

VOCATIONAL HIGHER SECONDARY  
FIRST YEAR

# RUBBER TECHNOLOGY

---

**Teachers' Sourcebook**



**Government of Kerala  
Department of Education**

**2005**

**State Council of Educational Research & Training (SCERT)**

Vidyabhavan, Poojappura, Thriuvananthapuram-12, Kerala

***Prepared by:***  
**State Council of Educational Research & Training (SCERT)**  
**Vidyabhavan, Poojappura, Thiruvananthapuram -12**  
**Kerala**  
***E-mail:scertkerala@asianetindia.com***

***Type setting by:***  
**SCERT Computer Lab.**

©  
**Government of Kerala**  
**Education Department**  
**2005**

## Preface

*Dear Teachers,*

*The activity based, process oriented and learner centred pedagogy is being introduced in the Vocational Higher Secondary Classes. It becomes imperative to make significant and meaningful changes in the learning process as well as in the evaluation system for its successful implementation.*

*Though Rubber Technology is comparatively a new area of science, its development is faster and critical in modern world. The technological developments in this area makes modern life comfortable and easy as it affects people of all walks of life. Rubber Technology is fully practical oriented which demands for a process oriented learning methodology which should develop the problem solving abilities of the learner and to equip them to face real ground situation.*

*This Sourcebook has been designed in such a way to help the teacher to provide suitable learning activities for effective and comprehensive learning. The success of the new approach depends upon the vision and commitment of the teacher. For the preparation of this Sourcebook SCERT Kerala has drawn the expertise of well experienced teachers from VHSE who are in constant touch with the pulses of Industry. This book provides guidance on theoretical and practical aspects of the subject as well as opportunities for planning the activities needed for the transaction of the curriculum and evaluation process.*

*Inviting your valuable comments suggestion and whole hearted support to improve this sourcebook.*

*With regards,*

Thiruvananthapuram  
25.11.2005

**Dr. E.Valsala Kumar**  
Director  
SCERT, Kerala

# Contents

## **Part I**

I	General Approach .....	6
II	Subject Approach .....	22
III	Planning .....	27
IV	Evaluation .....	33
V	Curriculum Objectives .....	46
VI	Syllabus .....	50

## **Part II - Theory**

1	Introduction to Natural Rubber .....	54
2	Rubber Plantations .....	58
3	Harvesting, Preservation & Marketing of Crops .....	62
4	Latex Concentration .....	72
5	Rubber Compounding .....	76
6	Field Crop Processing Machinery .....	81
7	Rubber Processing Machineries .....	88
8	Synthetic Rubber .....	101
9	Reclaimed Rubber .....	105

## **Part III - Practical**

1	Physical Properties of Field Latex .....	110
2	Latex Creaming .....	113
3	Preparation of Ribbed Smoked Sheet .....	117
4	Field Visit/ OJT Programme .....	121
5	Identification of Synthetic Rubber .....	123

## **Part IV**

	Sample Questions .....	126
--	------------------------	-----

# **PART I**

# GENERAL APPROACH

---

## **Introduction**

The ultimate aim of education is human refinement. Education should enable the learner to formulate a positive outlook towards life and to accept a stand which suits the well being of the society and the individual as well.

The attitude and potential to 'to work' has determined the destiny, progress and cultural development of the human race. As we all are aware, the objective of education to form a society and individuals having a positive work culture. The educational process expected in and outside our formal schools should concentrate upon inculcating concepts, abilities, attitudes and values in tune with these 'work culture.' Hence vocationalised education cannot be isolated from the main stream of education. In another sense, every educational process should be vocationalised. However, due to our inability to utilise the resources wisely, scarcity of job opportunities is a severe issue of the present society. For overcoming this deep crisis, emergent techniques have to be sorted out and appropriate researches have to be seriously carried out. It is in the sense that the content and methodology of vocational Higher Secondary Education have to be approached.

The Vocational Higher Secondary course was envisaged as a part of the National Policy on Education with the noble idea of securing a job along with education. The relevance of Vocational education is very great in this age of unemployment. This education system, which ensures a job along with higher education, stands aloof from other systems of education.

A learning environment which ensures vocational aptitude, vocational training, basic life skills, competencies related to different subjects, appropriate values and attitudes and existential readiness has to be provided here.

The curriculum should be one which recognises the specific personality of the learner and should develop it in a desirable way. It should provide opportunity to imbibe novel ideas to follow a critical approach and for learning through experiences.

The competency to transform ones own resources for the betterment of the society and the individual is to be ensured in each individual. Training in the sense of equality, democratic sense, environmental consciousness and devotion to the constitution is an inseparable factor of the curriculum.

The need of a systematic curriculum is prevailing in vocational subjects. A scientifically structured curriculum incorporating the unique features peculiarity of Kerala ensuring the possibility of higher education and utilising the national and international possibilities of employment is required.

The new curriculum should be capable of assimilating the life skills, scientific temper, attitude of co-existence, leadership qualities and mental health to face the challenges of life. It should be capable of strengthening the competencies imbibed by the learners up to the tenth class.

A curriculum for selecting vocational areas according to the aptitude of the students, learning it in depth, acquire general awareness in the basic areas and to secure jobs has become the social need of the day. A learner centred, process oriented, need based vocational curriculum is envisaged.

### **What is learning?**

- Learning is construction of knowledge and so it is a live and continuous mental process.
- Learning is a process of advancement through adding and correcting in the light of comparing the new issue with the previously learned concepts.
- Learning takes place as a part of the effort to solve problems.
- Learning takes place by assimilating bits of knowledge into ones own cognitive structure.
- Learning is not a linear process. It is a spiral process growing deeper and wider.
- Learning is an intellectual process rather than the mere memorisation of facts. Learning is a conglomeration of a variety activities like problem analysis, elucidation, critical thinking, rational thinking, finding out co-relations, prediction, arriving at conclusions, applications, grouping for other possibilities and extracting the crux. When opportunities are provided for intellectual processes learning will become effective and intellectual ability will get strengthened.

### **Theoretical foundations of learning**

Education is the best device that can be adopted for creation of a new society. It should be democratic in content and process and should acknowledge the rights of the learner. It should also provide opportunity for better citizenship training. The concept of equality at all areas

should get recognition in theory and practice.

There should be conscious programme of action to develop nationality, humanness and love and against the encroachment of the sectarianism of caste and religion.

The learner should be able to take firm steps and deferred against the social crisis like privatisation, liberalisation, globalisation etc and against all kinds of dominations.

They should develop a discrimination to use the acquired learning as a liberative weapon.

They should be able to view education and life with the perspective of social well being.

They should get opportunity to recognise that co-operation is better than competition and that co-operation is the key to social life and culture.

A basic awareness of all the subjects needed for life essential for all students.

The remnants of perspectives formed in us during the colonial period still influence our educational philosophy. The solution to the present day perplexities of the society which approaches education on the basis of competitions and marketisation is only a comprehensive view of life.

It is high time that education was recognised on the basis of the philosophy of human education. The human approach to education has to reflect in its content, learning process and outlook. The perspective of 'learning to be ' and learning to live together as expressed by the UNESCO and the concepts of existentialist intelligence intrapersonal and interpersonal intelligence.

The basis of new approaches on curriculum, teaching- learning process are derived from the developments place in the east and west of the world.

When we begin to see the learner at the centre of the learning process, the teaching process has to be changed timely. It is the result of the rapid growth and development of Science and Technology and Pedagogy. If we want to undergo the changing process, we have to imbibe the modern hypothesis regarding learner, they have;

- Great curiosity
- Good imagination
- Numerous other qualities and interests
- Independent individuality
- Interest in free thinking and working in a fearless atmosphere.
- Have interest in enquiring and questioning.
- Ability to reach conclusions after logical thinking.
- ability for manifest and establish freely the conclusions arrived at.

- Interest for recognition in the society.
- Determination to face the interference of society and make components which is a part of social life.
- 

When we consider the learning system, the domains to be stressed in education according to the modern development becomes relevant.

The *knowledge* domain consists of

- Facts
- Ideas
- Laws
- The temporary conclusions and principles used presently by scientists.

The learning is a process. The continuous procedures we undergo to reach a particular goal is process. The skills which are parts of the process to analyse the collected ideas and proofs and come to a conclusion is called *process skills*. Some important *process skills* are,

**the skills;**

- To observe
- To collect data and record
- To classify
- To measure and prepare charts
- To experiment
- To predict
- To recognise and control the variables
- To raise questions
- To generalise
- To form a hypothesis and check.
- To conclude
- To communicate
- To predict and infer
- To use tools.
- 

***Observation*** is the process of acquiring knowledge through the senses. It is purely objective oriented. Learning experiences which provide the opportunity to use all the senses may be used.

The process of grouping is known as ***classifying***. Starting from simple groupings of data, it can extend to the level of classification into minute sub-groups.

In addition to this, consider the skills related to *creative domain* also, they are skills:

- To visualize
- To connect facts and ideas in new ways
- To find out new and uncommon uses of objects
- To fantasize
- To dream
- To develop creative isolated thoughts
- 

**Creativity** is an essential component of process and activities. The element of creativity is involved in finding out problems, formation of hypothesis, finding 'solutions' to problems etc. Through activity oriented learning experiences, opportunities to express creativity can be created.

Again, the following factors consisting in the *Attitudinal domain* are also important as;

- Self confidence
- Love for scientific knowledge
- Attitude to know and value history
- Respect human emotions
- Decide with reasonable present problems
- Take logical decisions regarding personal values

**'Hypothesis'** is a temporary conclusion drawn using insight. Based on knowledge and experiences relating to the problems the causes and solutions can be guessed.

As regards the *application domain* the important factors are the ability to:

- observe in daily life examples of ideas acquired.
- take the help of scientific process to solve the problems of daily life.
- choose a scientific life style
- connect the ideas acquired with other subjects.
- integrate the subjects with other subjects.

Some basic stands have to be taken on the new scientific knowledge about intelligence learning and teaching. When such basic concepts are accepted changes are required in the following factors.

- The vision, approach, structure and content of the curriculum.
- The vision, approach, structure and content of the textbooks.

- Role of the teacher and the learner.
- Learner atmosphere, learning materials and learning techniques.

Some scientific perspectives accepted by modern world in educational psychology are given below.

### **Constructivism**

This approach puts forward the concept that the learner constructs knowledge. New knowledge is constructed when ideas are examined and practiced in new situations relating them with the previously acquired knowledge and experience. That is assimilated into the cognitive structure of one's knowledge. This method which gives priority to critical thinking and problem solving provides opportunity for self motivated learning.

### **Social Constructivism**

Social constructivism is a sub section of constructivism. Knowledge is formed, spread and imbibed and it becomes relevant in a social environment. Interactive learning , group learning, co-operative participatory learning, all these are concepts put forward by social constructivism.

The main propounders of constructivism are piaget, vygotsky and Bruner.

Discovery learning and interactive learning have prime importance. Learning takes place as a part of the attempt for problem solving. The activities of a learner who confronts cognitive disequilibrium in a learning situation when he tries to overcome it leads to the renewal of cognitive structure. It is through this process construction of new knowledge and the assimilation of them that learning take place. Observation and enquiry are unavoidable factors. The learner advances towards new areas of acquisition of knowledge where he tries to compare his new findings with the existing conceptions.

Learning is a live mental process. Rather than the ability for memorisation of facts cognitive process has to be given emphasis. The process of problem analysis, elucidation, critical thinking, rational thinking, finding out co-relation, prediction, hypothesis formation, application, probing for other possibilities, extracting the crux and other processes are of critical importance in learning.

Constructivism gives greater predominance to co-operative learning. Social and cultural factors influence learning. Sharing of knowledge and experience among learners, collective enquiry, assessment and improvement, group activity and collaborative learning, by sharing responsibilities with the objective of public activity, provide opportunity for effective learning.

In learning internal motivation is more important than external motivation. The learner should have interest and initiative in learning. Learning situation should be capable of forming a sense of ownership in of the learner regarding the learning process.

Learning is not a linear process. It progresses in a spiralled way advancing deeper and wider.

### **Learner - His Nature and Features**

The learners in standard XI has undergone a learner centered and process oriented learning experience up to X standard. He is adequately competent to select vocational subjects according to his aptitude and interest and to acquire higher education and profession as he wishes. The aspirations about future life is framed in this particular age foreseeing national and international job opportunities. Some of the peculiarities of the learner at this stage are:

- Physical, intellectual an emotional planes are intensive changes during this age and their reflections can be observed.
- Ability to enquire, discover and establish cause-effect relationship between phenomena.
- Readiness to undertake challenges.
- Capacity to shoulder leadership roles.
- Attempt to interpret oneself.
- Susceptibility to different pressures.
- Doubts, anxieties and eagerness about sex.
- Longing for social recognition.

### **Needs of the Learner**

- To make acquaintance with a job through vocational education.
- To acquire more knowledge in the concerned area through higher education.
- To recognise and encourage the peculiar personality of the later adolescent period.
- To enable him to defend against the unfavourable circumstances without any help

### **Role of the Learner**

- Active participant in the learning process.
- Acts as a researcher
- Sharer of information
- Sharer of responsibilities
- Collects information
- Takes leadership
- Involves in group work

- Acts as a co- participant
- Observes his environment
- Experiments and realises
- Makes interpretations and draws inferences.
- 

### **Role of the Teacher**

The teacher should;

- consider the ‘Stress and strain’ of the teenagers
- understand the socio- economic and cultural background of the students.
- promote and motivate the students to construct knowledge.
- arrange proper situations to interact in and outside of the classroom.
- guide the students by explanations, demonstrations etc.
- promote opportunity for co-operative learning and collaborative learning.
- facilitate interpersonal and intra-personal interactions.
- act as a democratic leader.
- act as a problem solver
- effectively guide the students for the selection and conduct of various continuous evaluation elements.
- continuously evaluate the progress of the learners.
- gives scaffolding/support wherever necessary.
- motivate for learning
- promote divergent thinking.
- act as a democratic group leader.
- act as a co-learner
- gives variety of learning experiences.
- be a constant student
- facilitate for reference/data collection
- have a clear understanding about the age, needs, peculiarities, abilities, nature, aptitude etc. of the learner.
- have the ability to motivate the learner in order to acquire and enrich their knowledge.
- be a guide to the learner in developing insights and creating responses on current affairs.

- be capable to lead the learner into a variety of learning methods and process based on curriculum objectives.
- be a link between school and community.
- be a good organiser, guide, friend, philosopher and co-learner.
- have an inter disciplinary approach in learning activities.
- be able to guide the learner in his/her career prospects based on his interest aptitude and ability.
- be impartial and democratic.
- provide ample experiences to attain the basic values and objectives of the curriculum.
- 

## **New Concepts of Learning**

### **1 Discovery Learning**

The teacher has to create a motivating atmosphere for the learner to discover concepts and facts, instead of listening always. Creating occasion to progress towards discovery is preferred. Instead of telling everything before and compelling to initiate the models, situations are to be created to help the children act models as themselves.

### **2 Learning by discussion**

That discussion leads to learning is Burner's theory. Here discussion is not opposing each other. It is a sharing on the plane of ideas. New ideas are arrived at by seeking explanations, by mutual giving and taking of ideas and by problem solving.

### **3 Problem solving and learning**

Only when the learner feels that some thing is a problem to be solved that he takes the responsibility of learning it. It is an inborn tendency to act to solve a problem that causes cognitive disequilibrium in a particular area. It is also needed to have confidence that one is capable of doing it. The problems are to be presented in consideration of the ability and level of attainment of the learner.

### **4 Collaborative learning**

This is the learning in which the responsibilities are distributed among the members of the group keeping common learning objectives. The common responsibility of the group will be successful only if each member discharges his duties. All the members will reach a stage of sharing the result of learning, equally through the activity with mutual understanding. The teachers who arrange collaborative learning will have to make clear the responsibilities to be discharged. This is possible through the discussion with the learners. Collaborative learning

will help to avoid the situations of one person working for the whole group.

## **5 Co-operative learning**

This is the learning in which the learners help one another. Those who have more knowledge, experience and competency, will help others. By this exchange of resources the learners develop a plane of social system in learning also. As there are no high ups and low ones according to status among the learners they can ask the fellow students doubts and for helps without any hesitation or in hesitation Care should be taken not to lead this seeking of help to mechanical copying. It should be on the basis of actual needs. So even while encouraging this exchange of ideas among the members of the group cautions acceptance is to be observed as a convention. There should be an understanding that satisfactory responses should come from each member and that the achievement of the group will be assessed on the basis of the achievement of all the members

## **6 Zone of Proximal Development**

Vygotsky observes that these is a stage of achievement where a learner can reach by himself and another higher zone where he can reach with the help of his teachers and peers and elders. Even though some can fulfil the learning activity by themselves there is the possibility of a higher excellence. If appropriate help is forth covering every learner can better himself.

## **7 Scaffolding**

It is natural that the learner may not be able to complete his work if he does not get support at the proper time. The learner may require the help of the teacher in several learning activities. Here helping means to make the learner complete the activity taking responsibility by himself. The teacher has to keep in mind the objective of enabling the learner to take the responsibility and to make it successful.

