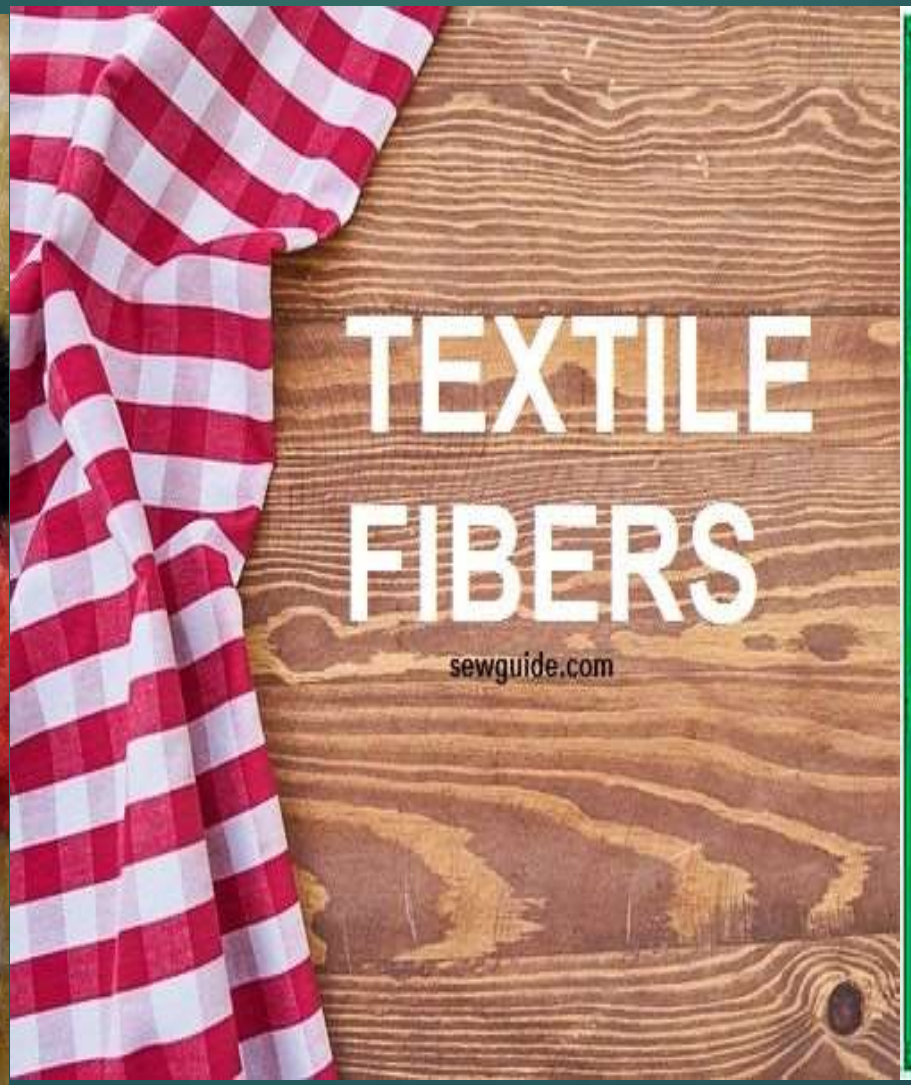
Textile fiber



CONTENTS

- What is fiber
- What is textile fiber
- Properties required for textile fiber
- Classification of textile fiber
- Natural fiber
- Manmade fiber

WHAT IS A FIBER

- A unit of matter, either natural or manufactured that forms the basic elements o fabric and other textile structures is called fiber.
- Fiber is smallest part of a fabric . It is individual fine hair like substance. Fiber usually are grouped and twisted together into a continuous strand called yarns. Yarns are then used to make various textile materials e. g. Women fabrics , knitted fabrics and lace .
- Fiber can also be used to make a fabric without first being made into yarns .Felt and non- woven material are two example of fabric made directly from fibers.
- Few fibres were known and used by ancient civilizations. But with the introduction of man-made & synthetic fibres, a variety of fabrics came into the market. This created a lot confusion in the minds of consumers. So it became necessary to classify then in order to reduce the consumer's confusion.
- Previously this classification consisted of only three simple divisions of natural fibres such as vegetable, animal and mineral matter. Many systems of classification have been developed and used for many years. Today, as many fibres are in use, sub-classifications were also included.

