Unit 2 COTTON
NATURAL CELLULOSIC FIBER

Can you tell?

- *Which is the most commonly used fiber in a temperate country like India?*
- *What is origin of cotton fiber?*
- *Why cotton is termed as natural cellulosic fiber?*

2.1 INTRODUCTION

Cotton is obtained from a bushy mallow plant and grows from the surface of seeds in the pods or bolls and so is also called "seed-hair fiber." The word "cotton" is derived from and Arabic word "quoton" which means plant found in the conquered land. It is one of the oldest fibers known to mankind. Its history is more than 5000 years old. India was the principal country in growing cotton and manufacturing cotton fabrics which were well known all over the world.

❖ Cotton Producing Regions :

The major cotton producing regions are India. China, America, Brazil, Russia, and Argentina. In India, it is cultivated on a large scale in South Indian Plateau, i.e.

Maharashtra, Tamil Nadu, Karnataka and Andhra Pradesh.

❖ Cultivation of cotton :

Cotton is cultivated most satisfactorily in warm, humid climates or in warm climates with adequate irrigation. The deep and black soil is generally most favourable for the cultivation. It grows well in the areas where the amount of rainfall is less but well distributed.

Carefully selected cotton seeds are planted in row. Approximately after 100 days, they begin to bloom as creamy white blossoms. These blossoms change to pink and then reddish purple. Within three days their petals fall off, leaving the ripening of seed pod. The fibers growing inside the pod expand it to about 1.5" long and 1" in diameter. It is now known as **cotton boll**. The boll bursts open about 50 to 80 m days after the flowering with fleecy white cotton ready for picking. Full grown Cotton plant is about 3 to 6 feet in height..

India mainly produces short staple cotton. Recently medium and long staple varieties of cotton like Buri, Laxmi, Varalaxmi, Devraj are cultivated. Arboreum and Harbacium varieties of cotton produce short, thick, rough but stronger fibers, These varieties are known as desi, asian or ancient cotton. Gossypium originated in America and possesses greater length and better qualities. Fibers of super fine quality and maximum length are obtained from Barbadense also famous as **Egyption cotton.** Organic cotton in one of the latest varieties of cotton and is cultivated without using synthetic fertilisers and insecticides. It has grate demand in Europrian countries. Experiments on growing species of coloured cotton are being done today. B. T. cotton is produced using technique of genetic engineering. which has improved resistance and for greater production in lesser cost it is cultivated.

Picture No. : 2.1 Hand Picking

Picture No. : 2.2 Mechanical Picking

2.2 MANUFACTURING PROCESS OF COTTON

1. Picking :

Full ripe bolls are picked by hand or by mechanical picking machines.

i) **Hand picking :** All cotton bolls do not ripen and open at the same time. Only those that are burst are picked by hand. It results in more uniform and better quality cotton, as pickers select only the mature fibers. Cotton fields are repicked for several times.

ii) **Mechanical Picking :** When mechanical pickers are used, the bolls are left on the plants until they all mature. Plants are sprayed with defoliants or chemicals which cause the leaves to shrivel and fall off.

The full ripe bolls are then picked by machines.

Interesting Historical Facts

Rust, John & Mack

Brothers & native Texans, they invented the automatic cotton picking machine in **1836**. This mechanical picker revolutionized the industry & increased production a great deal. It is estimated that four thousand previous attempts had been made to develop the mechanical cotton picker.

Picture No. : 2.3 Cotton boll

Picture No. : 2.4 Ginning

2. Ginning and Baling :

After the cotton is picked, it is taken to the ginnery. Cotton fibers called as lints are separated and the seeds are removed by the cotton gin. The cotton gin was invented by Eli Whitney in 1794. It subsequently promoted the growth of cotton industry. The modern gins remove foreign matters such as dirt, twigs, leaves and parts of boll.

Picture No. : 2.5 Cotton bales

Internet is my friend:

Collect information from internet about scientist Eli Whitney who inverted cotton gin.