## **8 Learning: a live mental process**

Learning is a cognitive process, only a teacher who has an awareness as to what the cognitive process is alone can arrange learning situations to the learner to involve in it. Learning can be made effectively and intellectual sharpness can be improved by giving opportunity for the cognitive processes like reminding, recognising compromising , co- relating, comparing, guessing, summarising and so on. How is cognitive process considered in language learning? Take guessing and prediction for example.

- Guessing the meaning from the context.
- Guessing the content from the heading.
- Predicting the end of the story.
- Guessing the incident, story from the picture.

- Guessing the facts from indications.
- and other such activities can be given the following activities can be given for the cognitive process of summarisation.
- Preparation of blue print.
- Preparation of list.
- Preparation of flow chart.
- Epitomising in one word.
- Giving titles and so on.
- Symbols, performance of characters indications, lines of a poem, tables, pictures, concepts, actions, body language and such things can be given for interpretation. Process based language given for interpretation. Process based language learning has to give prime importance to the cognitive process.

## **9 Internal motivation**

Internal motivation is given more importance than external motivation. The teacher has to arouse the internal motivation of the learner, A person internally motivated like this alone can immerse in learning and own its responsibility. How motivating is each of the activities is to be assessed.

## **10 Multiple intelligence**

The Theory of Multiple Intelligence put forward by Howard Gardener has created a turning point in the field of education. The National curriculum document has recommended that the curriculum is to be designed taking into consideration of this theory.

Main factors of the intellect :

### **1 Verbal / linguistic Intelligence**

Ability to read and write, making linguistic creations , ability to lecture competence effective a communication , all these come under this . This can be developed by engaging in language games and by teaching others.

### **2 Logical / mathematical Intelligence**

Thinking rationally with causes and effect relation and finding out patterns and relations come under this area, finding out relations and explaining things sequential and arithmetical calculations are capable of developing this area of intelligence.

### **3 Visual / spatial Intelligence**

In those who are able to visualise models and bringing what is in the imagination into

visual form and in philosophers, designers and sculptors this area of intelligence is developed. The activities like modelling using clay and pulp, making of art equipments, sculpture, and giving illustrations to stories can help the development of this ability.

#### **4 Bodily Kinaesthetic Intelligence**

The activities using body language come under this. This area of intelligence is more developed in dancers and actors who are able to express ideas through body movements and in experts in sports, gymnastics etc.

#### **5 Musical Intelligence**

This is an area of intelligence which is highly developed in those who are able to recognise the different elements of music in musicians and in those who can hear and enjoy songs. Playing musical instruments, initiating the songs of musicians, listening silently to the rhythms and activities like this are capable of developing this area of intelligence.

#### **6 Interpersonal Intelligence**

Those in whom this area of intelligence is developed show qualities of leadership and behave with others in a noble manner. They are capable of understanding the thought of others and carrying on activities like discussion successfully.

#### **7 Intrapersonal Intelligence**

This is the ability to understand oneself. These people can recognise their own abilities and disabilities. Writing diaries truthfully and in an analysing way and assessing the ideas and activities of others will help developing this areas of intelligence

#### **8 Naturalistic Intelligence**

A great interest in the flora and fauna of the nature, love towards fellow beings interest in spiritual and natural factors will be capable of developing this area.

#### **9 Existential Intelligence**

The ability to see and distinguish our own existence as a part of the universe, ability to distinguish the meaning and meaninglessness of life, the ability to realise the ultimate nature of mental and physical existences, all these are the peculiarities of this faculty of intelligence.

#### **Emotional Intelligence**

The concept of emotional intelligence put forward by **Daniel Golman** was used in framing the new curriculum. The fact that one's **Emotional Quotient (E.Q)** is the greatest factor affecting success in life is now widely accepted. The teacher who aims to focus on improving the emotional intelligence of students need to concentrate on the following.

***i) Ability to take decisions***

Rather than imposing decision on students while planning and executing activities, the students may be allowed to take part in the decision making process. Taking decisions through open discussion in the class, inviting students suggestions on common problems etc. are habits to be cultivated.

***ii) Ability to reach consensus***

- When different opinions, ideas and positions arise the students may be given the responsibility to reach a consensus.
- Imagining what would be the course of action in some situations, allowing to intervene in a healthy way in problems between individuals.

***iii) Problem solving***

- Developing the idea that there is reason and solution to any problem.
- Training in finding reasons for problems.
- Suggesting solutions through individual or group efforts.
- Discussing social problems.
- Analysing the shortcomings in methods to solve problems.

Whether plastic can be banned within school premises can be given as a problem. Group discussion will provide reasons and solutions. Problems which can influence classroom learning and for which the learner can actively contribute solutions need to be posed.

- Self criticism, evaluation
- Ability to face problem-situation in life
- Thinking what one would do if placed in the situation of others, how one would respond to certain experiences of others - All these foster the growth of emotional intelligence.

***iv) Life skills***

Life skills need to be given a prominent place in education. W.H.O. has listed ten skills required for success in life.

- Self awareness
- Empathy
- Inter personal relations
- Communication

- Critical thinking
- Creative thinking
- Decision making
- Problem solving
- Copying with emotion
- Copying with stress

The new curriculum addresses these areas.

Knowing the characteristics of the learner, role of the teacher and how to use the teachers handbook help the teacher to plan and effectively implement learning activities.

### **Objectives of the Vocational Higher Secondary Curriculum**

- To facilitate higher education while giving opportunity to enter in the field of employment.
- To develop environmental awareness, sense of national integration, tolerance and human values so as to ensure social and cultural improvement.
- To enable the learner to find on his own employment.
- To inculcate mental courage in the learner to face unfavourable situations.
- To make human resource development possible.
- To enable the learner to understand social problems and to react appropriately.
- To develop the learner to identify and develop his own competencies.
- To develop vocational aptitude, work culture and attitude in the learner so as to provide useful products and services to the society.
- To create an awareness about mental and physical health.
- To acquire awareness about different job areas and to provide backgrounds for acquiring higher level training in subjects of interest.
- To develop possibilities of higher education by creating awareness about common entrance examinations.

- To provide situation for the encouragement of creative thinking and organising training programmes in each area, creative abilities and to develop artistic talents.

### **Nature of Approach**

The learning device is to be organised in the selected vocational subjects in such a way that adequate practical experience should be given, making use of the modern technology. The development in each area on the basis of information technology is to be brought to the learner. The work experience in the respective fields(OJT, Field trip, Production/Service ..... training, Survey, Workshop, Exhibition, Youth festival, Physical fitness etc.) are to be adjusted suitable to the learning and evaluation process. The participation and leadership of the students in planning and execution is to be ensured through this kind of activities. Social service is to be made a part of the course.

### **Approach towards Vocational Higher Secondary Education**

The learning methodology has to be organised so as the learning provide adequate practical thinking on the opted vocational subject utilising the new technology. The development of information technology should be made available in each sector. Work experience, OJT, Field trip production, Service cum training centre, Survey, Workshops, Exhibitions, Youth festivals, Physical fitness etc should be systematised well appropriate to learning and evaluation. Learner participation should be ensured in the planning and implementation of these activities. Social service should be a part of the course. If a learner has to change his school, he should be provided an opportunity to continue his studies in the new school. While considering criteria for admission to higher courses, grades of vocational subjects should also be given due weightage. In tune with the changes in the Vocational Higher Secondary Education changes should be ensured in the field of higher education.

The teachers have to take special care in arranging learning activities for the development of all the faculties of intelligence.

### **Learning activities and learning atmosphere**

A proper learning atmosphere is essential for the betterment of learning activities.

They are:

- Proper physical environment
- Healthy mental atmosphere

- Suitable social atmosphere
- Active participation of PTA, Local bodies and SRG
- Reference materials and visual media equipments.
- Academic monitoring
- School Resource Group (SRG)



# APPROACH TO RUBBER TECHNOLOGY

---

---

## **Introduction**

Rubber is an important crop of Kerala. Lots of rubber products are made now which are inevitable for modern life. Prosperity of a country is measured by the percapita consumption of rubber also. Rubber plays an important role in Kerala which decides the economy and social development of Kerala. India is in third place in the production of rubber in world. 90% of rubber in India is produced in Kerala. Rubber Technology course deals with the production of rubber, processing of rubber and rubber product manufacture.

We can see the influence of rubber in all walks of life especially transport, health, engineering etc. Kerala plays an important role in rubber research field. This course helps to impart technical knowledge to ordinary pupil. Rubber technology helps to study different methods of value added rubber products manufacturing.

## **Learning Approach**

Learning approach of this course based on learning to know, learning together, and learning to deal. Learning is construction of knowledge. Following methods are used for construction of knowledge.

- 1 Discovery learning
- 2 Enquiry learning
- 3 Collaborative learning
- 4 Co-operative learning
- 5 Social culture learning.

Above methods can be used for Rubber Technology Course. Learning approach should stimulate the multiple intelligence and EQ of students. Learning should be learner centred, locally specific - life related and problem related process. The process based approach is an important feature of new curriculum. In the new activity oriented approach the role of teacher changes to facilitator of knowledge. He facilitates various learning situations, from which learner can create knowledge.

### **Need of New Approach**

Students should develop skills to use rubber machineries, equipments, chemicals to study practical, method of manufacturing rubber products. Learner centred learning should be used. Technical aptitude, discover learning and group working skills of students will be enhanced. The following skills to be achieved by the students.

- 1 Enhance curiosity
- 2 Achieve capability to analyse
- 3 Skills to assimilate higher levels of knowledge
- 4 Skills to use rubber technology in day to day life
- 5 Skills to convey the knowledge to society
- 6 Skills for communication
- 7 Skills to face technical problems and solving of which related to rubber product manufacture

### **Role of teacher**

In the learner centred curriculum, the teacher is a person who has to give intrinsic motivation among students. For achieving this goal, teacher should be

- 1 a facilitator of learning
- 2 a good communicator
- 3 an innovator
- 4 a good evaluator
- 5 a good organiser
- 6 able to consider the abilities, needs, special features, and age group of students at higher secondary level
- 7 able to understand the limitations of the students and their learning problems
- 8 a good guide to the overall development of the students
- 9 an innovator
- 10 able to raise the leadership qualities and self confidence of the students
- 11 an authoritarian in the concerned subject
- 12 able to arrest and sustain the attention of students
- 13 a good observer and motivator
- 14 able to bring out and encourage the inborn talents
- 15 a resource manager
- 16 a systematic record keeper
- 17 a counsellor to issue guidance to students

- 18 a person with a high level of practical competency
- 19 a self evaluator and good listener
- 20 able to create awareness in social problems
- 21 a person with democratic and humanitarian approach
- 22 a professional as well as philosopher
- 23 able to keep moral values
- 24 optimistic and impartial

### **Role of students**

- 1 Collection of data from fields like rubber factories, research institutions and plantations.
- 2 Collection of specimen from selling outlets and automobile workshops.
- 3 Make reports of products or their news with special mention to rubber factories.
- 4 Discussion, seminar and field visits with the active participation of faculty members, subject experts and research organisation in the field of rubber technology.
- 5 Preparation of project reports which enables an effective exposure to realities of rubber field.
- 6 Conduct case studies about the technical problems in industries/ product development.

### **Teaching aids**

- 1 Textbooks, Reference books, Sourcebook
- 2 Teaching notes, discussion notes, seminar reports, projects
- 3 Teaching equipments like OHP, LCD projector etc.
- 4 Charts, slides, diagrams, patterns
- 5 Laboratory, workshops
- 6 Factories, Research institutes, higher study centres
- 7 Study tour, Exhibition
- 8 Discussions and seminars
- 9 Journals
- 10 Field visits
- 11 Internet, Library

### **Learning Strategies**

Some of the important learning strategies are experiments, field visits, discussion, seminar, debates, project work, drawings, audio visual aids, model preparation, specimen collection, quiz, exhibition etc. These activities help students to develop their skills, abilities, leadership quality, research mentality and overall performance.

## **Experiments**

Experiment is an important learning strategy. The teacher gives guidelines about sources and tools used in each experiment. Experiment may be done group wise or individually according to the topic. Many parameters of rubber chemicals and latex characteristics are based on experimentation.

## **Discussion**

General discussions and group discussions are the important learning strategies for comprehensive learning. Technical subjects can be effectively communicated by these activities, so that the active participation and development of various skills like communication, leadership etc. can be assured. In all units of rubber technology this strategy is adopted for effective learning.

For general discussions the facilitator brings the attention of the learners to the topic by raising questions, pointing examples, exhibiting charts etc. The students are allowed to participate and contribute points, raise questions, for liveliness of the discussion and to arouse their curiosity. The points, ideas, conclusions are consolidated and validated at the end of each discussion.

In group discussions, topics are given to small groups for discussion. Handouts, journals, pamphlets, books, charts etc. can be distributed among the groups for guiding the discussion. Timely interference of the facilitator must be ensured for preventing the de-railment of ideas and contexts. Each group prepare write ups, charts, diagrams etc. and presented to the whole group for the effective co-operative learning. The points and ideas are consolidated and shared to the whole group.

## **Reference**

Referencing is an unavoidable learning method for technical subjects. Texts and books are very costly in the case of Rubber Technology and the availability is also less. Hence group referencing is encouraged in this subject. Student groups refer the materials relevant to the topics and prepare write ups. These write ups are presented in the whole group and thus the sharing of ideas is resulted. This strategy develops the positive attitudes and skills of the learner. Since the participation of the learner is assured, their enthusiasm and communication skills will be manifolded. The validated write-ups are compiled in the Student's Subject Diary.

The list of reference books are given at the end of each unit which are only samples. The facilitator and students can search for further sources. Internet sites, CD's, pamphlets, articles, journals etc. can also be effectively used in referencing.

## **Field visits**

One day visit may be conducted to the rubber processing industry and plantations, research institutes, laboratories, training centres. The teacher gives necessary guidance at every stage of factory visits. A real exposure to the factory and field atmosphere may enhance both technical and communicative skills.

## **Project Work**

Project work is an effective strategy of learning. It helps to make learning interesting and scientific. The teacher gives help and guidance to pupils, and analyse the work at every stages of completion of the project work. The project work may be based on techno-economic feasibility study of rubber products. Much provisions is in the field of Rubber Technology to adopt project report as an effective learning tool.

## **Seminar**

Seminar is a discussion held by students under the guidance of a teacher based on a particular topic. Seminar presentation is prepared on the basis of collected data, findings and inferences, chart, tables, photos etc. For seminar teacher gives topic and proper guidance. Both learner centred seminars and seminar by experts from rubber fields can be included.

## **Assignment**

Preparation of detailed notes, charts, diagrams etc. of concerned topic assigned by the teacher is helpful to collect information and gather knowledge. Some of the difficult task which cannot be attained in the classroom can be easily learned by assignments especially in the area of rubber products.

## **Drawings**

Preparation of diagrams and charts are very useful learning activity to convey different concepts and ideas, mainly the activity, chemical nature and end use of compounding ingredients.

## **Audio visual aids**

C.D.Rom, video clipping, slide projector, website etc. can be used to convey information and knowledge about rubber technology. The teacher prepare the topic and present through audio-visual medium. Topics related to synthetic materials, cross linking system, chemical structure etc. are effectively communicated by this way.

## **Specimen collection**

The students are advised to collect samples of different rubber products or chemicals. Teacher guides the students to display all the samples and their properties in the classroom. Raw materials, rubber products are collected in this way.

## **Quiz**

It can help to check the present knowledge of a particular topic. It may be conducted group wise or individually in all learning materials/ strategies. The teacher acts as guide or facilitator at all stages. From the different raw materials, rubber processing and polymer products can be included in this method.



# PLANNING

---

## **Introduction**

In the context of changing scenario in the field of education the role of teacher has been changed as a facilitator. The learning process should be learner centred and activity oriented. Learning activities would help to develop process skills and multiple intelligence. The activities are conducted in the classroom or outside, and they are to be completed in a time bound manner.

The teacher has to plan the activities necessary to ensure effective learning. The plan must be structured as.

- Year Plan
- Unit Plan
- Daily Plan

## **Year Plan**

An year plan has to be prepared in order to foresee picture of the whole activities to be conducted in an academic year. The annual plan is to be prepared by the teacher after examining the curriculum objectives, text book, source book and other learning materials. While preparing year plan the teacher will consider the facilities available in the school, the possibilities of field visits, interviews, seminars, projects, collections, discussions, lab work etc. which form part of the activities of the lessons. Activities are to be arranged by utilising the local resources available. For systematic and effective transaction of the curriculum the year plan is an important instrument. With the help of year plan the teacher can transact the curriculum systematically within the stipulated time.