TEXTILE FIBER

- Textile fibres are visible fundamental units from which fabrics are made. Fibres differ in size, colour, texture, source and many other properties. Some are long & others are short, some are scaly and some have crimp.
- Textile fiber like most substances made up of molecules .Fiber molecules are called polymer.

POLY=MANY

MER= UNIT

- The unit of a polymer is monomer.
- At the molecular level the polymer is extremely long and linear where as the monomer is very small.
- At the molecular level the polymer is extremely long and linear where as the monomer is very small. Monomers are usually chemically reactive where as polymer to inactive.
- Monomers join end to end to form polymer and this process is called polymerisation.

TEXTILE FIBER FROM MONOMER TO FABRIC

MONOMER

POLYMER

FIBER

YARN

FABRIC

PROPERTIES REQUIRED FOR TEXTILE FIBER

To qualify for use of a textile fiber, material must posses certain essential properties known as **primary properties**. While there are some **secondary properties** that are desirable but not essential. Their major role is to increase consumer satisfaction with the ultimate fabric.

The essential qualities or primary properties are as follows

- Length to breadth ratio
- Tenacity
- Flexibility
- Spinning quality or cohesiveness
- uniformity

PRIMARY PROPERTIES

- **Length to Breadth ratio:** Textile fibres are available in different lengths. Filaments are long continuous fibres of indefinite length measured in yards or meters. Staple fibres are the short fibres and are measured in inches or centimeters and range in length from ¾ " to 18". All natural fibres except silk are staple fibres. Man-made and synthetic fibres are all filament fibres. They are made as filaments since their length can be controlled when the fibre forming solution escapes through the holes of a spinnerette . Sometimes filament fibres are also cut into staple length to produce certain desirable qualities. In order to cut the filaments into staple length, several thousands of filaments are taken in the form of a loose rope or strand, often made crimpy and are cut to produce staple fibres ranging in length from 1" to 5". The rope of fibres is also refered to as 'Fibre tow'.
- **Flexibility or Pliability**: It is also one of the important primary properties. Many natural fibres are available without this quality. So they are qualified for textile use. Certain degree of flexibility or pliability is necessary for a fibre to be used as a textile fibre. A textile fibre needs to be bendable. For example a glass rod cannot be bent without breaking, but a glass filament can be bent easily. This property is essential to create yarns and fabrics that can be creased, have the quality of drapability, ability to move with the body and should allow for the free movement and also be comfortable. A stiff fibre will make stiff fabrics, which cannot be used comfortably.

- **Strength**: Strength is the second primary property of all textile fibres. In order to be serviceable, all fibres must possess this quality. The strength must be adequate for processing or spinning into a yarn and further making into a fabric. Fibres may vary in strength and the strength within a fibre may not be uniform throughout. It depends upon mainly the molecular structure of fibres
- **FIBRE TENACITIES :-**
- **Under Standard Conditions (700 F & 65% RH)**
  - Cotton - 4.0
  - Silk - 4.5
  - Wool - 1.5
  - Rayon - 1.5 to 2.4
  - Acetate - 1.2 to 1.5
  - Nylon - 4.5 to 5.9 (High tenacity fibres– 5.9 to 9.2)
  - Polyester - 4.4 to 7.8
  - Glass - 7.0

