INDIAN RUBBER INSTITUTE

COURSE ON
RUBBER LATEX PRODUCTS MANUFACTURE

Objective

This course is intended to give an exposure to the participants on the theoretical and practical aspects of manufacture of rubber products from latex. While it is meant primarily for technical personnel working in the industry, it is expected to be useful for students, researchers and others interested in rubber latex technology. While emphasis will be given to natural rubber latex, some of the important aspects of synthetic rubber latex will also be included.

Course content

1. **Introduction:** Definition and fundamental characteristics of latex; Comparison between latex and polymer solutions; Comparison between product manufacture from latex and solid rubbers; Handling of latex; Important latex products including their classification.

   1.5 h
2. **Natural rubber latex:** Important aspects of rubber cultivation; Tapping and collection of latex, Composition and properties of fresh latex; Preservation of latex; Methods of concentration of latex; Details of latex centrifuging and creaming; Specifications and quality control of concentrated latex; Storage of latex; Choice of latex type.

   2.5 h
3. **Synthetic rubber latices**: Basic principles of emulsion polymerization; Comparison of synthetic and natural rubber latices; Agglomeration and concentration of synthetic latices: SBR, NBR, CR, Vinyl Acetate and Vinyl Pyridine latices; Characterisation of synthetic latices; Salient features of compounding; Applications of synthetic latices.

   2.5 h
4. **Prevulcanised latex**: Principles of prevulcanisation: Methods of Prevulcanisation; Properties of prevulcanised latex; Advantages of prevulcanisation; Use of prevulcanised latex in different products.

   1.5 h
5. **Latex compounding ingredients:** Vulcanising agents; accelerators; Antioxidants; Fillers and pigments; Surface active agents including wetting agents, dispersing agents, stabilizers, emulsifiers, foam promoters etc.; Viscosity modifiers and protective colloids; Miscellaneous ingredients including mineral oils, tackifiers, antifoaming agents etc.

   2.5 h
6. **Preparation of compounding ingredients**: General principles; Preparation of

solutions; Preparation of dispersions; Equipment for preparing dispersions such as ball and pebble mills, colloid mills, ultrasonic mills etc.; Preparation of emulsions; Representation of latex formulations.

1.5 h

7. **Latex dipping**: Outline of the dipping process; Design of latex compounds for dipping; Different dipping processes such as straight, wet- coagulant, dry-coagulant, heat sensitized dipping and electrodeposition; Production of articles by dipping including details of formers, dipping tanks, sequence of operations and after-treatments; Defects in dipped goods.

   2.5 h

8. **Latex gloves**: Introduction to the glove industry; Different types of latex gloves; Details of production of examination, surgical and household gloves; Machinery used for automatic production of gloves; Protein removal from NR latex gloves; After-treatments for gloves; Manufacture of gloves from NBR latex; Testing and quality control of gloves; Defects and remedies; Packing .

   2.5 h

9. **Latex condoms**: Introduction to the condom industry; Different types of latex condoms; Details of production of condoms; Machinery for condom manufacture; Protein removal by leaching; After-treatments; Testing and quality control; defects and remedies; Packing.

   2.5 h

10. **Miscellaneous dipped goods**: Folley catheters; Urinary condoms; Balloons; Industrial gloves; Electricians' gloves; Football bladders; Feeding bottle nipples and soothers.

    2.5 h

11. **Latex foam**: Introduction to latex foam manufacture; Dunlop and Talalay Processes; Details of the Dunlop process; Compounding; Batchwise and continuous foaming; ; Machinery; Details of processes including frothing, refining, foam stabilization, moulding and gelling; Vulcanisation, washing, dewatering and drying; Testing and quality control; Defects and remedies; Foam backing of carpets.

    2.5 h

12. **Fibre foam**: Introduction to fibre foam products; Predominance of coir foam; Different processes in coir foam production such as curling of coir fibre, latex compounding, spreading of fibre and spraying of latex compound, drying and vulcanisation, pressing, finishing ; Quality control; Defects and remedies, Fibres other than coir.

    2.5 h

13. **Latex thread**: Introduction to elastic thread manufacture; Types of elastic thread; Latex thread by extrusion; Compounding of latex; Maturation of latex; Manual and automatic production; Machinery and equipment; Different stages in production; Extrusion, Coagulation, Washing, Drying and vulcanization, Band formation, Dusting, Spooling, Testing and quality control; Defects and remedies.