## YEARPLAN (THEORY)

TERM	MONTH	UNIT	NAME OF UNIT	HOURS	TOTAL
<b>I</b>	June	1	Introduction to Natural Rubber	5	70
	July	2 & 3	Rubber Plantation Harvesting, Preservation and Marketing of crop	30	
	August	3 & 4	Latex Concentration	10	
	September	5	Rubber Compounding	25	
	October	5 & 6	Field Crop Processing Machineries	20	
<b>II</b>	November	7	Rubber Processing Machineries	20	40
	December	7	Rubber Processing Machineries		
<b>III</b>	January	8	Synthetic Rubber	15	30
	February	9	Reclaimed Rubber	15	
				<b>Total</b>	<b>140 hours</b>

**YEARPLAN(PRACTICAL)**

<b>TERM</b>	<b>MONTH</b>	<b>UNIT</b>	<b>NAME OF UNIT</b>	<b>HOURS</b>	<b>TOTAL</b>
<b>I</b>	<b>June</b>	<b>1</b>	<b>Physical Properties of Field Latex</b>	<b>36</b>	<b>186</b>
	<b>July</b>	<b>1</b>	<b>Physical Properties of Field Latex</b>	<b>54</b>	
	<b>August</b>	<b>1</b>	<b>Physical Properties of Field Latex</b>	<b>54</b>	
	<b>September</b>	<b>2</b>	<b>Latex Creaming</b>	<b>42</b>	
<b>II</b>	<b>October</b>	<b>3</b>	<b>TSC, DRC, VFA</b>	<b>54</b>	<b>150</b>
	<b>November</b>	<b>3</b>	<b>Preparation of Ribbed Smoked Sheet</b>	<b>54</b>	
	<b>December</b>	<b>3</b>	<b>Volatile Matter and Dirt Content</b>	<b>42</b>	
	<b>January</b>	<b>4</b>	<b>Field Visit, OJT Programmes</b>	<b>54</b>	
<b>III</b>	<b>February</b>	<b>5</b>	<b>Synthetic rubber - Identification</b>	<b>50</b>	<b>104</b>
				<b>Total</b>	<b>440 hours</b>

### **Unit Plan**

The teacher should prepare unit plan before actual transaction of the lessons in the class room. This plan includes curriculum objectives, ideas to be transacted, process skills, learning materials required, the products obtained, evaluation methods and periods required. A model of unit plan is given below.

**MODEL UNIT PLAN**  
**1. INTRODUCTION TO NATURAL RUBBER**

Curriculum Objectives	Ideas/ Concepts	Skills	Activity	Materials	Products	Evaluation	Time
1.1 To get a clear picture about origin and propagation of rubber tree with special mention of Hevea Brasileniss through discussion, chart, display and reference	Contribution of Columbus Introduction of Hevea Brasilensis Experimental planting at Kew Garden & Tropical Asia Role of Henry Wickhalm & Joseph Priestly Early plantations in Calcutta, Nilambur and Thattakadu Large scale plantations in India	Observing Communicating Interpreting Inferencing	Chart Display Discussion Chart Display Reference	Charts Books	Chart Diary Write up Data sheets	Active participation Write up data sheet	3 hours
1.2 To understand the commercial sources of NR and present statistics, through data collection, internet discussion and charts	Graphic representation of present production and consumption Commercial sources of NR	Observing Communicating Interpreting Predicting	Data collection Chart preparation Discussion	Journals	Charts Tables	Authenticity of data Observation skills Chart	4 hours



# EVALUATION

---

## **Introduction**

Evaluation is a process of assessing scientifically the achievements of students in relation to the set objectives of the curriculum. Evaluation is an integral part of the learning process, and it is a systematic process of collecting, analysing and interpreting achievement both in scholastic and co-scholastic areas of learning. As learning is a continuous process, evaluation should also be continuous. Child progresses through different learning experiences, learning progress should be evaluated from time to time.

To make evaluation - continuous and comprehensive, following methods are adopted.

1. CE - Continuous and comprehensive evaluation
2. TE - Terminal evaluation
3. VCE - Vocational Competency evaluation
4. PE - Practical evaluation

## **Continuous Evaluation (C.E)**

In this method, multidimensional competencies of the learner are evaluated. The following tools are used for continuous evaluation.

- 1 Class Test
- 2 Project
- 3 Seminar
- 4 Group Discussion
- 5 Assignment
- 6 Collection

*Note:* Class test is compulsory, where as other tools are optional and select any two in addition to class test.

## **Grading Indicators of CE Items**

### **1. Class Test**

For the item class test, the average of first term and second term scores is to be considered.

The features of the class test are as follows.

- It is a tool used to find out and to solve the learning problems faced by pupils.
- It may be used as a tool to collect feedback from pupils during the learning process
- Class test need not be a written test. It can also be organised as a performance test.
- After completing a unit, it can be in the form of a unit test.
- It may not be a test including more than one unit.
- Attendance of all pupils may be ensured during class test.
- Class test may be carried out by the teacher handling the subject.
- Questions may be prepared in school by following the directions of school examination board.
- Class test should be informal. No timetable or printed question paper is required. No need of a blue print.
- Questions should be based on subject approach.
- Should be completed in one period.
- Arrange more remedial activities to uplift the lagging students identified through the class test.
- Discussion of value points with pupils and peer evaluation and self evaluation may be used.

### **2. Project**

#### **1 Ability to plan 4/3/2/1**

- ability to select suitable learning method for solving the problem
- ability to develop suitable tools
- ability to plan the duration of study, and the various activities to be carried out in each stage.

#### **2 Ability to collect data 4/3/2/1**

- ability to collect sufficient and relevant data
- ability to classify and arrange data for analysis
- reliability and authenticity of the collected data (this can be assessed based on their recording in the project diary)

- 3 Ability to analyse the data and drawing conclusion/ inference** 4/3/2/1
- ability to analyse the data
  - ability to draw inference based on the analysis of data
  - ability to give suitable suggestions based on the inferences
- 4 Ability to prepare the project report** 4/3/2/1
- ability to prepare the project report reflecting the process skills involved
  - communicability of report
  - authenticity of report
  - relation with the project diary
  - time bound completion
- 5 Viva- Voce (Contents and process)** 4/3/2/1
- ability to analyse the data
  - ability to justify the inference
  - ability to explain the strategies and methods adopted and communicate the findings

### **3. Seminar**

- 1 Ability to plan and organise (time, topics, sources of data, method of presentation etc.) 4/3/2/1
- 2 Skill in the collection of data (relevance, authenticity, variety of sources etc.) 4/3/2/1
- 3 Awareness of content (presentation of paper, participation in discussion, ability to substantiate his own ideas and views) 4/3/2/1
- 4 Ability to prepare the report (sequence in the presentation of the concepts, authenticity and clarity of ideas/ views/ concepts) 4/3/2/1
- 5 Skill in communication(presentation of paper, participation in discussion) 4/3/2/1

### **4. Group Discussion**

- 1 Ability to plan and organise (time, topics, sources of data, method of presentation etc.) 4/3/2/1
- 2 Skill in the collection of data (relevance, authenticity, variety of sources etc.) 4/3/2/1
- 3 Awareness of content (presentation of paper, participation in discussion, ability to substantiate his own ideas and views) 4/3/2/1
- 4 Ability to prepare the report (sequence in the presentation of the concepts, authenticity and clarity of ideas/ views/ concepts) 4/3/2/1
- 5 Skill in communication(presentation of paper, participation in discussion) 4/3/2/1

**5. Assignment**

- |   |  |         |
|---|--|---------|
| 1 | Awareness of content.  | 4/3/2/1 |
| 2 | Comprehensiveness of the content (coverage of content)               | 4/3/2/1 |
| 3 | Systematic and sequential arrangement (clarity, structure, language) | 4/3/2/1 |
| 4 | Own observation/ suggestions/ views/ judgement/ evaluation           | 4/3/2/1 |
| 5 | Timely submission  | 4/3/2/1 |

**6. Collection**

- |   |                                |         |
|---|--------------------------------|---------|
| 1 | Relevance                      | 4/3/2/1 |
| 2 | Variety                        | 4/3/2/1 |
| 3 | Awareness of content           | 4/3/2/1 |
| 4 | Systematic recording           | 4/3/2/1 |
| 5 | Neatness and timely submission | 4/3/2/1 |

**Continuous Evaluation Items (C.E)**

No.	Subject	Class Test	Project/ Collection/ Group discussion	Assignment/ Seminar	Total
1	Rubber Technology	1	1	1	3

**Recording of Grades**

**Project**

Subject : Rubber Technology		Item: Project					Total Score (20)
Sl. No	Name	Grading Indicators					
		I (4)	II (4)	III (4)	IV (4)	V (4)	
1	Anand	2	3	4	4	4	17
2	Shibu	4	3	4	4	4	19

- I Ability to plan
- II Ability to collect data
- III Ability to analyse the data and drawing conclusion/ inference
- IV Ability to prepare project report
- V Viva voce (content and process)

**Assignment**

<b>Subject : Rubber Technology</b>			<b>Item: Assignment</b>				
<b>Sl. No</b>	<b>Name</b>	<b>Grading Indicators</b>					<b>Total Score (20)</b>
		<b>I (4)</b>	<b>II (4)</b>	<b>III (4)</b>	<b>IV (4)</b>	<b>V (4)</b>	
1	Anand	2	3	4	4	4	17
2	Shibu	4	3	4	4	4	19

- I Ability of content
- II Comprehensiveness of the content
- III Systematic and sequential arrangement
- IV Own observation/ suggestions/ views/ judgement/ evaluation
- V Timely submission

**Class Test**

<b>Subject : Rubber Technology</b>			<b>Item: Class Test</b>		
<b>Sl. No</b>	<b>Name</b>	<b>Marks</b>		<b>Average</b>	<b>Score</b>
		<b>I Term</b>	<b>II Term</b>		
1					
2					

**CE Score - Rubber Technology (Consolidated Statement)**

Sl. No	Name	CE Items			Total (60)	Total CE Out of 20
		1 Project (20)	2 Assignment (20)	3 Class Test (20)		
1	Anand	18	17	19	54	18
2	Shibu	20	19	18	57	19

**CE Score - Class XI - Rubber Technology**

Sl. No	Name	Subjects of CE Scores							
		English (20)	GFC (20)	Rubber Technology (20)	Physics (20)	Chemistry (20)	Maths (20)	-	-
1									
2									
3									
4									
<b>Date</b>		<b>Signature</b>							

**Terminal Evaluation (T.E)**

Terminal evaluation should be in written form. The intention of the test must not be confined to memory test alone. It is an important tool for evaluating the facts, concepts and ideas gained by the learner. While preparing questions for the terminal evaluation, more emphasis should be given to the level of application, analysis, synthesis and evaluation than knowledge and understanding. The questions should be framed with provisions for students to apply various mental processes like:

- retrieve/ recollects/ retells information
- readily makes connections to new information based on past experiences and formulates initial ideas/ concepts
- detects similarities and differences
- classifies/ categorises/ organises information appropriately
- translates/ transfers knowledge or understanding and applies them in new situations.
- establish cause effect relationships
- makes connections/ relates, prior knowledge to new information/ applies reasoning and draw inferences
- communicates knowledge/ understanding through different media
- imagines/ fantasises/ designs/ predicts based on received information
- judges/ appraises/ evaluates the merits or demerits of an idea/ develops own solution to a problem

### **Guidelines for the preparation of question paper**

- 1 Questions should be prepared based on the curriculum objectives
- 2 Prime consideration should be given to the curriculum objectives which lead to the learner to diverse thinking process. Along with this, ideas related to the content should also be taken into consideration.
- 3 More than one curriculum objectives can be combined if necessary.
- 4 Questions which test only the memory of the learner should be avoided. Priority should be given to analysis, synthesis and evaluation type questions.
- 5 Different learning levels should be considered in making questions. That is all questions should aim at all levels of learners.
- 6 Even in questions of higher mental process there should be a chance for below average students to make an attempt.
- 7 Questions should be familiar and challenging in connection with the situations.
- 8 To avoid blind guessing, multiple choice and supply type questions may be mixed.
- 9 Along with questions clues can be given, if necessary.
- 10 Questions should be clear and legitimate.
- 11 Skills which are evaluated as a part of CE may be given less importance.
- 12 Drawing and picture which develop various components of mental processes may be included in the question.
- 13 Questions which demand neat labelled diagram should be avoided.

- 14 Arrangement of questions can be done in the order of scores.
- 15 No fixed number and pattern of questions necessary
- 16 Questions may be modelled so as to arouse the curiosity in the recent scientific development.
- 17 Questions may be modelled so as to promote interest and positive attitude towards technology.
- 18 Questions may be able to help the learners to face challenges in future and to equip themselves to appear competitive examinations.
- 19 Stress should be given to apply the innate thinking mental abilities of pupil.
- 20 Life related questions should be included.

### **Practical Evaluation (P.E)**

The following general indicators are identified for P.E

Identification	- 15 %
Procedure (Writing)	- 10%
Handling of Tools and Equipments	- 10%
Observation/ Tabulation	- 20%
Record/ Result	- 20%
Viva	- 15%
Total Score for P.E	- 150

PE should be done before the end of each item.

### **Vocational Competency Evaluation (VCE)**

Being a vocational course a system that judiciously evaluate the acquired value addition and consequent capacity building in the selected vocational subject is highly essential. As the other evaluation components like CE, TE and PE cannot assess the vocational competencies and professional skills acquired by the students, an Internship Evaluation (IE) component has been introduced to meet this requirement.

Internship evaluation should be done based on the following components.

#### **1 Regularity and punctuality**

A regular attendance and habit of time bound completion of task is very essential for the effective training

#### **2 Field visit/ survey**

The experience gained through field visit/ survey, increases the level of intrinsic motivation and positive attitude towards the vocational subject and thereby the student becomes a skilled personnel.

**3 OJT/ Simulated experiment**

Performance of short term industrial training, performance in production/ training centre/ testing stations/ laboratories outside the campus

Simulated experiments enable the students to practice the acquired skills in the real situation and thereby increasing self confidence and self reliance.

**Regularity and punctuality can be evaluated by 5 point grading system**

		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
1	Regularity	Never regular	Often regular	Usually regular	Most of the time regular	Always regular
2	Punctuality	Never Punctual	Often Punctual	Usually Punctual	Most of the time punctual	Always punctual

Regularity and punctuality can be assessed by using attendance of the student and time bound completion of tasks.

**Indicators for field visit****4/3/2/1**

- Attitude of readiness towards the task
- Capacity for observation
- Data collection
- Application of ideas
- Documentation / Recording

**Indicators for survey****4/3/2/1**

- Planning
- Data collection
- Consolidation of data and analysis
- Drawing inference
- Reporting

**III OJT/ Simulated Experiment**

- involvement/ participation
- skills in doing work/ communication skill
- time bound action

- capacity for observation and analysis of innovation
- documentation, recording and display

**Performance in outside testing laboratories**

- ability for planning and organisation
- punctuality and turn out
- handling
- data collection and inference
- tabulation and result

**Performance - production cum training centre**

- mastery of vocational subject
- managerial capacity
- promoting self confidence
- innovative approach
- promoting self reliance

**Vocational Competency Evaluation(VCE) Items**

<b>Items</b>	<b>Score</b>
Regularity & Punctuality	10
Field visit/survey (any one)	20
OJT/simulated experiment Performance - PTC (any one) }	20
<b>Total</b>	<b>50</b>

A minimum of 80% attendance is required for promotion to the second year. Those who have shortage of attendance should repeat first year. Those who have more than 80% attendance but failed to achieve 30% of internship evaluation will be promoted to the second year. He has to improve the component in which he performed poorly. He has to attain the minimum by improving the particular component to get eligible for appearing second year public examination.







## Government of Kerala

### Board of Vocational Higher Secondary Examinations

Reg: No.

Thiruvananthapuram

Dated : \_ \_ \_ \_ \_

#### Evaluation Sheet

Sri./Smt. \_\_\_\_\_ is awarded Scores/grade as detailed below in the First Year Vocational Higher Secondary Examination held in \_\_\_\_\_

Name of School : \_\_\_\_\_ Admission No : \_\_\_\_\_

Name of Vocational Course : \_\_\_\_\_

Subject	Score Obtained					Positional Grade	Grade in words
	CE 20	TE 80	PE 150	IE 50	Total		
<b>Part- I</b>							
English			—	—			
General Foundation Course			—	—			
<b>Part- II Vocational Subjects</b>							
Vocational Theory			—	—			
Vocational Practical	—	—		—			
Vocational Competency	—	—	—				
<b>Part- III Optional Subjects</b>							
	<b>20</b>	<b>60</b>	<b>20</b>				
Physics				—			
Chemistry				—			
	<b>20</b>	<b>80</b>					
Mathematics			—	—			

CE- Continuous Evaluation, TE- Term End Evaluation, PE- Practical Evaluation, IE- Internship Evaluation.

Grades	A+ 90% and Above - Outstanding	<b>A</b>	80- 89% - Excellent.
	B+ 70 - 79% - Very Good	<b>B</b>	60- 69% - Good
	C+ 50 - 59% - Above Average	<b>C</b>	40- 49% - Average
	D+ 30 - 39% - Marginal	<b>D</b>	20- 29% - Need improvement
	E Below 20% - Need improvement		

Marks Entered by \_\_\_\_\_

Marks checked by \_\_\_\_\_

Supdt/ T. O \_\_\_\_\_

SECRETARY

# **CURRICULUM OBJECTIVES (THEORY)**

---

## **Unit 1**

### **Introduction to Natural Rubber**

- 1 To get a clear picture about the origin and propagation of rubber tree with special mention to Hevea Brasiliensis through discussion, chart, display and reference
- 2 To understand the commercial sources of NR and present statistics through data collection, internet, discussion and charts

## **Unit 2**

### **Rubber Plantation**

- 1 To identify different clones and to familiarise different propagation methods (seedlings, budgrafting, polybag clones) through field trip, chart display, experiment and discussion.
- 2 To get awareness about planting, manuring, plantation maintenance, cover crop and application of fungicides through field trip, observation and discussion.