- **Cohesiveness or Spinnability**: Cohesiveness is the ability of the fibres to stick together during spinning. The cohesiveness in fibres may be due to the longitudinal contour or the cross sectional shape that enable them to adhere together. The surface or the skin structure of the fibre may also influence cohesiveness. For example, wool fibre possesses scales on the outer skin of the fibre which help in interlocking fibres while spinning. If the surface or shape of a fibre do not contribute for cohesiveness, the same can be compensated by using filament yarns. As filaments are present throughout the length of the yarns, there is little necessity of having the ability to stick. So this cohesiveness is often conveniently replaced by spinning quality. Polyester is having the lowest cohesiveness but it can be made into staple yarns by using less percentage of cotton and later burning it through carbonising process.
- **Uniformity**:In order to produce fine yarns, uniformity in the raw material is required. Fibres that are used to produce yarns need to be similar in length and width, in spinning quality and in flexibility. All man-made and synthetic fibres are uniform since they are made through artificial processing. But in case of natural fibres, it is not so. Fibres differ is many aspects, and so it is not possible to produce very fine materials in natural fibres unless some extra processing is done.

SECONDARY PROPERTIES

- **Physical shape:-**The physical shape of the fibre is an important factor in determining many of its properties. It includes the surface contour (smooth, rough, serrated), the shape of the cross section and the width and length of the fibre. The shape of the cross section influences certain factors such as lustre, body and hand. The surface contour in turn influences cohesiveness, resiliency, loft and thickness. It contributes to resistance to abrasion, Pilling and comfort factors such as absorbency and warmth. The cross sectional shape can be changed for all artificial fibres unlike natural fibres as the fibres are moulded though spinnerets.

- **Colour and Lustre:** Lustre is the amount of light reflected from a surface. It is more subdued than shine. Light rays are broken up into many short rays unlike the shine in which the light ray is reflected back wholly without any breaks. The lustre is due to smoothness, fibre length, flat or lobal shape. It determines the fibres natural brightness or dullness. The natural fibre silk has the high lustre and cotton is the dullest natural fibre

- **Density:** Density is the mass of a unit volume of material. It is expressed as gms/cubic cm or pounds per cubic foot. The specific gravity of a fibre indicates the density relative to that of water at 4oC. All textile fibres are heavier than water except olefin fibres. Only these fibres float on water. Cotton, wool fibres are heavy and nylon is comparatively lighter. The lower the density the more the covering power. A pound of wool and a pound of nylon weigh the same but the fibres are more in nylon than in wool. High density results in heavy fabrics, low density results in light weight fabrics.

  Absorbency: Generally textile fibres have certain amount of water as an integral part of the fibre. All most all textiles fibres are naturally hygroscopic (i.e they pick up moisture from air). But the amount of moisture the fibres absorb may differ. Absorbency in the ability to take in moisture and moisture regain is the percentage of moisture a bone-dry fibre will absorb from the air under the standard conditions of temperature and moisture. Fibres that absorb water easily are known as hydrophilic (water loving) fibres. Natural protein and vegetable fibres, rayon and acetate are hydrophilic fibres. Fibres that have difficulty in absorbing water are known as hydrophobic fibres.

Elasticity: Elasticity is defined as the ability of fibres to return back to original shape after being stretched. Elastic recovery is the ability of fibres to return from strain and is expressed in percentage. If a fibre returns to original length after stretching to a specified length, it is said to have 100% elastic recovery.
Elasticity is required in fabrics when subjected to stretch during wear. This property is influenced by the side chains & cross linkages between the molecules. If strong bonds are present in between chains of molecules, the fibre tends to return to its original length. If the bonds are not strong it can't recover to its original length but takes up the new shape.

Surface contour: Some fibres have smooth even contour when examined longitudinally, others are rough and uneven. For ex- wool is carried many small scales that cause fibres to cling closely together. Cotton is twisted making it reflect light unevenly and giving it a dull appearance. The lobes of multilobal fibres cause shadows [under microscope] appear as dark lines and are known as stristions.

THERMAL PROPERTIES

- The thermal behaviour of fibres is also an important factor for determining their performance and care. The burning characteristics of fibres help in fibre identification.