Chart No. : 2.1

Manufacturing Process of Cotton

	**Picking** • hand picking • mechanical picking
	**Ginning & Baling** • separating cotton seeds from the fibres • packing the fibres into large bales
	**Grading** • Cotton fibres are classified according to their quality. • Price is established based on this quality.
	**Opening, Cleaning & Blending** • Bales are opened at mills and fibres are cleaned. • Fibres are mixed for uniform quality and laps are made.
	**Carding** • First step to bring fibres in one direction. • Thick tube like Card slivers are made.
	**Combing** • A continuation of Carding process for high quality yarns. • Thin tube like Combed slivers are made.
	**Drawing** • Combed silvers are stretched and made very thin. • Fibres are now totally in one direction.
	**Roving** • A stage inbetween sliver and yarn. • Slight twist is added.
	**Spinning** • Final process where yarn is actually made. • Fibres are given desired amount of twist and wound on bobbins.

The cotton fibers are then compressed into large rectangular bales. These are covered with jute or polythene bags and bound with bands. Each bale is of specific weight and dimension. It is of 180 kg. in weight and generally 120 c. m. × 50 c. m. × 40 c. m. in dimension.

3. Grading :

Cotton fibers are classified according to length, properties, colour and quality

of fibers. Fiber properties measured are fineness, colour, length, uniformity and strength. When all the property values have been determined, the final quality of cotton is registered. The fiber price is established on the quality of the cotton. .

4. Opening, Cleaning and Blending

The bales are opened at the mill and compressed masses and hard lumps are loosened. Fibers from several bales are mixed together. It results in more uniform yarn. The heavier impurities such as dirt, burrs, parts of seeds and leaves etc. are removed mechanically.

5. Carding

In the lap stage, the fibers are still in a tangled condition with some impurities. These impurities must be removed and the fibers must be straightened before it can be made into yarn. This initial process of arranging the fibers in a parallel fashion is called as carding. Card is a textile machine with teeth or wires. It receives the fibers in matted laps or loose fibers and converts into **card sliver.** Sliver is round, with 3/4 to one inch wide, continuous, untwisted rope like strand of fibers. Card sliver produces carded yarns or carded cottons serviceable for inexpensive cotton fabric.

Picture No. : 2.6 Carding

Picture No. : 2.7 Combing

6. Combing

For high quality cotton yarns, fibers are combed as well as carded. The long, desirable fibers of same length are separated from the short, undesirable fibers stock by combing process. In this Process 2 % to 25 % of fibers are removed. The comb is a unit of yarn manufacturing machinery, which arranges fibers in parallel order in the form of **comb sliver.** Only the best grades of the cotton are generally combed. Combed yarns are of outstanding evenness, smoothness, fineness and strength than carded yarns. This process is also applied to coarser yarns when high quality is desired.

7. Drawing

It is a process in yarn manufacture in which the sliver from either the carder or comber is elongated by passing it through a series of pairs of rollers, each pair moving faster than previous one. This permits combing several slivers and drawing and elongating them to straighten the fibers. It helps in creating grater uniformity. The process of drawing is also commonly called **drafting**. In this stage first time a little amount of twist is inserted.

8. Roving

It is an intermediate state between sliver and yarn. It is carried out on roving frame where further the size of sliver is reduced approximately one-eighth of it's original

diameter. At this stage very little amount of twist is inserted to hold the fibers together. The new strand called **roving** is laid onto a bobbin.

9. Spinning

This is the final process of manufacturing yarn. During spinning the roving is made thinner to the desired diameter, called the **final draft**. The twist is given to a yarn to give strength and other desirable characteristics. The yarn is then wound onto the bobbin, spools or cones by winding process.

Picture No. : 2.8 Spinning

Development of staple fibers into yarn.

Chart No. 2.2

1. Lap to Card Sliver by **carding** process.
2. Card Sliver to Combed Sliver by **combing** process.
3. Sliver to Roving by the **drawing-** out process.
4. Roving to Yarn by the Drawing and **Twisting** process.
5. Yarn reeled on bobbins, spools or cones by **winding** process.

2.3 PROPERTIES OF COTTON FIBER

Cotton is a remarkable fiber which has many good properties making it one of the most popular fiber in our country and around.

❖ Microscopic Properties

Under the microscope, the longitudinal view of cotton shows a flat ribbon-like structure. There are twists or convolutions seen throughout the length. The diameter is uneven and there is very little lustre. (For diagram refer to Practical No. 8)

Chart No. 2.3

Microscopic Characteristic of Cotton

- Flat ribbon like appearance
- Diameter is uneven
- Convolutions (twists) are seen

B) Physical Properties:

1. **Length :** Individual fibers range from $\frac{1}{8}$ inc.- $2\frac{1}{2}$ inches. Long staple length in cotton is desirable because the fibers can be spun into yarns of higher tensile strength.
2. **Luster :** Cotton has very little luster. A process called 'Mercerization' increases the luster.
3. **Strength :** Cotton has a tenacity of 3.0-5.0 grams/ denier. This produces a fiber of moderate to above – average strength. Cotton is 10-20% stronger when wet. Mercerized cotton is stronger than unmercerized cotton.