## **Unit 3**

### **Harvesting, Preservation and Marketing of Crop**

- 1 To conceive the ideas about rubber tapping devices, tapping methods, tapping task, tapping rest through field visit, discussion and assignment and audio visual aids
- 2 To conceive basic concepts of collection of latex and field coagulum through field visit and discussion
- 3 To list out the chemical composition of NR latex through reference, experiment and seminar
- 4 To get an awareness about transportation coagulation, spontaneous coagulation and storage of latex through field visit and discussion
- 5 To get a clear idea about latex preservation systems through reference, discussion and experiment
- 6 To get an awareness about the preparation of different NR marketable forms such as Cenex, Sheets, block rubber, creep and to make RMA grades through specimen collection, field

visits, experiments, reference and group discussion

#### **Unit 4**

##### **Latex Concentration**

- 1 To familiarise different concentration methods viz - creaming, centrifuging, evaporation and electro decantation through field visit, specimen collection, experiment, seminar and audio visual aids.
- 2 To familiarise preservation systems involved in the concentrated latex through reference (BIS Standards), seminar and group discussion.

#### **Unit 5**

##### **Rubber Compounding**

- 1 To acquire basic concepts of rubber compounding and compounding ingredients through collection of specimen, discussion, project, classification and experiments.
- 2 To conceive the idea of different cross linking systems and curing methods through project, reference and discussion.

#### **Chapter 6**

##### **Field Crop Processing Machineries**

- 1 To get a clear picture about centrifuging machine for latex concentration, through discussion, reference and field visit
- 2 To familiarise the sheeting rollers and batteries for the production of RSS, through field visit, group discussion and audio visual aids
- 3 To develop the concept of machine used for creep production such as PLC, sole-creep, through field visit, group discussion and reference
- 4 To acquire a deep knowledge of various machineries and equipments used for the production of different grades of block rubber through field visit, reference and audiovisual aids.

#### **Chapter 7**

##### **Rubber Processing Machineries**

- 1 To acquire a deep knowledge about various type of mixing mill through assignments and group discussion
- 2 To acknowledge the working principle of Banbury, Intermix, Kneader, through field visit, reference, group discussion and internet
- 3 To get a clear idea of calenders used for sheeting and coating, through chart and group discussion

- 4 To familiarise the working and components of extruder through field visit, group discussion and reference
- 5 To acknowledge the parts and working of various moulding presses through reference and assignment
- 6 To get an idea about spreading machine for rubber coating to substrate through reference and assignments
- 7 To get an idea about solution mixer, through seminar and group discussion
- 8 To get a clear picture of vulcaniser through field visit and assignment

## **Chapter 8**

### **Synthetic Rubber**

- 1 To familiarise the general structural properties compounding and application such as SBR, PBR, IR, CR, NBR and comparison between NR and SBR through discussion, classification, reference and project

## **Chapter 9**

### **Reclaimed Rubber**

- 1 To get a clear idea about different production methods, compounding and applications of reclaimed rubber through reference, assignment, discussion and experiment



# **CURRICULUM OBJECTIVES**

## **(PRACTICAL)**

---

---

### **Unit 1**

#### **Physical Properties of Field Latex**

- To determine the physical properties of fresh field latex through experiments as per BIS
- To determine the NH<sub>3</sub> content of preserved field latex (PFL) through experiments as per BIS

### **Unit 2**

#### **Latex Creaming**

- To cream the field latex and to find out the efficiency of creaming through experiments.
- To determine the TSC and DRC of field and concentrated latex through experiments.

### **Unit 3**

#### **Preparation of Ribbed Smoked Sheet**

- To prepare ribbed smoked sheets through work practice.
- To determine the volatile matter of raw rubber through experiments.
- To determine the dirt content of rubber through experiments.

### **Unit 4**

#### **Field Visit/ OJT Programme**

- To get a clear picture of plantations, crepe factories, block rubber units through field visit/ OJT programmes

### **Unit 5**

#### **Synthetic Rubber**

- To identify different synthetic rubbers through physical and chemical analysis.



# SYLLABUS (THEORY)

---

## **Theory - 140 Hours**

### **Unit 1**

#### **Introduction to Natural Rubber (5 hours)**

- ◆ Historical development of Hevea Brasilensis into commercial source of NR, Present production pattern - World statistics - Indian statistics

### **Unit 2**

#### **Rubber Plantation (10 hours)**

- ◆ Plantation - Rubber tree - its propagation- planting and plantation maintenance

### **Unit 3**

#### **Harvesting, Preservation and Marketing of Crop (20 hours)**

- ◆ Rubber tapping, collection of latex, composition of latex, transportation and storage of crop - preservation of latex - processes of latex into marketable forms, RSS, crepe, crumb - grading of rubber

### **Unit 4**

#### **Latex Concentration (10 hours)**

- ◆ Latex concentration - centrifuging - creaming - preservation of latex.

### **Unit 5**

#### **Rubber Compounding (25 hours)**

- ◆ Rubber compounding - definition and objectives - compounding - curing agents - accelerators - antioxidants - Zinc oxide - stearic acid - process acids - fillers - polishing agents - blowing agents - vulcanisers - cross linking systems

## **Chapter 6**

### **Field Crop Processing Machineries (20 hours)**

- ◆ Rubber machinery - machinery for production of commercial grades of NR and Latex
  - (i) Centrifugal machine for latex concentration
  - (ii) Sheeting rollers and batteries for the production of rubber smoked sheets
  - (iii) Machinery used for creep production
  - (iv) Machinery used for production of solid block rubber

## **Chapter 7**

### **Rubber Processing Machineries (20 hours)**

- ◆ Basic Rubber Machineries
  - (i) Various types of mixing mill
  - (ii) Internal mixers
  - (iii) Calenders
  - (iv) Extruders
  - (v) Moulding presses - hydraulic and hand operated
  - (vi) Spreading machine
  - (vii) Solution mixer
  - (viii) Vulcanizers

## **Chapter 8**

### **Synthetic Rubber (15 hours)**

- ◆ Synthetic rubber - SBR - manufacturing process - comparison of properties of SBR with NR - compounding of SBR.
- ◆ Manufacture, compounding properties and application of polybutadiene, butyl rubber nitrile rubber, Neoprene rubber, applications

## **Chapter 9**

### **Reclaimed Rubber (15 hours)**

- ◆ Reclaimed rubber - different methods of manufacture - compounding - major uses



# SYLLABUS (PRACTICAL)

---

---

## **Unit 1**

### **Physical Properties of Field Latex**

- Physical and chemical properties of fresh field latex - viscosity, specific gravity, colloidal nature, coagulum content, PH value, sludge content, determination of ammonia content.

## **Unit 2**

### **Latex Creaming**

- Creamed latex - composition, preparation, efficiency of creaming, DRC, TSC and determining of volatile fatty acid number.

## **Unit 3**

### **Preparation of Ribbed Smoked Sheet**

- Work practice - Production of RSS, creep, determination of volatile matter and dirt content.

## **Unit 4**

### **Field Visit/ OJT Programme**

- Field visit/OJT programme. Planting techniques, creep and block rubber production, specification test of creep and block rubbers.

## **Unit 5**

### **Synthetic Rubber**

- Synthetic rubber - characteristics of different elastomers, physical and chemical testing - SBR, BR, Nitrile, CR, 11R and reclaimed rubber.



# **PART II- THEORY**

# 1. INTRODUCTION TO NATURAL RUBBER

---

---

## Introduction

Rubber is the most versatile and strategic material known to mankind both on account of its range of application in everyday life, defence and civilian purposes and its behaviour under the most diverse conditions of application. The percapita consumption of rubber is treated as an indicator of development of a country. It is the most important agriculture crop and our state's annual production is about 7 lakhs, Metric Tons which is 95% of the production in India. In this unit we discuss the fascinating history of origin, propagation and commercial plantations through group activities. We also discuss the current statistics of production and consumption of natural resources and compile them with active participation of students which rivets their intrinsic interest to the significance of NR.

## Curriculum Objectives

- To get a clear picture about the origin and propagation of rubber tree with special mention to *Hevea Brasilenis* through discussion, chart, display and reference
- To understand the commercial sources of NR and present statistics through data collection, internet, discussion and charts

## Syllabus (5 hours)

- Historical development of *Hevea Brasiliensis* into commercial source of NR, Present production pattern - World statistics - Indian statistics

## 1.1 Origin and Propagation of Natural Rubber

### Activity 1.1.1 Chart Display

- Teacher display the picture of Columbus and map showing the route through which natural rubber came to India.
- Teacher write some points about history of plantations on the blackboard by raising some questions to the whole group.
- Since the data are insufficient the topic is given for discussion in small groups.

### **Consolidation**

- Contribution of Columbus
- Origin of NR

### **Product**

- Chart
- Student's Diary
- Discuss whether the developed power is completely transferred to the output shaft.
- If not, what happens to the developed power.

#### Activity 1.1.2 Discussion

- Students are divided into small groups
- Students are allowed to discuss the history of NR in groups, with the help of textbook and handouts
- A write up is prepared by each group
- Presentation of write up by each group
- Teacher validates the discussion points

### **Consolidation**

- Introduction to Hevea Brasilensis
- Experimental planting at Kew Garden UK and Tropical Asia
- Role of Sir.Henry Wickhalm and Joseph Priestly
- Early plantations in Kolkatta, Nilambur and Thattekad
- Large scale plantation in India

### **Product**

- Write up

## **1.2 Commercial Sources of Natural Rubber**

#### Activity 1.2.1 Data Collection

- The teacher issues recent journals to the students
- Collect the data regarding commercial source of NR and present statistics of production and consumption
- The teacher concludes the above data

### **Consolidation**

- Statistics of present production and consumption of NR

- Commercial sources of NR

### **Product**

- Chart

#### Activity 1.2.2 Discussion

- Students are divided into small groups
- They are allowed to discuss the production, consumption and demands of NR, with the help of handouts and journals

### **Consolidation**

- Graphic representation of present production and consumption

### **Product**

- Table containing present statistics of production, consumption and future demands.

### **Reference**

- NR Handbook by RRII Kottayam
- Handbook of Rubber Technology by Steven Blow
- Rubber Asia
- Rubber and its cultivation published by the Rubber Board

**UNIT ANALYSIS - UNIT 1**  
**INTRODUCTION TO NATURAL RUBBER**

Curriculum Objectives	Ideas/ Concepts	Skills	Activity	Materials	Products	Evaluation
1.1 To get a clear picture about origin and propagation of rubber tree with special mention of Hevea Brasileniss through discussion, chart, display and reference	Contribution of Columbus Introduction of Hevea Brasileniss Experimental planting at Kew Garden & Tropical Asia Role of Henry Wickhalm & Joseph Priestly Early plantations in Calcutta, Nilambur and Thattakadu Large scale plantations in India	Observing Communicating Interpreting Inferencing	Chart Display Discussion Chart Display Reference	Charts Books	Chart Diary Write up Data sheets	Active participation Write up data sheet
1.2 To understand the commercial sources of NR and present statistics, through data collection, internet discussion and charts	Graphic representation of present production and consumption Commercial sources of NR	Observing Communicating Interpreting Predicting	Data collection Chart preparation Discussion	Journals	Charts Tables	Authenticity of data Observation skills

## 2. RUBBER PLANTATIONS

---

### Introduction

The rubber tree is a sturdy, quick growing tall tree and grows on well drained soil. A warm humid equable climate (21-35°C) and a fairly distributed rainfall of not less than 200 cm is necessary for the optimum growth of the tree. Though the rubber tree is originated in the forests of Brazil now a days it is cultivated in wide spread plantation areas. Many techniques like germination, cloning, grafting etc. are used for the propagation of rubber tree. In India agricultural researches have fetched fruitful results in this area. The clone like RR11-105, RR11-108, RR11-308, RR11- 414 etc. developed by the Rubber Research Institute of India have proven records of cultivation and yield. In this unit students can acquire adequate knowledge about the clones and propagation methods. Preliminary information of plantation management, cover cropping, manuring, pest control etc. are also included.

### Curriculum Objectives

- To identify different clones and to familiarise different propagation methods (seedlings, budgrafting, polybag clones) through field trip, chart display, experiment and discussion.
- To get awareness about planting, manuring, plantation maintenance, cover crop and application of fungicides through field trip, charts and discussion

### Syllabus (10 Hours)

- Plantation - Rubber tree - its propagation- planting and plantation maintenance

### 2.1 Plantation Techniques

#### Activity 2 . 1 . 1 Field Visit

- Divide students into small groups
- Field trip is arranged to the nearest nursery and plantation
- Teacher displays a chart showing different clones
- Students interact with farmers to understand the planting techniques

### **Consolidation**

- Palkulam seeds
- RR11 105, RR11 606, RR11 414, GT 1
- Grafting, Polybag clones
- Sequential operation of budgrafting

### **Product**

- Visit report

#### Activity 2 . 1 . 2 Chart

- Students should prepare a chart showing the characteristics and properties of clones
- Also prepare a flow chart showing planting technique

### **Consolidation**

- Technical names of planting materials

### **Product**

- Chart

#### Activity 2 . 1 . 3 Experiment

- Conduct a budgrafting on a one year old rubber plant

### **Consolidation**

- Bud grafting skill

### **Product**

- Budded plant

## **2.2 Plantation Maintenance**

#### Activity 2 . 2 . 1 Chart Display

- Teacher shows a chart containing terracing, set outing, pit formation etc.

### **Consolidation**

- Setouting of land
- Pit formation
- Importance of spacing of plants

### **Product**

- Write up

Activity 2 . 2 . 2 Field Visit

- Arrange a field trip to a new plantation
- Observe the method of planting, manuring, platform making etc.
- Prepare a brief write up

**Consolidation**

- Setouting and preparation of pits
- Plantation maintenance such as platform forming, stem supporting, cover crop establishment

**Product**

- Visit report

Activity 2 . 2 . 3 Discussion

- Group wise discussion is allowed about different types of fungicides and their series of application
- Summarise the discussion points - fungicides, their generic names and trade names

**Consolidation**

- Fresh preparation of fungicides
- Application of fungicides

**Product**

- Write up containing dosage and application techniques

**Reference**

- Rubber and its cultivation published by RRII
- High Polymer Latices (Vol-1) - D.C.Blackely
- Trade Journals of different institutions and companies

**UNIT ANALYSIS - UNIT 2**

**RUBBER PLANTATION**

Curriculum Objectives	Ideas/ Concepts	Skills	Activity	Materials	Products	Evaluation
2.1 To identify different clones and to practice different propagation methods (seedlings, bud grafting, polybag clones) through field trip, discussion, chart display and experiment	Palkulam seeds, RRII 105, RRII 606, RRII414, GTI Grafting, Polybag clones, sequential operations of budgrafting	Observing Experimenting Communicating	Field trip Discussion Chart Experiment	Charts Planting materials Budding knife Polythene sheets and bags	Visit report Budded plant Chart	Class Test
2.2 To create awareness about planting, manuring, plantation maintenance, cover crops and application of fungicides through field trip, observation and discussion	Set outing and preparation of pits Planting Order of manuring Platforming, stem supporting Cover crop Fungicides, application	Observing Communicating	Display of charts Field trip Discussion	Books Charts	Write ups Visit report	Class Test Comprehensiveness of write up

# 3. HARVESTING, PRESERVATION AND MARKETING OF CROPS

---

---

## Introduction

NR Latex is a peculiar crop harvested round the year after the maturation of tree. The latex is extracted from the bark of the rubber tree by controlled wounding. This latex is highly susceptible to degradation which is a challenge for the storage till its further steps of processing. This necessitates the preservation of latex during storage for a longer time. Then it is converted into different marketable forms for easy transportation and product manufacture. By virtue of field visit included in this unit students are able to conceive the ideas of crop extraction, preservation storage and processing. This unit also covers the chemical composition, coagulation aspects and marketable forms of Natural Rubber.