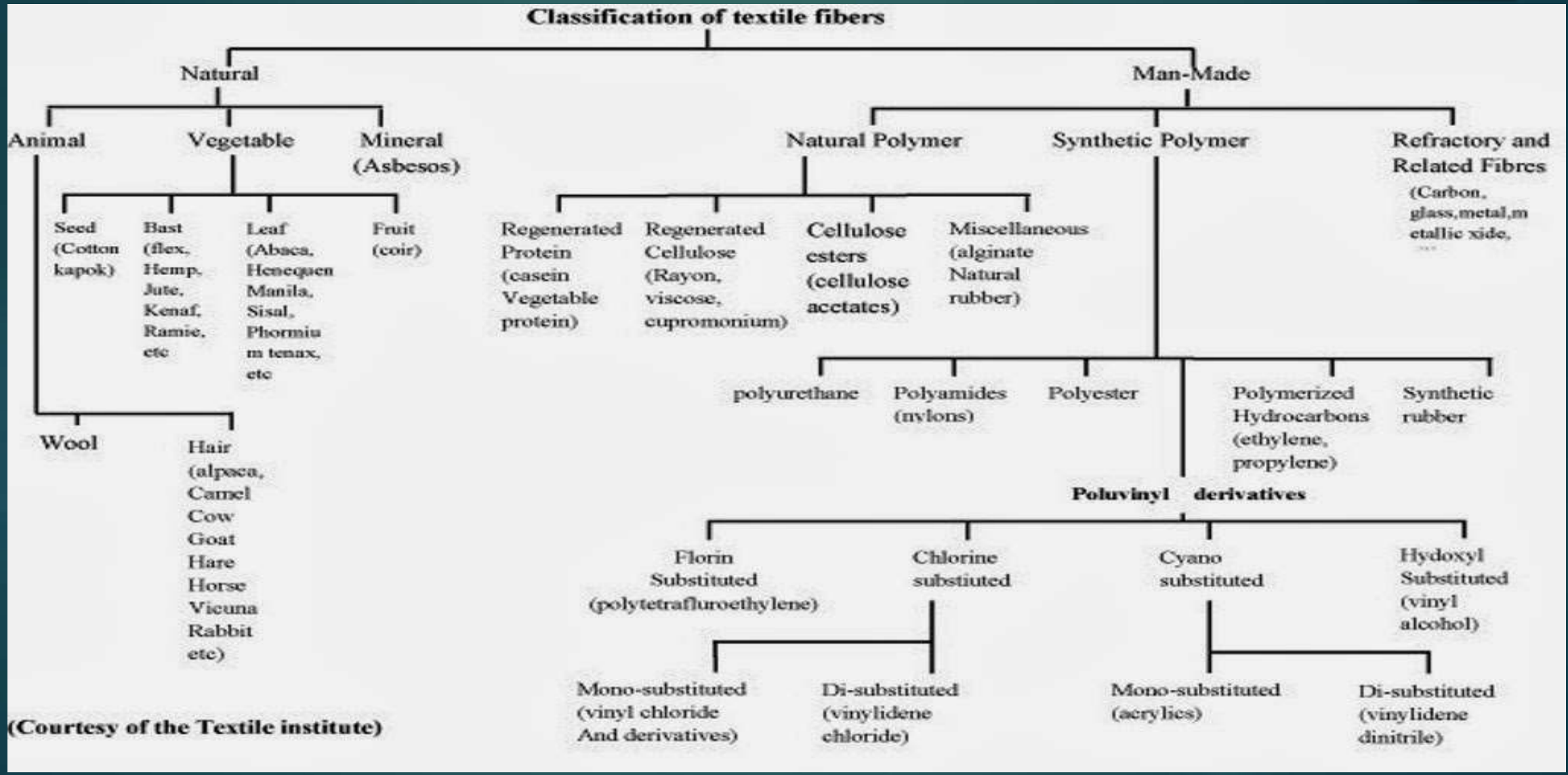
- Among the textile fibres which are in use, some are heat sensitive and some are not heat sensitive. Heat sensitivity is the ability to soften, melt or shrink when subjected to heat like plastic. This category of fibres is also known as thermoplastic fibre. All synthetic & acetate are thermoplastic fibres.

