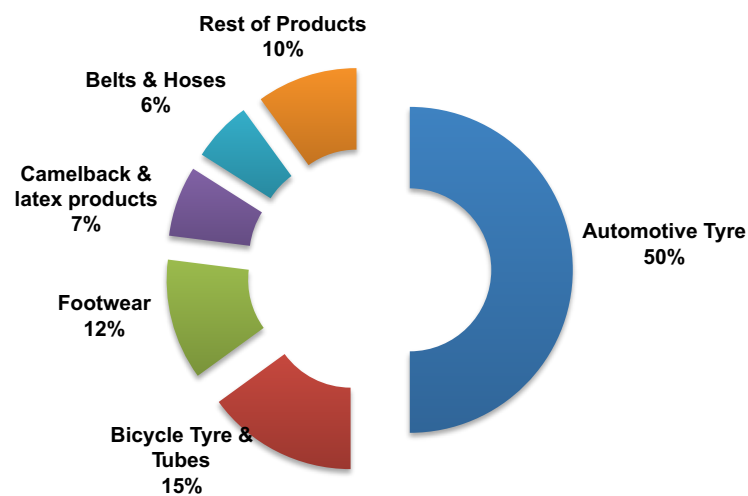


Fig. 1.1.12. Rubber consumption details

UNIT 1.2: Types of Rubber Internal Mixing

Unit Objectives

At the end of this unit, you will be able to:

1. Describe what is rubber compound?
2. Tell the history of rubber mixing.
3. Explain concept of rubber internal mixing.
4. Describe the construction of Banbury mixer.
5. Differentiate between Banbury mixer and intermix mixer.
6. Illustrate the purpose of rubber internal mixing

1.2.1 What is rubber compound

A rubber compound is a mixture of various ingredients in which rubber polymer is the most prominent part. There are various types of rubber compound, which are made by changing the ingredients to suit different requirements as per application. We can produce different rubber compounds by varying rubber polymer/s and ingredients and utilize the rubber compounds thus produced for producing cost effective rubber products with required performance requirements.

1.2.2 History of rubber mixing

Rubber mixing is a very old process which was first done in USA on Hancock's pickle machine, also called two roll machine. The machine was patented in 1837. In 1865, first model of double rotor of internal mixer was designed by the quartz mill of Nathaniel Goodwin. But this machine was not having good strength for rubber mixing. Then in 1878, Paul Pfeleiderer designed and patented a new twin rotor design machine. This machine was robust and suitable for rubber mixing. Now a days, all rubber mixing is done in Internal mixers.

In internal mixers, mixing is done in closed chambers by two rotors, rotating in opposite direction. Since, compound ingredient is contained in chamber, hence we get more homogenized compound is prepared.

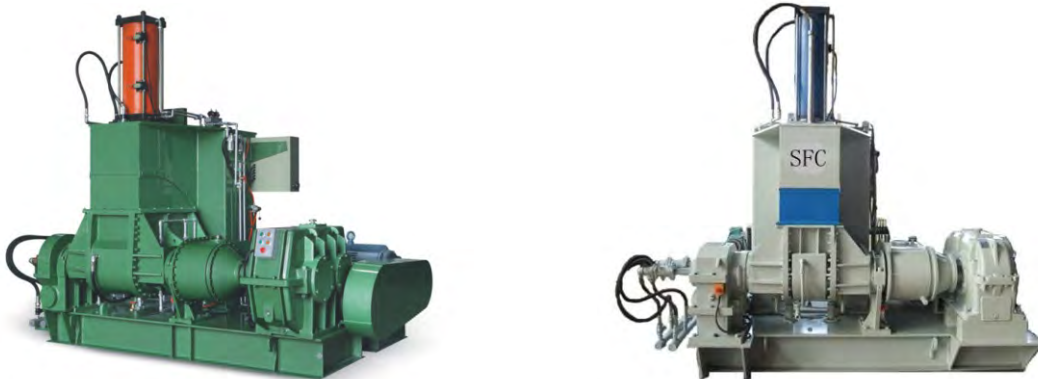


Fig. 1.2.1. Internal mixer for rubber compound making

1.2.3 Mixing mill

Mixing mill was invented in 1835. It was primarily used of mixing vulcanizing agent in rubber compound. It has 2 roller in its construction in open. Roller rotates in opposite direction at different speed. It is also used for sheeting purpose. During rotation, compound generates lot of heat due to friction. For maintaining the temperature of compound during mixing, it has got provision of water circulation inside the rollers. It is very important to keep compound at lower temperature in order to avoid vulcanization before moulding or other operation.



Fig. 1.2.2. Mixing mill

1.2.4 Rubber internal mixer

Rubber internal mixer has 2 types -

1. Tangential rotor type (Banbury mixer)
2. Intermeshing rotor type (Intermix mixer)

Banbuey mixer

There were many issues being faced in earlier designed rubber mixers. So, Fernley H. Banbury in USA designed Banbury mixer in 1916. Since it was designed by Fernley H. Banbury, hence it was named as Banbury mixer. It solved lot of issues of rubber mixing and it became very popular very soon.

It works on concept of rotating material between rotor wings and wall of chamber. In this design rotor never mesh each other. It allows the rotors to rotate at different speed, which provide maximum friction to material between rotor to rotor and rotor to wall. There are many design available for rotors, which depends on the type of mixing process.

For higher productivity, 4 rotor Banbury mixers are used now a days.

Intermix mixer

This mixer was designed and patented by Francis Shaw and company of Manchester in 1930. It works on intermeshing mechanism of both rotors, which gives more friction and rotation to material. In this mixer, rotors rotates at same speed and intermesh with each other. It has got various benefits over tangential systems, such as - effective temperature control which result in lower power consumption, fill levels are 5% lower due to narrow intermeshing zone. This design is getting popularity now a days.



Fig. 1.2.3. Intermix mixer

Variable Internal Clearance (VIC) Mixer

This mixer was designed and patented Italy in 1987. It was developed to solve issue faced in intermeshing mixer. In this mixers you can move rotors on its axis to adjust the clearance between them. This feature is very useful and permit more clearance which is required during initial phase of mixing. later on when rubber lumps are broken in small pieces, you can reduce the clearance between rotors to achieve more homogenize compound. This is relatively new design but getting popularity day by day.

Notes 



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