## Curriculum Objectives

- To conceive the ideas about rubber tapping devices, tapping methods, tapping task, tapping rest through field visit, discussion and assignment
- To conceive basic concepts of collection of latex and field coagulum through field visit and discussion
- To list out the chemical composition of NR latex through reference, experiment and seminar
- To get an awareness about transportation, coagulation, spontaneous coagulation and storage of latex through field visit and discussion
- To get a clear idea about latex preservation systems through reference, discussion and experiment
- To get an awareness about the preparation of different NR marketable forms such as Cenex, Sheets, block rubber, creep and to make RMA grades through specimen collection, field visits, experiments, reference and group discussion

## Syllabus (20 Hours)

- Rubber tapping, collection of latex, composition of latex, transportation and storage of crop
  - preservation of latex - processes of latex into marketable forms, RSS, ADS crepe, crumb
  - grading of rubber

### 3.1 Tapping

#### Activity 3 . 1 . 1 Field Visit

- Students are divided into groups
- Assign work to each group
- Tapping devices, tapping methods
- Summarise the field visit report

#### Consolidation

- marking of trees
- tapping of angle and direction
- observing knives, spout, cup hangers, cups, buckets and drums and rain guarding
- slaughter tapping and ladder tapping

#### Product

- Visit Report

#### Activity 3 . 1 . 2 Display

- Teacher displays the template and tapping knives for marking rubber trees
- Students prepare a list of tools and utensils used for crop extraction mentioning its uses

#### Consolidation

- Template marking
- Michie Golledge
- Jebong
- Gouge Chisel
- Tapping shields

#### Product

- List of tools and utensils, for tapping

#### Activity 3 . 1 . 3 Discussion

- Teacher assists the students to discuss the topic of intensive tapping, puncture tapping, tapping task and tappability
- s/2, d/2, ABCD panels
- tapping rest
- factors affecting yield
- summarise the discussion points

### **Consolidation**

- Tappability
- s/2, d/2
- ABCD Pandz
- Intensive tapping
- Puncture tapping
- Tapping task
- Tapping rest
- CUT (Cut Up.....Tapping)

### **Product**

- Write up

#### Activity 3 . 1 . 4 Audio Visual Aids

- C.Ds of different tapping methods, template marking, rain guarding are shown
- Issue print outs to groups

### **Consolidation**

- Methods of tapping
- Template marking
- Rain guarding

### **Product**

- Print out

## **3.2 Crop Collection**

#### Activity 3 . 2 . 1 Field Visit

- Students are divided into groups
- A trip to the nearest field is to be arranged
- Observe the collection methods of latex and field coagulum
- Summarise the visit report

### **Consolidation**

- Factors affecting yield
- Collection of latex, treelace, cuplump earth scrap

### **Product**

- Visit report

Activity 3 . 2 . 2 Discussion

- Divided into groups
- Classification of field coagulum rubber based on purity
- Summarise the discussion points

**Consolidation**

- Collection of latex, treelace, cuplump, earth scrap

**Product**

- Write up of discussion points

**3.3 Constituents of Natural Rubber Latex**

Activity 3 . 3 . 1 Reference

- Students are asked to prepare write up about chemical composition of NR latex

**Consolidation**

- Constituents of latex, different phases of latex

**Product**

- Write up, regarding chemical composition of latex

Activity 3 . 3 . 2 Experiment

- Conduct an experiment to determine the chemical constituents of the latex, in groups.
- TSC, DRC and NRC are recorded
- Measure the physical property of latex
- Teacher evaluates the results

**Consolidation**

- Constituents of latex
- Properties of latex such as viscosity, special gravity etc.

**Product**

- Record

Activity 3 . 3 . 3 Seminar

- Conduct a seminar by a selected student regarding the chemical composition of latex
- Percent of chemical constituents
- Teacher summarise the seminar report

### **Consolidation**

- Constituents of latex

### **Product**

- Seminar report

## **34 Storage of Latex**

### Activity 3 . 4 . 1 Field Visit

- Students are divided into groups
- Arrange trip to a large plantation
- Spontaneous coagulation due to micro organisms
- Precaution
- Storage of latex

### **Consolidation**

- Precaution in transportation and storage of latex
- Effect of micro organisms
- Use of anticoagulants

### **Product**

- Field visit report

### Activity 3 . 4 . 2 Discussion

- Students are divided into groups
- What are the precautions to be taken for transportation and storage of latex? Give details.
- Destabilisation - reasons and remedies
- Discussion points are concluded, and present in the class by group leaders

### **Consolidation**

- De stabilisation
- Anti coagulants
- Storage, effect and microorganisms

### **Product**

- Discussion write up

### 3.5 Latex Preservation

#### Activity 3.5.1 Reference

- Students are advised to refer relevant books and make brief notes on preservation systems, its necessity, effect of  $\text{NH}_3$ , significance of different preservation systems

#### Consolidation

- Necessity of preservation
- Effect of  $\text{NH}_3$
- Significance of different preservation systems

#### Product

- Write up

#### Activity 3.5.2 Discussion

- It is preferable to discuss the following matters in groups
- Requisites of an ideal preservative
- Effect of ammonia
- Conclude the discussion points and prepare a write up

#### Consolidation

- Requisites of an ideal preservative
- Effect of ammonia

#### Product

- Write up

#### Activity 3.5.3 Experiment

- Conduct an experiment to determine ammonia content of preserved field latex in the laboratory

#### Consolidation

- Ammonia content of latex

#### Product

- Record

### **3.6 Marketable forms of Natural Rubber**

#### Activity 3 . 6 . 1 Field Visit

- Arrange a field trip to creep unit and crumb rubber unit
- Allow students to collect data from experts there
- Based on above data, draw flow charts of creep rubber production

#### **Consolidation**

- Manufacturing process of ISNR, grades
- ADS
- PLC
- EBC
- Bleaching, Preferential coagulation
- Castor oil, fungicides (Para nitro phenol)

#### **Product**

- Field visit report and Flow chart

#### Activity 3 . 6 . 2 Experiment

- Teacher demonstrates preparation of RSS
- Students prepare a write up containing different steps of RSS manufacture

#### **Consolidation**

- RSS manufacture

#### **Product**

- Write up

#### Activity 3 . 6 . 3 Reference

- Prepare write ups on concentrated latex, Green Book, Grading of ISNR and RSS

#### **Consolidation**

- Concentrated Latex
- Green Book
- Grading of ISNR and RSS

#### **Product**

- Write up

Activity 3 . 6 . 4 Group Discussion

- Divide students into small groups
- Discuss the grading of block rubbers
- RSS
- Summarise the discussion points and present in the class

**Consolidation**

- Grading of Block rubber
- Grading of RSS
- Green Book

**Product**

- Write up

**Reference**

- Handbook of Rubber Technology by Steven Blow
- Green Book
- Rubber and its cultivation by RRII
- NR Handbook by RRII

**UNIT ANALYSIS - UNIT 3**  
**HARVESTING, PRESERVATION AND MARKETING OF CROPS**

Curriculum Objectives	Ideas/ Concepts	Skills	Activity	Materials	Products	Evaluation
3.1 To conceive the ideas about rubber tapping, tapping devices, tapping task, tapping rest through field visit, discussion, assignment and audiovisual aids	Tappability Marking of trees Template marking Tapping angle and direction Operational definition Knives, spout, cup hangers, cups, buckets, drums s/2, d/2, panels (A, B, C, D) Intensive tapping Slaughter tapping Ladder tapping Puncture tapping Tapping task Factors affecting yield Tapping rest Rain guarding	Observing Communicating Making of operational definition	Field visit Display Discussion Audiovisual aids	Tapping knives Chart Template Books Computer	Write ups Operational definition Visit report Printout List of tapping materials	Assignment Quiz Write-up
3.2 To conceive basic concepts of collection of latex and field coagulum through field visit and discussion	Collection of latex, treelace, cup lump, earth scrap	Observing Communicating	Field visit Discussion	Books	Visit report Write up	Viva voce Comprehensiveness of write up

Curriculum Objectives	Ideas/ Concepts	Skills	Activity	Materials	Products	Evaluation
3.3 To list out the chemical composition of NR latex, through reference, experiment and seminar	Constituents of latex Properties of latex TSC, DRC, NRC Different phases	Measuring Communicating Inferring	Reference Experiment Seminar	Latex samples, beaker, Petridish Acid - Handroller Oven Chemical balance	Record Seminar report Write up	Accuracy Clarity of seminar
3.4 To create an awareness about transportation, coagulation, spontaneous coagulation, and storage of latex through field visit, discussion	Precaution in transportation of latex Effect of microorganisms Destabilisation Anticoagulants Storage	Observing Communicating	Field visit Discussion	Books Latex Sample	Write ups Record	Class test Viva-voce
3.5 To get a clear idea about latex preservation systems through reference, discussion and experiment	Necessity of preservation Effect of NH <sub>3</sub> Requisites of an ideal preservative Significance of different preservation system	Observing Communicating Experimenting	Reference Discussion Experiment	Books Preservatives Latex	Write up Record	Class test Write up
3.6 To create an awareness about the preparation of different NR marketable forms such as Cenex, sheets, Block rubbers, crepe and to make RMA grades through specimen collection, field visit, experiment, reference and group discussion	Concentrated latex RSS Green Book Grading Fungicides ISNR ADS PLC EBC Bleaching Preferential coagulation Anti-crumbing agents	Observing Communicating Classifying Controlling variables Experimenting	Field visit Experiment Reference Group Discussion	Books Flow chart Samples Latex Aluminium Dish Acid Sieve	Visit report Write up Flow charts RSS	Comprehensiveness of Visit Report Quality of RSS Clarity of Flow chart

# 4. LATEX CONCENTRATION

---

## Introduction

Natural Rubber Latex exudes from the tree with a dry rubber content of 30-40%. It is therefore uneconomical to transport preserved field latex over large distances. The usual procedure is to concentrate it to about 60% DRC. Moreover many important latex products can only be manufactured from concentrated latex. Latex concentrates are of uniform quality and have a higher degree of purity. This unit contains various technical aspects of latex concentration processes. The proposed visit to the latex concentration units will give a clear idea about the processes and methods and quality parameters of latex concentrate.

## Curriculum Objectives

- To familiarise different concentration methods viz - creaming, centrifuging, evaporation and electro decantation through field visit, specimen collection, experiment, seminar and audio visual aids.
- To familiarise preservation systems involved in the concentrated latex through reference (BIS Standards), seminar and group discussion.

## Syllabus (10 Hours)

- Latex concentration - centrifuging - creaming - preservation of latex.

### 4.1 Latex Concentration

#### Activity 4 . 1 . 1 Field Visit

- Students are divided into groups
- Assign work to each group
- Centrifuging process
- Skim rubber preparation
- Conclude the field visit report

### **Consolidation**

- Justification of latex concentration
- Stoke's Law
- Centrifuging
- Skim rubber
- Specification parameters of Cenex

### **Product**

- Field visit Report

#### Activity 4 . 1 . 2 Project

The facilitator gives a project to small groups regarding

- Preparation of creamed latex, with not less than 60% DRC
- Facilitator evaluate the product-creamed latex and compared with skilled value
- Whether the student build up capacity?

### **Consolidation**

- Creamed latex preparation
- DRC determination, creaming agent, Theory of creaming

### **Product**

- Creamed latex

#### Activity 4 . 1 . 3 Specimen Collection

- Collect specimen of creamed and centrifuged latex
- Determine the DRC of samples

### **Consolidation**

- Creamed Latex
- Centrifuged Latex

### **Product**

- Creamed Latex
- Skim rubber
- Centrifuged Latex

#### Activity 4 . 1 . 4 Audio Visual Aids

- Demonstrate the preparation of Latex concentration methods such as electrodecantation and evaporation
- Issue print outs

### **Consolidation**

- Electrodecantation
- Evaporation, Osmosis

### **Product**

- Print out

## **4.2 Preservation of Latex Concentrate**

### Activity 4.2.1 Group Discussion

- Students are divided into groups
- Give them topic of preservation systems used in concentrated Latex (HA)
- Summarise the discussion points

### **Consolidation**

- HA preservation system
- Dosage
- Alkalinity

### **Product**

- Write up

### Activity 4.2.2 Reference

- Prepare write ups on LAZDC preservative system

### **Consolidation**

- LAZDC Preservative System Dosages

### **Product**

- Write up and Table

### Activity 4.2.3 Seminar

- Give a seminar - LATZ System
- Conclude the seminar report

### **Consolidation**

- LATZ system
- Dosage
- Compare with LAZDC & HA System

### **Product**

- Seminar report

### **Reference**

- Hig Polymer Latices by D.C.Blackely
- Handbook of Rubber Technology by Steven Blow
- NR Handbook by RRII

## UNIT ANALYSIS - UNIT 4 LATEX CONCENTRATION

Curriculum Objectives	Ideas/ Concepts	Skills	Activity	Materials	Products	Evaluation
4.1 To familiarise different concentration methods viz, creaming, centrifuging, evaporation and electrodecantation through field visit, specimen collection, experiments, seminars and audio visual aids	Justification of latex concentration Specification of cenex Stoke's law Theories of creaming Creaming agents Centrifuging Skim rubber Osmosis Electro decantation Factors influencing creaming efficiency	Observing Experimenting Classifying Communicating	Field visit Specimen collection Project Audiovisual aids	Latex Creaming agent Soap Measuring jar H <sub>2</sub> SO <sub>4</sub> Computer Analytical balance	Creamed latex Skim rubber Table Print out	Class Test Table (Dosage - Time) DRC of creamed latex
4.2 To familiarise preservation systems involved in the concentrated latex through reference (BIS std), seminar and group discussion	HA system LAZDC system LATZ system	Communicating Inferring	Group discussion Reference Seminar	Reference books BIS Table	Table Write up Seminar report	Class test Comprehensiveness of write up

# 5. RUBBER COMPOUNDING

---

## Introduction

The mixture of rubber and ingredients used for the manufacture of any rubber product is called 'compound' and the art and science of making such a compound is called compounding. The primary requirement of adding different compounding ingredients to develop a rubber compound is to meet different service needs at an economic price. Optimisation of physical properties is also taken into account. The selection of ingredients and its optimum dosage are of most importance, and requires both skill and knowledge for the successful compounding of rubber. In this unit students classify the different compounding ingredients according to their effects on physical properties of the product and also on the basis of their functions in rubber. On the completion, students will be able to design a rubber compound for a typical product with specified service properties.

## Curriculum Objectives

- To acquire basic concepts of rubber compounding and compounding ingredients through collection of specimen, discussion, project, classification and experiments.
- To conceive the idea of different cross linking systems and curing methods through project, reference and discussion.

## Syllabus (25 Hours)

- Rubber compounding - definition and objectives - compounding - curing agents - accelerators and retarders - age resistors - Zinc oxide - stearic acid - process aids (physical and chemical)- fillers - polishing agents - blowing agents - vulcanising agents - cross linking systems, pigments

## 5.1 Fundamentals of compounding

### Activity 5.1.1 Specimen Collection

- Students are asked to collect samples of compounding ingredients
- Display above items

### Consolidation

- Significance of each ingredient

### Product

- Specimens

#### Activity 5.1.2 Classification

- Students are divided into groups
- Facilitator demonstrates each ingredients functions
- Each groups asked to classify the ingredients according to their functions
- List out each group findings and conclude them.
- Specimen collection

### Consolidation

- Different class of ingredients and their functions.

Activators	:-	Metal oxides and fatty acids
Accelerator	:-	ZDC, MBT, MBTS, CBS, DPG, DOTG, TMT, TMTD, ZMBT, ZDC, Vulcator F
Antioxidants	:-	SP, PBN, TMQ, HSL
Antiozonants	:-	Wax, diamines
Process oils	:-	Aromatic oil, Naphthenic oil
Peptisers	:-	Renacit 7
Fillers	:-	(a) Reinforcing - Carbon Black (HAF, GPF, FEF...) (b) Non - reinforcing - clay, whiting, silica, silicates
Vulcanising agents	:-	sulphur, metal oxides, sulphur bearing chemicals
Special additives	:-	Colour, Blowing agents, factice, flame retardants, antistatic agents etc.

### Product

- Chart
- Specimen

#### Activity 5.1.3 Discussion

- Facilitator discusses some points about designing of compounds
- Facilitator transact the following ideas
- Dosage of each ingredients
- Density - volume relationship

- Undesirable properties of some ingredients
- Summarise the discussion points and prepare a write-up

### **Consolidation**

- Principle of compounding
- Compound design
- Significance of each ingredient

### **Product**

- Write-up

#### Activity 5 . 1 . 4 Experiment

- Conduct experiments to determine purity of chemicals
- Measure density of chemicals
- Facilitator evaluate the record

### **Consolidation**

- Purity of chemical ingredients
- Density of compounding ingredients

### **Product**

- Record

#### Activity 5 . 1 . 5 Project

- Students are divided into groups
- Groups are asked to prepare different rubber compounds for a typical product
- Vulcanise the compound
- Measure the physical properties such as hardness, swelling, specific gravity
- Compare the physical properties of each product
- Prepare a proper report
- Facilitator evaluate this record and assess their building capacity

### **Consolidation**

- Compound designing
- Mixing and curing
- Testing

### **Product**

- Record

## 5.2 Curing System

### Activity 5.2.1 Discussion

- Facilitator gives an idea about different cross linking systems
- Students are divided into groups
- They are asked to discuss the effect of each cross-linking system on rubber
- Summarise the discussion points

### Consolidation

- CV, EV-Semi-EV
- S-bearing, non-S-curing systems

### Product

- Write up

### Activity 5.2.2 Reference

- Reference notes are prepared about different cross linking systems
- Distinguish soft and hard vulcanisate

### Consolidation

- CV, EV, Semi-EV, S-bearing, Non-s- curing system, Dosages of curing agents

### Product

- Write up

### Reference

- Handbook of Rubber Technology by Steven Blow
- Vanderbuilt Rubber Handbook
- Rubber Technology and Manufacture by C.M.Blow
- Introduction to Rubber Technology by Maurice Morton
- Rubber materials by J.A.Brydson

**UNIT ANALYSIS - UNIT 5**  
**RUBBER COMPOUNDING**

Curriculum Objectives	Ideas/ Concepts	Skills	Activity	Materials/ Equipments	Products	Evaluation
5.1 To acquire basic concepts of rubber compounding and compounding ingredients through collection of specimen, discussion, project, classification and experimenting	Principle of compounding Structure and properties of natural rubber Compound design Mixing and curing Significance of each ingredient Purity and density Typical formulation	Observing Classifying Measuring Communicating Making operational definition	Specimen collection Classification Discussion Project Experimenting	Elastomers compounding ingredients Mixing mill Press	Specimen rubber compound Vulcanisate Chart Write up Record	Clarity of chart Class Test
5.2 To conceive the idea of different cross linking systems through reference and discussion	CV EV Semi-EV S-bearing non--S-curing Dosage of curing agents	Observing Communicating	Reference Discussion	Books Periodicals	Write ups	Clarity and comprehensiveness of write up and seminar report

# 6. FIELD CROP PROCESSING MACHINERY

---

---

## Introduction

The crop of rubber tree is obtained in latex form which has limited commercial applications. The field latex is susceptible to degradation due to bacterial action and get coagulated within a short period. The phenomenon necessitates the preservation and further processing of latex. Field coagulams are obtained as tree lace, cup lump and earth scrap which are crude and impure and demands purification for technical perfection. Raw rubber processing is carried out using a number of machines. Latex is processed into concentrated latex and dry rubber forms. Field coagulams are purified and baled using a number of machines. A technical person in the field of rubber technology should be well versed in the working and operations of these machines. This unit deals with the technical aspects and working of machinery for processing of latex field coagulams

## Curriculum Objectives

- To get a clear picture about centrifuging machine for latex concentration, through discussion, reference, field visit and audio-visual aids
- To familiarise the sheeting rollers and batteries for the production of RSS, through field visit, group discussion and audio visual aids
- To develop the concept of machine used for crepe products such as PLC, sole-creep, through field visit, group discussion and reference
- To acquire a deep knowledge of various machineries and equipments used for the production of different grades of block rubber through field visit, reference and audiovisual aids.