CHEMICAL PROPERTIES

- The reaction of fibres to various chemicals is helpful in use and care of fabrics, chemical reactivity is the effect of acids, alkalies, oxidizing agents and solvents. The fibres react differently to various chemicals and these are explained under each fibre.

- The dyeability of fibres comes under chemical properties

CLASSIFICATION OF TEXTILE FIBRES



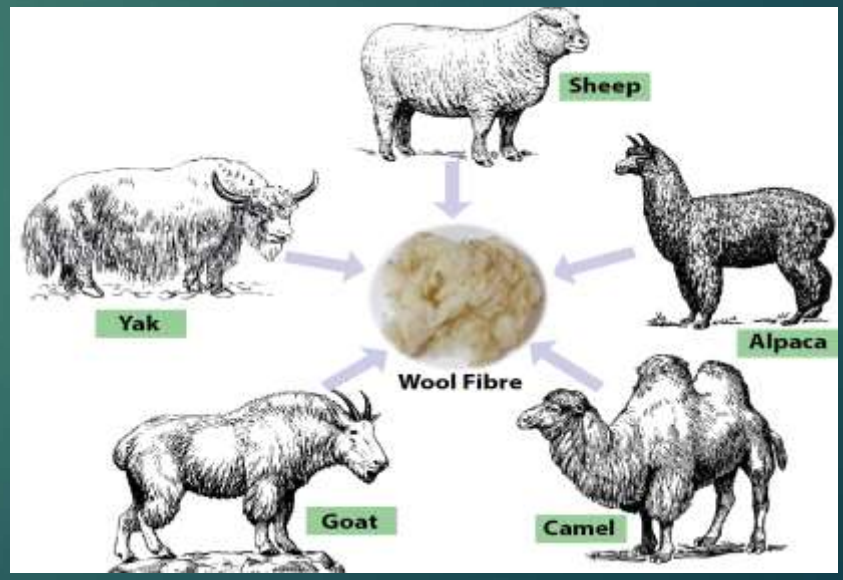
(Courtesy of the Textile institute)

Textile fibres are classified into two categories

- **NATURAL FIBRE:** Fibres that are produced by geological processes, or from the bodies of plants or animals. They can be used as a component of composite materials, where the orientation of fibers impacts the properties. Natural fibers can also be matted into sheets to make paper or felt.

Cotton fibre [kapok]

Wool fibre



Natural fibres

- **Cellulosic fiber**

  [cotton, kapok, flax, linen, jute, hemp, ramie, sunn, pineapple, sisal, coir]
- **Protein fiber**

  [wool, silk, mohair, camel hair, fur, cashmere]
- **Mineral fiber**

  [asbestos]
- **Rubber**

MANMADE FIBRE

Fibres made by humans through chemical synthesis, as opposed to natural fibers that are directly derived from living organisms. They are the result of extensive research by scientists to improve upon naturally occurring animal and plant fibers. In general, synthetic fibers are created by extruding fiber-forming materials through spinnerets, forming a 'different' fiber. These are called synthetic or artificial fibers. Synthetic fibers are created by a process known as polymerization, which involves combining monomers to make a long chain or polymer. The word polymer comes from a Greek prefix "poly" which means "many" and suffix "mer" which means "single units". (Note: each single unit of a polymer is called a monomer). There are two types of polymerization: linear polymerization and cross-linked polymerization.

Manmade fibres

- **Regenerated fibres**

[rayon, acetate, tryacetate, vicara, ardril, chinon, casler, aralac]

- **Synthesized fibres**

[nylon, terylene, Dacron, orlon, vinyon]

- **Mineral fibres**

[glass, modacrylic]

- **Elestomeric fibres**

[spandex, rubber]

THANK YOU