Think about it!

Why florist wet the cotton thread before making garlands?.

4. **Elastic recovery and elongation:** Cotton fiber has very little natural elasticity. It is more elastic than linen but less than silk and wool. Cotton has an elongation of 3-10%, with a recovery of only 75% at 2% extension.
5. **Resiliency :** Cotton has low resiliency, due to this cotton fabrics wrinkle easily and needs frequent ironing. Application of resin finishes improves the resiliency of cotton. .

6. **Moisture regain :** Moisture regain of unmercerized cotton is 8.5% at 65% relative humidity and 70o F temperature. Mercerized cotton absorb more moisture than nonmercerized fibers. Moisture regain for mercerized fiber varies from 8.5-10% the moisture regain factor of cotton has made it more desirable as summer wear. Water has little effect on cotton, other than swelling of the fiber, which may cause shrinkage. Even boiling water has no action on cotton. Cotton is stronger when wet. This property of cotton does not demand for any special care while laundering the fabrics.

7. **Density:** Cotton is one of the high density fibers used with a density of 1.54 – 1.56 gm/cc. This makes the fabric heavy in weight.

Chart No. 2.4

Properties of Cotton Fiber		Can you tell
Microscopic	Flat ribbon – like structure, twists / convolutions are present.	
Length	Staple fiber $\frac{1}{8}$ Inch to 2 $\frac{1}{2}$"	We usually don't wear cotton clothes while going to parties or marriages. Why?
Luster	Low	
Strength – (Tenacity)	Very good 3.0 – 5.0 g/d strength increases in wet condition	Dhobies beat the cotton clothes on the stone while washing them and they are still not damaged. Why?
Elasticity	Low	
Resiliency	Low	After washing, cotton clothes can not be worn again without ironing. Why?
Moisture absorption	Very good	Cotton clothes take a long time to dry. Why?
Density	More – 1.5 gm/cc	
Eggect of Mildew	Easily affected	Towels, napkins, dish clothes, mops etc. are always made of cotton. Why?
Effect of Moth	Not easily affected	
Effect of Heat	Can withstand high temperature. Burns readily, keeps on burning, smells like burning paper	Cotton clothes are preferred in summer season. Why?
Heat conductivity	Good	

Hint : The answers lie in the properties of the fiber.

C) BIOLOGICAL PROPERTIES :

1. **Effect of mildew :** Being a cellulosic fiber, cotton fabrics especially sized fabrics are affected by mildew readily when permitted to remain in damp condition. Small greenish-black or rust colored spots caused by mildew (fungus) develops, and a musty odour may be detected. Therefore, cotton material should be kept in a dry atmosphere.
2. **Effect of moth :** Being a cellulosic fiber cotton is not attacked by moths and beetles..

D) THERMAL PROPERTIES:

1. **Effect of Heat :** C Cotton burns readily and quickly. While burning it smells like a burning paper & leaves small amount of fluffy gray ash.
2. **Heat Conductivity :** Cotton is good conductor of heat and hence suitable for summer wear.

2.4 USES OF COTTON

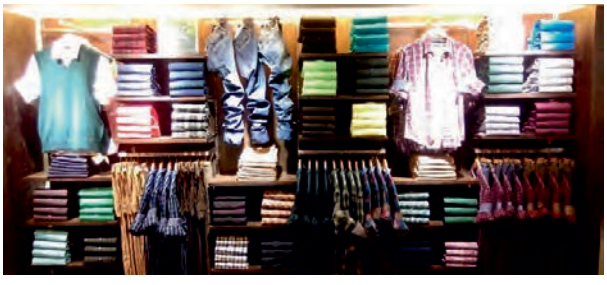
Cotton is the single most widely used fiber and it is an excellent choice for a multitude of purposes. Due to its comfort factor, strength, absorbency, softness cotton has almost universal acceptance. Due to its good moisture regain, these fabrics are very comfortable to wear in hot humid climate in tropical country like India. Due to its good heat resistance they can be used very safely while working in kitchen or while bursting fire crackers. Cotton fiber has high wet strength and most soaps and detergents used in home laundering do not have any harmful effect on them. This makes the fabric care less demanding and hence most of cotton fabrics can be laundered and dried at home without any special precautions.