## Syllabus (20 Hours)

- Rubber machinery - machinery for production of commercial grades of NR and Latex
  - 1 Centrifugal machine for latex concentration
  - 2 Sheeting rollers and batteries for the production of ribbed smoked sheets
  - 3 Machinery used for creep production
  - 4 Machinery used for production of solid block rubber

## **6.1 Centrifuging Machine**

### Activity 6 . 1 . 1 Discussion

- The facilitator provides some points about the working and parts of centrifuging machine
- Students are divided into small groups
- Group discussion is carried out in each group with the help of handouts and pamphlets
- Presentation of prepared write-ups

### **Consolidation**

- De-Level centrifuging machines and its parts
- Function of bowl, separator, skim screw

### **Product**

- Write up

### Activity 6 . 1 . 2 Reference

- The facilitator provides the details of reference sources
- The students prepare write ups about the parts and functions of parts of the centrifuging machine
- The write ups are scrutinized by the facilitator

### **Consolidation**

- De-Level Centrifuging machine parts
- Function of parts of centrifuging machine
- Efficiency of centrifuging machine

### **Product**

- Write up

### Activity 6 . 1 . 3 Field Visit

- Obtain the prior permission to visit a centrifuging unit
- The facilitator provides hints and points to be noted during the visit
- Students prepare visit report
- Facilitator validate the report

### **Consolidation**

- De - level centrifuging machines and its parts
- Bowl, separators, feed mechanism, skim screw, ball mill

- Serum treatment
- Up keeping of centrifuging machine
- Safety measures

### **Product**

- Visit report

## **6.2 Sheeting Rollers**

### Activity 6 . 2 . 1 Field Visit

- Facilitator gives some hints and points to be noted in the field visit
- Conduct a field trip to nearest sheeting battery
- Students prepare a field visit report
- Report is validated by the facilitator

### **Consolidation**

- Production of RSS
- Sheeting batteries

### **Product**

- Visit report

### Activity 6 . 2 . 2 Audio Visual Aids

- Exhibition of video clippings/ CDs of RSS manufacturers
- Students prepare short notes/ printouts

### **Consolidation**

- Production of RSS
- Sheeting batteries

### **Product**

- Printout/ short notes

### Activity 6 . 2 . 3 Group Discussion

- Divide students into small groups
- Groups are asked to discuss the production of RSS
- Sheeting batteries and its advantages
- Summarise the discussion points

### **Consolidation**

- Sheeting rollers
- Sheeting batteries
- Accessories

### **Product**

- Write up

## **63 Crepe Mills**

### Activity 6 . 3 . 1 Field Visit

- Facilitator gives hints about the points to be noted
- Conduct a field trip to a nearest crepe mill
- Students prepare a visit report
- Report is validated by the facilitator

### **Consolidation**

- Coagulation tanks, soaking tanks
- Crepe mills
- Macerators
- Bailing press

### **Product**

- Visit report

### Activity 6 . 3 . 2 Group Discussion

- Students are divided into small groups
- Give them the topic and points to be noted about the machines used in the crepe production
- Summarise the discussion points

### **Consolidation**

- Different type of tanks
- Crepe mills
- Macerators
- Safety precautions

### **Product**

- Write up

## 64 Machinery for Block Rubber Production

### Activity 6 . 4 . 1 Field Visit

- Obtain prior permission to visit a solid block rubber factory
- Conduct a field visit to the nearest crumb rubber unit
- Students are asked to prepare about the working principle, parts and up keeping of machinery and equipment to solid block rubber
- Validation of the report by the facilitator

### Consolidation

- Soaking tank, washing tank, coagulation tank
- Macerator
- Hammer mill
- Chopper
- Drying chamber
- Baling press, weighing balance

### Product

- Visit report

### Activity 6 . 4 . 2 Reference

- The facilitator provides the details of reference sources
- Students prepare a write up containing the details of machinery for solid block rubber production
- The write ups are scrutinised by the facilitator

### Consolidation

- Different type of tanks
- Macerator, parts
- Hammer mill - parts
- Drying chamber - Temperature control
- Bailing press - operation

### Product

- Write up

Activity 6 . 4 . 3 Audio visual exhibition

- Exhibition of video clippings/ CDs related to the solid block rubber manufacture
- Students prepare short notes/ print outs

**Consolidation**

- Working and parts of machinery for solid block rubber
- Safety devices
- Accessories

**Product**

- Print out/ short notes

**Reference**

- Rubber Technology and Manufacture by C.M.Blow
- Polymer processing - Philip Freikley
- Rubber Technology and Manufacture by Anil Boomic
- Natural rubber Handbook by RRII

## UNIT ANALYSIS - UNIT 6

### FIELD CROP PROCESSING MACHINERIES

Curriculum Objectives	Ideas/ Concepts	Skills	Activity	Materials	Products	Evaluation
6.1 To get a clear picture about centrifuging machine for latex concentrate through discussion, reference, field visit	De-Level Centrifuging machine and its parts Function of bowl separator, skim screw Feeding mechanism Efficiency of centrifuging Ball milling Serum treatment	Observing Communicating Inferring	Discussion Reference Field visit	Books Diagrams	Visit report	Class test Clarity
6.2 To familiarise the sheeting rollers and batteries for the production of RSS through field visit, group discussion and audio visual aids	Sheeting Roller Sheeting Battery Production of RSS	Observing Communicating	Field visit Group discussion Audio visual aids	Books Diagrams Computer	Visit report Print out	Class test Viva-voce
6.3 To develop the concept of machines used for creep production such as PLL, sole creep, off grade creep through field visit, group discussion and reference	Coagulation tanks Soaking tanks Creep mills Maceration Baling press	Observing Communicating	Field visit Group discussion	Books Diagrams	Visit report Write up	Class test Visit report
6.4 To acquire a deep knowledge of various machineries and equipments used for the production of different grades of block rubber through field visit, reference and audio visual aids	Soaking tanks Coagulation tanks Macerator Hammer mill Chopper Washing tanks Drying chamber Baling press Weighing balance	Observing Communicating	Field visit Reference Audio visual aids	Books Diagrams Computer	Visit report Write up Print out	Class test Visit report

# 7. RUBBER PROCESSING MACHINERIES

---

---

## **Introduction**

Majority of rubber products are manufactured from dry rubber. These include a variety of products ranging from huge earth mover tyres to tiny o-rings and valves. Dry rubber in its crude form is of nil use. But it can be compounded with ingredients and into desirable forms and specific applications. For compounding of rubber its viscosity should be lowered by applying stress and shear forces. The most common machinery used for this purpose are internal mixers and open mills. Incorporation of compounding ingredients is also carried out using these machines. The compounds are of plastic nature and can be shaped into different forms using machines like extruders, calenders, dies etc. The compound is vulcanised in curing equipments. Tyres and moulded items are cured in moulds placed in curing presses in which shaping is also effected. Machinery for rubber mixing, compounding, and curing are of much importance and significance. In this unit we describe the technical details, operations and working of rubber processing machinery. Much emphasis is given to the various safety precautions of operation for the safe and effective practices in rubber machinery.

## **Curriculum Objectives**

- To acquire a deep knowledge about various type of mixing mill through assignments and group discussion
- To acknowledge the principle of working of Banbury, Intermix, Kneader, through field visit, reference, group discussion and internet
- To get a clear idea of calenders used for sheeting and coating through chart and group discussion
- To familiarise the working and components of extruder through field visit, group discussion and reference
- To acknowledge the parts and working of various moulding presses through reference and assignment
- To get an idea about spreading machine for rubber coating to substrate through reference and assignments

- To get an idea about solution mixer, through seminar and group discussion
- To get a clear picture of vulcaniser through field visit and assignment

### **Syllabus (20 Hours)**

- Basic Rubber Machineries
  - (i) Various types of mixing mill
  - (ii) Internal mixers
  - (iii) Calenders
  - (iv) Extruders
  - (v) Moulding presses - hydraulic and hand operated
  - (vi) Spreading machine
  - (vii) Solution mixer
  - (viii) Vulcanizers

### **7.1 Mixing Mills**

#### Activity 7.1.1 Reference

- The facilitator provides the details of reference sources
- Students prepare a write up containing the details of various types of mixing mill, their parts, functions of each component, mill accessories
- The write ups are scrutinised by the facilitator

### **Consolidation**

- Open mixing mill
- Refiner mill
- Cracker mill
- Strip mill
- Friction ratio
- Nip
- Reduction gear
- Mill accessories

### **Product**

- Write up and sketches

Activity 7 . 1 . 2 Group Discussion

- Students are divided into small groups
- Give them the topic and points to be noted about safety devices of mixing mills, friction ratio, mill accessories, size of the mill
- Summarise the discussion points

**Consolidation**

- Safety devices
- Mill accessories
- Friction ratio
- Reduction gear
- Size of the mill

**Product**

- Write up

Activity 7 . 1 . 3 Assignment

- Students are asked to prepare an assignment regarding cooling systems of open mixing mill
- The assignment should contain a schematic diagram of cooling arrangement of cooling arrangement of mill rolls
- The assignments are scrutinised by the facilitator

**Consolidation**

- Cooling systems of open mixing mill
- Diagram of cooling arrangement of mill rolls

**Product**

- Write up

Activity 7 . 1 . 4 Assignment

- Students are asked to prepare an assignment of various parts of an open mixing mill with a neat sketch

**Consolidation**

- Various parts of mixing mill
- Neat sketch of open mixing mill
- Location of accessories

### **Product**

- Diagram

## **7.2 Internal Mixers**

Activity 7.2.1 Internet

- Provide the website of various manufacturers of Banbury, Intermix and Kneader
- Students are asked to get the printout about the technical specifications of above machineries

### **Consolidation**

- Banbury parts
- Size of Banbury
- Rotor and Chamber and drop door
- Intermix parts
- Kneader parts

### **Product**

- Print out

Activity 7.2.2 Reference

- The facilitator provides the details of reference sources
- Students prepare a detailed write up about the working of Banbury, Intermix, Kneader, advantages of Banbury over mixing mill
- The write ups are scrutinised by the facilitator

### **Consolidation**

- Comparison between Banbury and Open mixing mill
- Fill factor
- Rotor
- Ram
- Chamber
- Size
- Intermix
- Kneader

### **Product**

- Write up

Activity 7 . 2 . 3 Field Visit

- Arrange a field trip to a major rubber company
- Students are divided into groups
- Students are advised to communicate with technical experts to conceive the technical know-how of Banbury working principle of intermix and kneader
- Prepare a process flow chart of each machine

**Consolidation**

- Banbury - parts
- Working of Banbury, Intermix and Kneader, Batch weight
- Drop door, mixing techniques
- Reduction gear, safety devices

**Product**

- Factory visit report and Process flow chart

Activity 7 . 2 . 4 Group Discussion

- Divide into several groups
- Allow to discuss the topic - comparison between banbury and open mixing mill
- Speed, direction, shape of rotors
- Ram pressure, capacity, cycle time etc. to be discussed by each group
- Facilitator summarise the discussion points

**Consolidation**

- Comparison between banbury and open mixing mill
- Speed, direction and shape of rotor
- Ram pressure, capacity, cycle time

**Product**

- Write up

**7.3 Calenders**

Activity 7 . 3 . 1 Chart

- Exhibit a chart showing different types of calenders with accessories and calendering processes
- Students are asked to prepare a diary with a neat sketch

### **Consolidation**

- Types of calenders
- Parts of calenders
- Calendering of sheeting processes

### **Product**

- Write-up

#### Activity 7 . 3 . 2 Field Visit

- Facilitator gives the hints about the points to be noted during visit
- Conduct a field visit to a nearest rubber factory
- Students prepare a visit report of calender - sheeting, coating etc.

### **Consolidation**

- Types of calenders
- Parts
- Nip adjustment
- Sheeting, coating

### **Product**

- Visit report

#### Activity 7 . 3 . 3 Group Discussion

- Divide students into small groups
- Groups are asked to discuss the roll cambering, cooling and heating systems of calender roll, nip adjustment, size of calender, speed and direction of rolls.
- Each group is asked to present their conclusion
- Summarise the discussion points

### **Consolidation**

- Various parts of calenders and their function
- Size of roll
- Roll cambering
- Nip adjustment
- Heating and cooling arrangement

### **Product**

- Write up

## **7.4 Extruders**

### Activity 7 . 4 . 1 Reference

- The facilitator provides the details of reference sources
- The students prepare write up about components of extruder
- Types of extruder - hot feed and cold feed
- L/D ratio
- Accessories and attachments
- The write ups are scrutinised by the facilitator

### **Consolidation**

- Hot feed and cold feed extruders
- Parts, size, accessories
- Cooling system
- L/ D ratio
- 
- 

### **Product**

- Write-up

### Activity 7 . 4 . 2 Field Visit

- Obtain the prior permission to visit a rubber extrusion unit
- The facilitator provides hints and points to be noted during the visit
- Allow students to collect technical data from technical persons
- Students should prepare a visit report
- Facilitator valuate the report

### **Consolidation**

- Extruder machine and its vital parts
- Power transmission through reduction gear
- Heating and cooling provision
- Accessories
- Extruder attachments such as conveyor belts

### **Product**

- Visit report

Activity 7 . 4 . 3 Group Discussion

- Students are divided into several groups
- Give the topic L/D ratio, flight volume of screw and different dies
- Group leaders are asked to present their concluded points
- Summarise the discussion points

**Consolidation**

- L/D ratio
- Flight volume
- Different dies

**Product**

- Write up

**7.5 Moulding Presses**

Activity 7 . 5 . 1 Reference

- The facilitator provides the details of reference sources
- The students prepare write ups about the moulding presses - hand operated and hydraulic
- Size, daylight, hydraulic pressure system
- The write ups are scrutinised by the facilitator

**Consolidation**

- Moulding presses - hand operated and hydraulic
- Size, daylight, hydraulic pressure system, Ram pressure

**Product**

- Write-up

Activity 7 . 5 . 2 Assignment

- Students are asked to prepare and submit an assignment about heating systems, steam heating and electrical heating, thermal fluid heating
- Validate the assignment

**Consolidation**

- Heating system of moulding presses
- Steam heating and electrical heating
- Thermal fluid heating

## **Product**

- Assignment

## **7.6 Spreading Machines**

Activity 7 . 6 . 1 Reference

- The facilitator provides the details of different sources
- Students prepare a write up containing the details of spreading machine and its vital parts, functions etc.
- The write ups are scrutinised by the facilitator

## **Consolidation**

- Principle of spreading operation
- Spreading machine
- Schematic diagram
- Doctor's blade
- Speed of machine
- Hood (extraction unit)

## **Product**

- Write-up

Activity 7 . 6 . 2 Assignment

- The students are asked to prepare and submit an assignment about wind up mechanism of spreading machine with a schematic diagram
- Facilitator validates the assignment

## **Consolidation**

- Speed and wind up mechanism of spreading machine
- Schematic diagram

## **Product**

- Assignment and diagram

## **7.7 Solution Mixer**

Activity 7 . 7 . 1 Seminar

- Given a topic for seminar
- Solution mixer
- Summarise the seminar report

### **Consolidation**

- Solution mixer
- Z blade container
- Stirrer
- Rubber cement

### **Product**

- Seminar report

#### Activity 7 . 7 . 2 Group Discussion

- Students are divided into small groups
- Discuss the topic of working of solution mixer for the preparation of adhesives
- Summarise the discussion points