    2.5 h

14. **Latex adhesives**: Introduction to latex based adhesives; General principles of formulation such as choice of polymer, adhesion promoters, plasticizers,

curatives, fillers, thickeners etc; Paper and leather adhesives based on NR, SBR and PVA; Rubber-textile bonding adhesives; Evaluation of adhesives; Latex treatment of tyre chords.

2.5 h

15. **Miscellaneous latex applications**: Moulded and cast latex products; Latex based surface coatings; Latex in paper; latex-cement compositions; Latex modified bitumen; Soil stabilization and seepage control with latex; Flowers and other ornamental products from latex.

2.5 h

16. **Allergic reaction to NR latex products and related issues**: Intorduction to the issue; Causes of allergic reactions ; Types of allergy; Proteins in latex causing allergy; Removal of proteins from latex and products; Estimation of proteins in latex products; Allergic reactions to chemical residues in latex products; Removal of residues; Non-natural rubber materials in medical devices; Nitrosamines in latex products.

2.5 h

17. **Recent developments in latex technology**: Deproteinised NR latex; Radiation vulcanized NR latex; Latex based nanocomposites.

18. **Quality management systems:** Intoduction**;** ISO 9001 systems; Quality management principles; Implementation of the system; Certification; Quality auditing; Finanacial and economic aspects; Benefits.

2.5 h

. 19 **Effluent treatment**: Importance of the issue; General principles of effluent treatment; different types of effluents from latex products manufacture; Organic and inorganic pollutants in the effluents; segregation of effluents; Rubber traps and clarifiers for removal of rubber and other solids; Anerobic and aerobic treatmentent systems; Testing of effluents; Final discharge and/or reuse of treated effluents; ISO 14000 Environment management systems.

2.5 h.

Laboratory work

1. **Latex testing**: Total solids content; Dry rubber content; pH; Alakalinity; Mechanical stability time; Chemical stability; Potassium hydroxide number; Volatile fatty acid number; Electrical conductivity; Density; Sludge and coagulum contents; Concentration of metallic ions like Copper, Manganese, Iron and Magnesium; Viscosity measurement by capillary and Brookfield viscometers.

4.0 h

2 **Latex creaming :** 1.5 h

3 **Testing of compounding ingredients:** Melting points of curatives, antioxidant etc; Purity determination of sulphur, accelerators, zinc oxide etc. by chemical analysis; pH and sp.gravity of fillers.

2.5 h

4 **Preparation of compounding ingredients:** Preparation of dispersion by ball milling; Preparation of emulsions of liquid ingredients; Preparation of solutions such as potassium oleate, ammonium laurate etc; Testing of stability of dispersions and emulsions.

2.5 h

5. **Physical testing of vulcanisates:** Preparation of films; Preparation of test pieces. from films and products; Testing of tensile strength, elongation at break and modulus, Measurement of set; Thermal ageing of test specimens and measurement of ageing resistance; Equlibrium swell and degree of cure; chloroform test of prevulcanised latex

2.5 h

6 **Chemical testing of vulcanisates:** Extractable protein assay; Residual sulphur content; Residual accelerators

2.5 h

Plantation/Factory Visits

1. **Visit to rubber estate/small holding :** To familiarize with the practices in rubber plantations particularly with respect to tapping, latex collection, preservation and storage.

2. **Visit to latex centrifuging factory**: To familiarize with the operations in a latex centrifuging unit particularly on the aspects of quality.

3. **Visit to Rubber Research Institute of India:** To acquaint with special tests on Latex and latex products and the latest developments in R&D on NR with special reference to latex.
4. **Visit to product manufacturing units**: To familiarize with the manufacturing Processes for products such as gloves, condoms, elastic thread, latex foam, balloons etc.

Total : 3 days

Duration

The total duration of the course is expected to be two weeks (About 12 working days of which three days will be earmarked for visits). Every day about half an hour will be earmarked for open discussion between the participants and the faculty members, who will be handling the classes on that day.

Course Evaluation

It is proposed to have simple tests for the participants at the beginning and conclusion of the course to make an evaluation of the effectiveness of the course in achieving the stated objectives.