Cotton is extensively used with man made fibers to achieve new combinations of properties that are not available in the fibers separately. In such blends the cotton fiber contributes characteristics of comfort, absorbency, softness while manmade fibers add strength and easy care. The fibers have great importance in medical field.

Bedsheets, pillow covers, curtains used in hospitals can be easily sterilized by autoclave. Due to its high absorbency they are used for bandages. It is also favorite fabric for various active sports wear. Cotton due to its high absorbency, absorbs sweat and hence are comfortable as sports wear and for summer clothing. Following are the main uses of cotton.

Picture No. : 2.9 Apparel uses of Cotton

1. **Apparel uses :** Inner garments, hosiery items, scarf, sarees, hand gloves, socks, hats, caps, shirts, pants and various sports wear.



Picture No. : 2.10 Apparel uses of Cotton

Picture No. : 2.11 Apparel uses of Cotton

2. **Household uses :** curtains, bed sheets, pillow covers, napkins, table cover & mats, towels, mattress, bathroom mats etc.

Picture No. : 2.12 Household Uses of Cotton

3. **Medical uses :** Threads, bandages, gauze, sterilized cotton, doctor's aprons etc.

Picture No. : 2.13 Medical uses

4. **Industrial and commercial, miscellaneous uses :** Shoe laces, embroidery threads, sewing threads, ropes, twines, socks bags, handbags, laces, nets, trimmings.

Picture No. : 2.14 Commercial Uses

Use Your Brain Power

1. Can you rearrange the steps in Cotton Manufacturing.

1) Roving

1) _____

2) Drawing

2) _____

3) Picking

3) _____

4) Grading

4) _____

5) Carding

5) _____

6) Ginning & Baling

6) _____

7) Combing

7) _____

8) Spinning

8) _____

9) Opening, Cleaning & Blending

9) _____

EXERCISE

Objective Type Questions

I. Match the pairs

A		B	
1.	Carding	a)	quality determination
2.	Spinning	b)	combed silver
3.	Ginning	c)	twisting
4.	Combing	d)	separating lint from seed
5.	Grading	e)	card silver
		f)	Opening cotton bales

II. State whether the following sentences are true or false.

1. Cotton is a bast fiber.
2. Cotton is composed of protein
3. Cotton is easily affected by mildew.
4. Combed yarns are of superior quality.
5. Ginning of cotton separates Lint from seeds.
6. Cotton has poor heat conductivity.

Multiple choice questions

III. Select and write the most appropriate answer from the given alternatives.

1. Burning cotton smells like burning
   a) Plastic b) Paper c) Hair
2. Under the microscope, structure of cotton is
   a) Flat twisted b) Circular
   c) Scaly
3. Natural cellulosic fiber is
   a) Wool b) Cotton c) Mohair
4. Resiliency of cotton is
   a) Poor b) Medium c) Good
5. Source of cotton is
   a) Animal b) Rock c) Plant

IV Complete the flow chart usuing correct word.

1) Carding → ☐

→ **Drawing** → ☐

→ ☐

Short Answer Type Questions

V List in order steps involved in the manufacture of cotton yarns.

VI Give reasons

1. Cotton fabrics are heavy in weight.
2. Cotton is suitable for summer wear.
3. Cotton can be used safely in kitchen.
4. Cotton fiber is more suitable in medical field.
5. Cotton clothes creases easily.

VII Answer in short.

1. What is Ginning?
2. What is Picking?
3. What is Grading?
4. What is Baling?
5. What is Spinning?

VIII Answer the following.

1. Explain microscopic appearance of cotton.
2. Thermal properties of cotton.
3. Biological properties of cotton.
4. Explain moisture regain and resiliency of cotton.
5. Explain Density and strength of cotton.

Long Answer Type Questions

1. Explain Carding and Combing of Cotton.
2. Explain uses of Cotton.

Self-Study/Project

- Visit a hospital and make a list of items made of cotton for medical use.
- Make a list of Cotton Household articles used in the house.

❄ ❄ ❄