### **Consolidation**

- Working of solution mixer
- Z-blade container
- Stirrer

### **Product**

- Write up

## **7.8 Autoclaves**

#### Activity 7 . 8 . 1 Field Visit

- Obtain prior permission for visit to a rubber unit where steam curing method used
- The facilitator provides hints and points to be noted during the visit and converse with experts to get technical know how of working of vulcanisers
- Students prepare visit report
- Facilitator validates report

### **Consolidation**

- Size capacity and closing mechanism of vulcanisers
- Pressure gauge
- Heat insulation

### **Product**

- Visit report

Activity 7 . 8 . 2 Assignment

- Give the topic about steam generating devices for vulcanisers such as boiler
- Facilitator validates the assignment

**Consolidation**

- Steam generation and circulation
- Furnace fuels
- Pressure gauge
- Temperature control

**Product**

- Assignment

**Reference**

- Handbook of Rubber Technology by Steven Blow
- Rubber Technology and Manufacture by C.M.Blow
- Vanderbilt Rubber Handbook

## UNIT ANALYSIS - UNIT 7

### RUBBER PROCESSING MACHINERIES

Curriculum Objectives	Ideas/ Concepts	Skills	Activity	Materials	Products	Evaluation
7.1 To acquire a deep knowledge about various types of mixing mills, through assignments, and group discussion	Open mixing mill Refiner mill Cracker mill Strip mill Friction ratio Nip, reduction gear Safety devices Mill accessories Cooling system	Observing Communicating	Reference Group discussion Assignment	Books Brochures	Sketch Assignment Write up	Class test Clarity of assignment
7.2 To acknowledge the principle of working of Banbury, Intermix and Kneader through field visit, reference, group discussion and internet	Advantage of banbury over open mixing mill. Fill factor Roton, Ram chamber, drop door, size of Banbury, major suppliers in termix parts kneader parts cycle time	Observing Communicating	Field visit Charts Group discussing	Books Chart Internet	Visit report Write up Diagram	Write up
7.3 To get a clear idea of calenders used for sheeting and coating through charts and group discussion	Types of calenders parts, size Cambering Nip adjustment Cooling and heating system	Observing Communicating	Field visit Charts Group discussing	Books Chart Internet	Visit report Write up Diagram	Write up

Curriculum Objectives	Ideas/ Concepts	Skills	Activity	Materials	Products	Evaluation
7.4 To familiarise the working and components of extruder through field visit, group discussion and reference	Hot feed and cold feed Parts Size, accessories Cooling L/D ratio	Observation Communicating Interpreting	Field visit Group Discussion Reference	Books Internet Chart	Visit report Write up Reference note	Class test Write up
7.5 To acknowledge the working and parts of various moulding processes, through references and assignments	Screw press Hydraulic press Parts Day light Size and capacity Heating devices	Observation Communicating	Reference Assignment	Computer Books Journals	Write up Assignment	Write up Clarity
7.6 To get an idea about the spreading machinery for rubber coating to substrate through reference and assignment	Principle of spreading Parts Doctor's blade Speed Wind up Mechanism Hood	Observation Communicating	Reference Assignment	Books Computer Diagram	Write up Print out Schematic diagram Assignment	Write up
7.7 To get an idea about solution mixer through seminar and group discussion	Z blade container Stirrer Rubber adhesives	Observing Communicating	Group discussion Seminar	Books Computer Diagram	Write up Print out	Write up
7.8 To get a clear picture of vulcaniser through field visits and assignment	Size, closing mechanism Pressure gauge Heat insulation Steam	Observing Communicating	Field visit Assignment	Books Computer	Write up Print out	Write up Class test

# 8. SYNTHETIC RUBBER

---

## Introduction

The development of transport industry necessitated huge quantity of rubber world wide. The production of NR is limited as the cultivable lands are comparatively less. Moreover the second world war cut the supply lines of NR to Europe. The strategic importance of this raw material compelled the technologists in developed countries produced alternative rubber in adequate quantities. Germany succeeded in the attempt and produced Buna - S which is a copolymer of Styrene and Butadiene. Since then many rubbers were developed by polymerising different petroleum by-products. Nowadays numerous synthetic rubbers are available with special characteristics and applications. Synthetic rubbers quantify almost double that of NR.

In this unit we discuss the monomers, production techniques, properties and application of synthetic rubber.

## Curriculum Objectives

- To familiarise the general structural properties compounding and application such as SBR, PBR, IR, CR, NBR and comparison between NR and SBR through discussion, classification, reference and project

## Syllabus (15 Hours)

- Synthetic rubber - SBR - manufacturing process - comparison of properties of SBR with NR - compounding of SBR. Manufacture, compounding properties and application of polybutadiene, Butyl, Nitrile and CR.

## 8.1 Synthetic Rubber - Structural Properties and Application

### Activity 8 . 1 . 1 Reference

- The facilitator provides the details of reference sources
- The student prepare write up about structure, properties and application of synthetic rubbers of the following: SBR, PBR, IIR, CR and NBR
- The write ups are scrutinised by the facilitator

### **Consolidation**

- Monomer
- Polymer chains
- General properties
- Compounding and application

### **Product**

- Write up

#### Activity 8 . 1 . 2 Classification

- Students are asked to classify the synthetic rubbers based on the properties and applications. (General and special purpose)
- Students are asked to classify synthetic rubbers based on different curing systems used.
- Facilitator validates the classified table

### **Consolidation**

- General purpose and special purpose elastomers
- S-curing elastomers
- Metal oxide elastomers
- Peroxide curing rubber
- Resin curing rubber

### **Product**

- Table

#### Activity 8 . 1 . 3 Discussion

- The facilitator provides some points about comparison of NR with SBR based on compounding, properties and application
- Students are divided into groups
- Group discussion is carried out in each group with the help of handouts and pamphlets
- Presentation of prepared write ups
- Summarise the discussion points

### **Consolidation**

- Comparison of SBR with NR based on compounding properties and application

### **Product**

- Write up

**Reference**

- Synthetic Rubber - Their Chemistry and Technology by D.C.Blackley
- Handbook of Rubber Technology by Steven Blow
- Vanderbilt Rubber Handbook
- Rubbery materials by J.A.Brydson

**UNIT ANALYSIS - UNIT 8**

**SYNTHETIC RUBBER**

Curriculum Objectives	Ideas/ Concepts	Skills	Activity	Materials	Products	Evaluation
8.1 To familiarise general structural properties, compounding and application of synthetic rubbers such as SBR, PBR, IIR, CR, NBR and comparison between NR and SBR through discussion, classification and reference	<p>Monomer</p> <p>Polymer chain</p> <p>General properties</p> <p>Compounding</p> <p>Applications</p> <p>Comparison between NR and SBR</p> <p>Sulphur curing</p> <p>Metal oxide curing</p> <p>Resin curing</p>	<p>Observing</p> <p>Classifying</p> <p>Inferring</p>	<p>Discussion</p> <p>Reference</p> <p>Classification</p>	<p>Books</p> <p>Periodicals</p> <p>Internet</p> <p>Rubber specimen</p>	<p>Write up</p> <p>Table</p>	<p>Write up</p> <p>Table</p>

# 9. RECLAIMED RUBBER

---

## Introduction

One of the major problems that modern world faces is the enormous amount of wastes heaping daily and its management. Rubber wastes which are not biodegradable are also of considerable quantity. Since they remain non degradable for years, they cause severe ecological impacts. Worn out automobile parts and tyres are the biggest class of rubber waste. In this context recycling of rubber waste is much relevant on both ecological and economical reasons. Rubber wastes can be devulcanised and reused. The re-vulcanisable rubber material resulted by the devulcanisation of ground rubber waste is called reclaimed rubber. This unit deals with the production processes, machinery used and chemical aspects of reclaimed rubber. The major application areas and processing methods are also included. The unit aims to arouse the learners eco-consciousness and to rivet their attention to the economical attractions in the use of reclaimed rubber

## Curriculum Objectives

- To get a clear idea about different production methods, compounding and applications of reclaimed rubber through reference, assignment, discussion and experiment

## Syllabus (15 Hours)

- Reclaimed rubber - different methods of manufacture - compounding - major uses

## 9.1 Reclaimed Rubber - Production and Application

### Activity 9 . 1 . 1 Reference

- The facilitator provides the details of reference sources
- The students prepare write ups of the following
  - manufacture and properties of reclaimed rubber
  - specific gravity, mooney viscosity, swelling etc.
  - compounding of reclaimed rubber
  - advantages and limitations of reclaimed rubber

- application of reclaimed rubber
- Teacher validates the write up

### **Consolidation**

- Reclaiming processes
- Compounding
- Properties and application

### **Product**

- Write up

#### Activity 9 . 1 . 2 Experiment

- Students are divided into groups
- Each group prepare a compound based on a typical recipe with different reclaimed loadings
- Each group vulcanise their compound and measure the hardness and % swelling of vulcanizate
- Experiment results are recorded
- Teacher concludes the dosage property relationships based on presented data

### **Consolidation**

- Compounding and properties of applications of reclaimed rubber

### **Product**

- Record

#### Activity 9 . 1 . 3 Assignment

- Teacher brings the attention of students to the necessity and ecological importance of recycling of rubber waste
- Students are asked to prepare an assignment on the classification of rubber waste with special mention to the ecological significance of reclaimed rubber
- Present the assignment by the student

### **Consolidation**

- Classification of rubber waste
- Ecological significance of recycling
- Application level

### **Product**

- Assignment

#### Activity 9 . 1 . 4 Group Discussion

- Teacher should give the points to be discussed
  - (i) Reclaiming process
  - (ii) Application of reclaimed rubber
- Summarise the discussion points
- Report is validated by the facilitator

### **Consolidation**

- Grinding of rubber waste
- Sieving
- Magnetic separator
- Reclamation
- Reclaiming agents
- Digestion process
- RHC
- WTR, ITR, Butyl reclaim
- Coloured reclaim

### **Product**

- Write up

### **Reference**

- Rubber Technology and Manufacture by C.M.Blew
- Handbook of Rubber Technology by Steven Blow
- Vanderbilt Rubber Handbook

**UNIT ANALYSIS - UNIT 9**

**RECLAIMED RUBBER**

Curriculum Objectives	Ideas/ Concepts	Skills	Activity	Materials	Products	Evaluation
9.1 To get a clear idea about different production methods, compounding and application of reclaimed rubber through reference, assignment, discussion and experiment	Rubber wastes Classification Types of reclaim Reclaiming agents Ecological significance of recycling Compounding, properties of application	Observing Experimenting	Discussion Reference Assignment Experiment	Books Specimens Journals	Write up Assignment Record	Write up Class test Record

# **PART III-PRACTICAL**

# 1. PHYSICAL PROPERTIES OF FIELD LATEX

---

---

## Introduction

Latex is a white slightly yellowish liquid of specific gravity of about 0.98. Its physical properties have much importance in the processing of latex. The processing and product manufacture are particularly based on the characteristics of latex. In this unit the students are exposed to conduct experiments related to physical properties of Natural Rubber Latex.

## Curriculum Objectives

- To determine the physical properties of fresh field latex through experiments as per BIS
- To determine the NH<sub>3</sub> content of preserved field latex (PFL) through experiments as per BIS

## Syllabus

- Physical and chemical properties of fresh field latex - viscosity, specific gravity, colloidal nature, coagulum content, PH value, sludge content, determination of ammonia content.

## 1.1 Physical Properties

Activity 1.1.1 Experiment

### 1 Specific gravity

Weigh specific gravity bottle -  $W_1$

Fill with latex and weigh -  $W_2$

Clean the bottle and fill with water and weigh -  $W_3$

Find the specific gravity =  $\frac{W_2 - W_1}{W_3 - W_1}$

### 2 Viscosity

Ostwald's Viscometer is taken and time of flow of latex is noted (t)

Time of flow of water is noted (t')

Density of latex is determined by specific gravity bottle method (d)

Density of water is (d<sup>1</sup>)

$$\text{Viscosity of latex } m = \frac{ntd}{t^1d^1}$$

*h*<sup>1</sup> = viscosity of water (0.0008)CPS

### **3 Colloidal nature of latex**

Visual observation against light - Put a drop of latex into water in a glass jar and observe the turbidity.

### **4 Coagulum Content**

Weight of 180 *m* seive (W<sub>2</sub>)

Seive the standard quantity of latex is sieved and weighed (W<sub>2</sub>)

Dry and find the weight of seive (W<sub>3</sub>)

$$\% \text{ of coagulum content} = \frac{W_3 - W_1}{W_2} \times 100$$

### **5 P<sup>H</sup> Value**

a. Litmus paper method

b. P<sup>H</sup> meter method

c. Sludge content

    Weigh specific quantity of latex

    Centrifuged for standard time

    Remove the serum alternatively and sludge taken in the sieve is dried. Weigh and determine the sludge as per BIS

## **1.2 Ammonia Content**

Activity 1.1.1 Experiment

Latex sample is diluted with 20 ml water and titrated against standardised HCl using methyl orange as indicator.

$$\% NH_3 = \frac{1.7 \times N \times V}{W}$$

N = Normality of HCl

V = Volume of HCl

W = Weight of latex in grams

**UNIT ANALYSIS - UNIT 1**  
**PHYSICAL PROPERTIES OF FIELD LATEX**

Curriculum Objectives	Ideas/ Concepts	Skills	Activity	Materials	Products	Evaluation
1.1 To determine the physical properties of fresh field latex through experiments as per BIS	Viscosity Specific Gravity Colloidal Nature Coagulum content pH value Sludge content	Observing Handling of equipments Experimenting Recording Inferring	Experiment	Samples Ost.Viscometer Sieve PH paper Specific gravity Bottle Balance Stop watch Centrifuge	Lab Record	Accuracy of result Handling of equipments Time Record Book
1.2 To determine the NH <sub>3</sub> content of preserved field latex through experiments as per BIS	% of NH <sub>3</sub> content of PFL Storage life	Observing Handling of equipments Experimenting Recording Inferring	Experiment	Sample beaker burette pippette Methyl Orange HCl	Record	Accuracy of result Handling of equipments Time Record

## 2. LATEX CREAMING

---

### Introduction

Rubber Latex is a dispersion of rubber particles in a aqueous serum. In any dispersion, the dispersed particles cream or sediments under the influence of gravity. Rubber particles being lighter than serum tend to cream up. The processing of latex into creamed concentrates involves the mixing of a creaming agent such as ammonium alginate or cooked tamarind seed powder with properly preserved field latex and allowing the latex to separate into two layers, an upper layer of concentrated latex of 50-55% DRC and lower layer of serum containing very little rubber.

### Curriculum Objectives

- To cream the field latex and to find out the efficiency of creaming through experiments.
- To determine the TSC and DRC of field and concentrated latex through experiments.

### Syllabus

- Creamed latex - composition, preparation, efficiency of creaming, DRC, TSC and determining of volatile fatty acid number.

### 2.1 Latex Creaming

#### Activity 2.1.1 Experiment

Take one litre field latex in a measuring jar and mixed with creaming agent (2.5 gram tamarind seed powder in 85ml water and cooked). 0.5 gram soap is dissolved in 100ml water and added. Stir well and keep the mixture for 48 hours. Progress of creaming is observed frequently. The efficiency of creaming can be calculated as:

$$h_c = \frac{FxC}{fxc} \times 100$$

where C = Drc of cream

c = Drc of field latex

F = weight of cream

f = weight of field latex

## **2.2 TSC**

### Activity 2.2.1 Experiment

Weigh a specified quantity of field latex (2-10 gm) in a petridish. Keep in an air oven at  $70 \pm 2^\circ\text{C}$  till getting constant weight.

$$\% \text{ of T.S.C} = \frac{W_3 - W_1}{W_2 - W_1} \times 100$$

where

$W_1$  = weight of petridish

$W_2$  = weight of latex and petridish

$W_3$  = weight of dried film + petridish

## **2.3 DRC**

### Activity 2.3.1 Experiment

- Weigh a specified quantity of field latex (5-10gm) in a petridish.
- Add water to get a TSC of approximately 20%
- Coagulate the latex with acetic/ formic acid
- Wash the coagulum
- Squeeze with the help of hand roller
- Dry coagulum in an air oven at  $70^\circ\text{C} \pm 2^\circ\text{C}$  till getting constant weight.
- A duplicate test should also be done.

$$\% \text{ DRC} = \frac{W_3}{W_2 - W_1} \times 100$$

where,

$W_1$  = weight of petridish

$W_2$  = weight of latex + petridish

$W_3$  = weight of dried film

## 2.4 Volatile Fatty Acid Number

### Activity 2.4.1 Experiment

Weigh 50 gram of field latex of known TSC and DRC in a 250ml beaker and coagulated with 30% Ammonium Sulphate solution. Collect the serum and acidified with 50% H<sub>2</sub>SO<sub>4</sub> in the ratio of 5:1. Take 10 ml of serum in a Markham still apparatus and distilled 100 ml of Ba (OH)<sub>2</sub>. Distillate is titrated against solution. VFA can be calculated as following equation.

$$VFAN_o = \frac{561 \times N \times V \left[ 50 + \frac{(100 - DRC)}{100d} \times W \right]}{\frac{25}{3} \times W \times TSC}$$

N = Normality of Ba (OH)<sub>2</sub>

V = Volume of Ba (OH)<sub>2</sub>

W = Weight of latex

d = density of serum

**Note:**

Ba (OH)<sub>2</sub> is standardised using potassium hydrogen phthalate

## UNIT ANALYSIS - UNIT 2

### LATEX CREAMING

Curriculum Objectives	Ideas/ Concepts	Skills	Activity	Materials	Products	Evaluation
2.1 To cream the field latex and to find out the efficiency of creaming through experiments	Creaming agent Emulsifier Efficiency of creaming	Observing Handling of tools and equipments Measuring Experimenting Inferring	Experiment	Latex sample Soap Sod Algenate Tamarind Seed Powder Measuring Jar Rubber tube	Creamed Latex Record	Efficiency of creaming Record time
2.2 To determine the DRC and TSC of field and concentrated latex through experiments	Metrolac method Coagulation method Relation of DRC with NRC	Observing Handling of equipments Measuring Experimenting Inferring	Experiment	Latex sample Acetic acid Rectified spirit Petridish Beaker Burette Glassrod Air oven Thermometer Analytical Balance Digital Balance	Record	Handling Accuracy Time Record Viva
2.3 To determine VFA number of latex samples through experiment	Fatty acid number Storage life Preservation	Observing Handling Experimenting	Assembling of Markham still Experiment	Latex sample Ammonium sulphate H <sub>2</sub> SO <sub>4</sub> , Indicator Antiforming agent. Distillation, Apparatus(Markham Still)	Record	Record Time

## **3. PREPARATION OF RIBBED SMOKED SHEET**

---

### **Introduction**

A major share of natural rubber is produced by the small scale plantations in India and is marked in the form of Ribbed Smoked Sheets (75% of the total production in India). Different grades of RSS are available in the market. High quality sheets can be produced in small scale plantation by giving proper attention in the manufacturing process. The carelessness and unhygienic conditions will affect the quality and hence the grade of RSS may be lowered which will minimise the income of the producer. In this unit methods of production of high quality sheets are included. Unit also covers the tests like volatile matter and dirt content of sheet rubber.

### **Curriculum Objectives**

- To prepare ribbed smoked sheets through work practice.
- To determine the volatile matter of raw rubber through experiments.
- To determine the dirt content of rubber through experiments.

### **Syllabus**

- Work practice - Production of RSS, creep, determination of volatile matter and dirt content.

### **3.1 Preparation of RSS**

#### **Activity 3.1.1 Work Practice**

Two litres of latex is taken and sufficient water is added so as to adjust the TSC to 12.5%. The mixture is allowed to stand for 20 minutes for sedimentation. The sediments are removed and the latex is sieved through a 35 mesh sieve. About 4 litres of latex is transferred into an aluminium dish of standard size. Formic acid/ Acetic acid is generally used for coagulation. A general indication of acid requirement for coagulation is given in the table below.

Acid requirement of coagulation of 4 litres of diluted latex containing half kilogram rubber.

Sl.No		Acetic acid	Formic acid
1	For the next day sheeting	3 ml diluted to 300 ml	45 ml diluted to 300 ml
2	For the same day sheeting	4 ml diluted to 400 ml	2 ml diluted to 400 ml

Acid is added, stirred well and froth is removed and kept undisturbed. After coagulation, the coagulum is washed in running water. They are sheeted in smooth rollers to a thickness of 3 mm and finally passed through the grooved roller. While sheeting the coagulum is washed continuously and the sheet is also washed in running water.

Mould growth on sheets can be prevented by dipping the fresh sheets in a dilute solution of 0.1% Para Nitro Phenol for 10 minutes. The wet sheets are allowed to drip on reapers in well ventilated dripping shed without direct exposure to sunlight. The sheets after 4 to 6 hours dripping in shades are put in smoke house where the temperature is maintained between 40° C and 60°C. The sheets are to be turned on reapers everyday for uniform smoking and drying to avoid reaper marks. 4 days of smoking is generally sufficient under normal conditions.

### Grading

The completely dried sheets are carefully inspected and graded according to standards as per IS 15361-2003.

## 32 Volatile Matter

### Activity 3.2.1 Experiment

100 gms of Natural Rubber is homogenised in an open mill and 10 gram of it is placed in an air oven for one hour at a temperature of 100°C ± 5°C. After drying the sample is weighed and volatile matter is found as per formula.

$$\% \text{ Volatile Matter} = \frac{W_1 - W_2}{W_1} \times 100$$

$W_1$  = Weight of sample

$W_2$  = Weight of sample after drying

## 33 Dirt Content

### Activity 3.3.1 Experiment

Two grams of peptised, homogenised rubber sample is put in 150ml of solvents taken in a beaker. Reflux for 2 hours. The mixture is sieved through a preweighed sieve of 40

microns, and dried at 100°C in an air oven. After drying the weight is taken and the percentage dirt content is calculated as

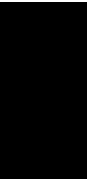

$$\% \text{ dirt} = \frac{S_1 - S}{S} \times 100$$

where,

$S_1$  = weight of residue and seive

S = weight of seive alone

**UNIT ANALYSIS - UNIT 3**  
**PREPARATION OF RIBBED SMOKED SHEET**

Curriculum Objectives	Ideas/ Concepts	Skills	Activity	Materials	Products	Evaluation
3.1 To prepare ribbed smoked sheets through work practice	Dilution, Bulking, Seiving, Coagulation, Froath removal Sheeting, Washing & Dripping Drying and Smoking, Homogenising	Observing Handling Practice	Work Practice Visual Inspection	Latex Aluminium Dish Formic acid Sieve Rubber roller	Ribbed Smoked Sheet Record	Quality of RSS Record Book
3.2 To determine the volatile matter of raw rubber through experiment	Volatile matter % VM =  $W_1$ = Initial weight $W_2$ = Dried weight Drying temperature and time (1 hour at 100°C)	Observing Measuring	Experiment	Open mill Air oven Petridish	Record	Accuracy Time Record
3.3 To determine the dirt content of rubber through experiment	Dirt Content 	Observing Measuring	Experiment	Open mill Air oven Seive Vacuum pump	Record	Accuracy Time Record

## **4. FIELD VISIT/OJT PROGRAMME**

---

### **Introduction**

Field visit and O.J.T programmes should be arranged to acknowledge the industrial atmosphere and technical know how. This also allows students to interact with industrial experts.

### **Curriculum Objectives**

- To get a clear picture of plantations, crepe factories, block rubber units through field visit/OJT programmes

### **Syllabus**

- Field visit/OJT programme. Planting techniques, creep and block rubber production, specification test of creep and block rubbers.

### **4.1 Field Visit**

#### *Activity 4 . 1 . 1     Field Visit*

- One day field visit may be arranged to update practical knowledge of students
- Arrange visit to plantations
- Arrange visit to creper rubber units
- Arrange visit to block rubber manufacturing units
- Students are asked to prepare visit reports
- Validate the visit reports

#### *Activity 4 . 1 . 2     On the Job Training (OJT)*

- Training programmes should be arranged in industries
- Duration upto one month
- Students are asked to prepare training report
- Validate the training report

**UNIT ANALYSIS - UNIT 4**  
**FIELD VISIT/ OJT PROGRAMME**

Curriculum Objectives	Ideas/ Concepts	Skills	Activity	Materials	Products	Evaluation
4.1 To get a clear picture of the plantations, crepe factories, Block rubber units through field visit/ OJT programme	Plantation techniques Creep rubber production Block rubber production Specification test of crepe and block rubbers	Observing Practicing	OJT Field visit		Visit report Training report	Report Viva

# 5. SYNTHETIC RUBBER

---

## Introduction

Identification of various synthetic rubber can be done in the school laboratory. Preliminary and chemical analysis are conducted to identify the various synthetic elastomers to raw form.

## Curriculum Objectives

- To identify different synthetic rubbers through physical and chemical analysis.

## Syllabus

- Synthetic rubber - characteristics of different elastomers, physical and chemical testing - SBR, BR, Nitrile, CR, 11R and reclaimed rubber.

## 5.1 Identification of Elastomers

### Activity 5.1.1 Experiment

- Preliminary Examination
  - Specific gravity
  - Visual appearance
  - Bouncing test
  - Feel test
  - Flamability test
  - Beilstein test
- Chemical Analysis
  - Chlorine
  - Bromine
  - Fluorine
- Nitrogen containing tests
- Sulphur containing tests
- Test for polymers containing inorganic materials

Confirmatory tests for various synthetic elastomers such as SBR, BR, IR, 11R, NBR and CR.

**UNIT ANALYSIS - UNIT 5**  
**SYNTHETIC RUBBERS - IDENTIFICATION**

Curriculum Objectives	Ideas/ Concepts	Skills	Activity	Materials	Products	Evaluation
5.1 To identify different synthetic rubbers through physical and chemical analysis	Beilstein test Flamability test Preliminary test Chemical Analysis for nitrogen, bromine, chlorine, silicon, sulphur etc. Conformity test	Observing Experimenting Inferring Identifying	Experiment Chart Preparation	Raw polymer FeCl <sub>2</sub> , FeSO <sub>4</sub> , AgNO <sub>3</sub> , sodium nitrosopruside, NH <sub>3</sub> , HCl, H <sub>2</sub> SO <sub>4</sub> , HNO <sub>3</sub> , Br <sub>2</sub> in CCl <sub>4</sub> , etc.  Weighing balance, glass ware Bunsen burner etc.	Record	Handling of glasswares Accuracy of result

# **PART IV**

# SAMPLE QUESTIONS

---

1. Trace out the correct route through which Natural rubber came to India from the following list of countries

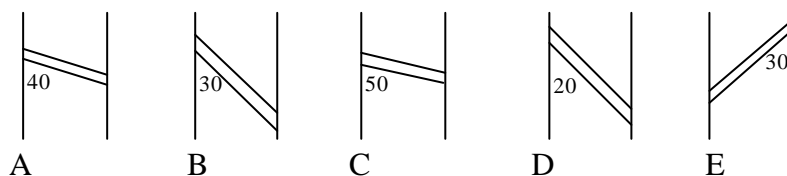
Srilanka	Brazil
Britain	Mexico
USA	India

2.           Thailand           India  
               Indonesia       Malaysia  
               Srilanka         China

Write the list of nations producing natural rubber in descending order of production of NR

3. In the past two decades the usage of seedlings were few, where as polybag clones are widely used. Can you explain why ?
4. As farmer has an almost level plot of 40 metre x 25 metre. Prepare a pit map for planting RRII 105 clones in a scientific manner
5. Early moving tapping gives more yield. Justify the statement

6.



Which is the standard making of tapping budded trees

7. Pushing forward and pulling back are the two cutting operations. Identify the knives suitable for each work

8. The constituents of NR later is given below, Indicate appropriate % age of each content.

Water  
Rubber  
Lipids  
Protein  
Resins  
Sugar  
Ash

9. A rubber planter intends to keep the latex for one month. Is it possible ? Can you help him for it.

10. Sabu wants to start a rubber band unit. Can you suggest an appropriate method and procedure to concentrate field latex from his 10 Acre plantations

11. Bini tested a field latex sample and recorded TSC as 29.8% and DRC 32.5% comment about the result.

12. About 20% of NR is obtained as field coagulums. These are marketed purer forms produced though different process. Can you list out the sequential operations of productions of ISNR - 50

13. PLC is produced from latex. Prepare a flow diagram showing the process.

14. Smoking is supporting action in the production of R.S.S. State the advantages of smoke drying.

15. Prepare a report about the creepe unit that you visited

16.            Mixing moll      Hammer mills  
                Coagulum cutter Cold Extruder  
                Calendar        Pelletiser  
                Kneeder            Ball mill  
                Slitting knives    Goggle press  
                Banbury            Shrudders  
                Granulators       Choppers  
                Creper              Crumblers

List out the machineries for the production of block rubbers from the above list.

17. Match the following

Columbus	Fry whistling particles	Cenex
Alpha level	Preservative	Stock's law
Ammonia	Brazil	Preferential Coagulation
Creaming	Centrifuging	Bubbling
Yellow colour	Sodium alginate	Hevea braziliensis

18. Classify the following accelerators based on their activity in rubber

MBT	DPG
CBS	ZDL
TMT	ZMBT
MBTS	Xanthates
TMTD	

19. Suggest a curing system for producing heat resistant gasket from N.R.

20. Carbon black reinforces rubber where as clay doesn't. List out 5 other reinforcing and non reinforcing fillers.

21. Some major parts of Alpha level centrifuge are given below

Casing	Skim Screw
Bowl	Feed mechanism
Separator disc	
Distributor	

Prepare a schematic representations of the machine and explain the working

22. List out of the utensils and machineries used in the production of ribbed smoked sheets

23. List out of the machineries in the production of block rubbers are given below. Explain the functions of each.

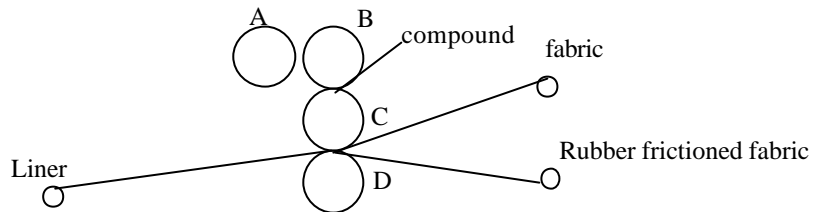
Coagulum cutters	
Slitting knives	Expellers
Granulators	Shredders
Hammer mill	Creepers
Pelletisers	Crumbles

24. Complete the following table of mills

Parts	Metal used	Function
Rolls	Chilled Cast Iron	_____
Bush bearing	_____	Friction reducing
_____	_____	Nip Adjustment
Pinion gears	_____	_____
Mill housing	_____	_____
Mill guides	_____	_____
_____	_____	Emergency stop

25. Kneader is a roto type internal mixer. Do you agree with this ? Give reasons

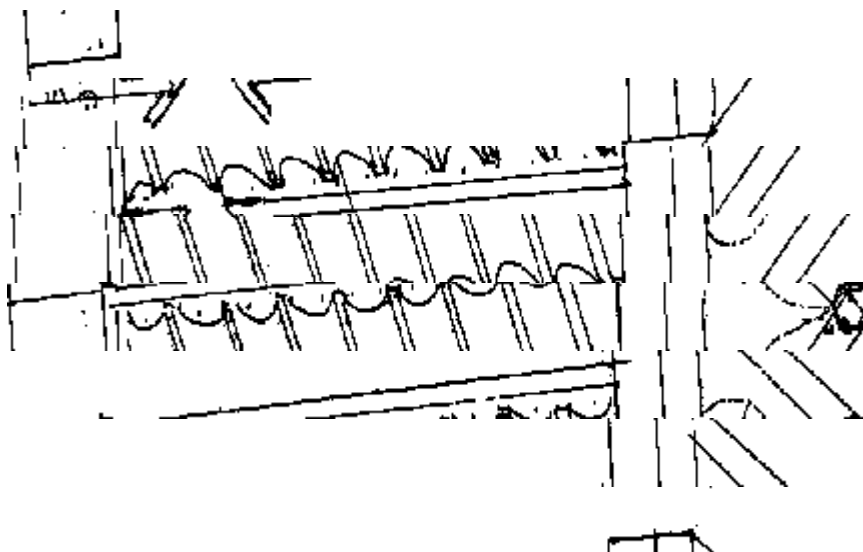
26.



Rolls C, D even speed  
 Rolls A, B uneven speed

Above figure shows frictioning of rubber on fabric. Find out the technical faults. Suggest the corrections.

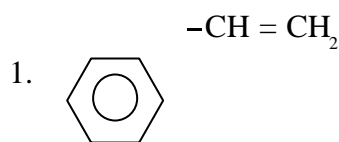
27. Figure shows the cross section of a rubber extruder. Identify the parts and their functions.



28. Some rubber products are given below suggest appropriate moulding devices

- |               |                  |
|---------------|------------------|
| 1. Cycle tube | 2. Rubber band   |
| 3. Tea mat    | 4. Hawaii sheets |

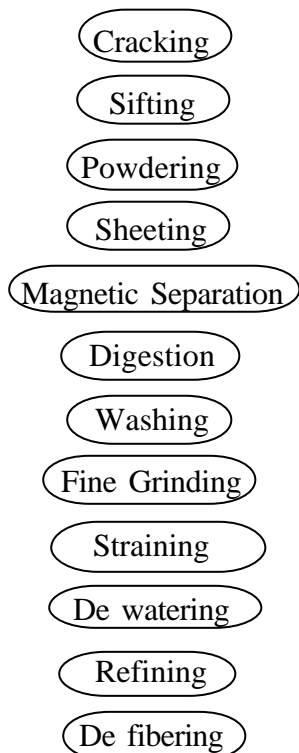
29. Name the following monomers



Name the polymer obtained by the copolymerisation of these monomers and write down its structure and polymerization technique.

30. SBR, NBR, IIR, CR, PBR are some important synthetic rubbers. Classify them according their major uses.

31. Different steps of digest process are given below. Prepare the correct flow chart



32. Heaping of worn out tyres is a serious ecological problem. As a rubber technologist can you suggest some remedial steps to save the environment.

