



UNIT-1: INTRODUCTION TO FIBER AND YARN

Food, clothing and shelter are the three basic human needs. While food keeps us healthy, shelter offers covering and clothing offers protection. Fabrics are so much a part of daily life that it is impossible to think about survival without them. Clothes, towels, napkins, bed linen, floor coverings, dust clothes etc. The daily life revolves around them and the choice of these to perform the specific function for their application makes them appropriate for usage.

An informal knowledge of textiles is known to all which enables one to think about the choice of clothing for a hot sunny day or a rainy day or a chilly weather. Studying textiles involves a basic understanding of the various units that comprise a fabric

1.1 Terminology, Properties, End uses

Fibers are the smallest part of the fabric. They are fine hair like substances categorized as either natural or man made.

Based on their length fibers can be classified as Staple Fibers and Filament fibers.

- Short Fibers - Staple Fibers
- Long Fibers - Filament Fiber



Fig. 1 Staple fibers



Fig. 2 Filament fiber

Based on their origin Fibers are classified as Natural or Man Made fibers.

Natural fibers are those that are in fiber form as they grow or develop and come from animal, plant or mineral sources. **Man Made fibers** are made into fiber form from chemical compounds produced in manufacturing facilities.

- Natural fibers - Plants and animals
- Man-made fibers - Chemical substances

1.2 Classification of Fibers

- * Natural fibers can be further classified upon their source as:
 - * Vegetable or Cellulosic fibers, may come from the seed, stem or leaves.
 - * Animal or Protein fibers are obtained from the hair covering of the animal or from the secretions of an insect.
 - * Mineral fiber is the one that is formed in the ground.
 - Cellulosic fibers- Plant sources (seed, stem, leaves etc) Ex: Cotton, Linen
 - Protein fibers- Animal sources (hair coverings, secretions) Ex: Wool, Silk
 - Mineral fibers - Ground Ex: Asbestos



FIBERS				
Natural			Man Made	
Plant	Animal	Mineral	Regenerated Cellulosic	Synthetic
Cotton	Wool	Asbestos	Rayon	Nylon
				Polyester
Linen	Silk		Lyocell	Acrylic
				Spandex

1.2.1 Vegetable or Cellulosic fibers

Cotton

A Seed fiber, found attached to the seed of the cotton plant is the most important apparel fiber. The fiber is natural cream or tan colored with length ranging between of ½ to 2 ½ inches.

Favourable Properties: Cotton, identified as a comfortable fiber exhibits good strength, high absorption, soft hand and good heat conductivity thus making it an ideal choice for clothing in summer. The fiber is also widely used as medical, surgical and sanitary supplies and possesses good heat resistance and can be ironed at high temperature. Its nature of high absorption enables the fiber to be dyed and cleaned easily.

Unfavourable Properties: The fiber has a little lustre, and wrinkles easily. The fiber is susceptible to attacks by mildew, fungus, silverfish and bacteria.

End uses: The combination of properties like , pleasing appearance, comfort, easy care, moderate cost and durability makes cotton ideal for warm weather clothing, active wear, work clothes, upholstery, draperies, carpets, towels and bedding.

Flax

A bast fiber, obtained from the stem of the Flax plant, the fiber when made into a fabric is called Linen. Is one of the oldest textile fibers, and Linen has been used as mummy wraps. It is a medium weight fiber of naturally light tan color with a fiber length between 2 - 36 inches

Favourable Properties: Has excellent strength and is the strongest of the vegetable fibers. It has slightly more lustre than cotton, and absorbs moisture readily. It has the highest safe ironing temperature.

Unfavourable Properties: Similar to cotton wrinkles easily but can be easily laundered.

End Uses: Linen is majorly used as dress materials and table linen.

1.2.2 Animal or Protein Fibers

Wool

Wool is one of the earliest fibers to be spun into yarn and made into cloth. Wool is a protein





fiber obtained from the hair of the sheep, and is similar to the human hair. It is of a naturally cream, brown or black color with a fiber length of 1 - 18 inches. The best known wool is obtained from Merino sheep, which is native to Australia and New Zealand. It emits a smell of burning hair when burnt and leaves a brittle black bead.

Favourable Properties: The wool fiber is scaly and has crimp in its structure due to which the air gets trapped enabling the body to remain warm. . Wool fiber burns slowly with spluttering and once removed from flame it is self-extinguishing.

Unfavourable Properties: The fiber is very weak and gets even weaker when wet. The fiber is sensitive to alkalis such as strong detergents and hence it is best to dry clean or wash with mild soaps with a very gentle action, otherwise shrinkage or loss of shape may occur . It is readily attacked by moth and carpet beetles.

End Uses: Based in the length and fineness of the fibers wool can be converted into two types of fabrics, Woollens, which are made of shorter lengths of wool fibers and Worsteds, which are made of longer length of wool fibers. Worsteds fabrics are expensive are used as suiting.

Silk

Silk is considered as the “queen of fibers”. The Chinese were the first to develop silk and reel it from the cocoon, in 2600 BC. The discovery of silk is accidental, when the princess was having a cup of hot tea sitting under a mulberry tree a cocoon fell into a cup on trying to remove it from the tea a continuous strand was unraveled. Silk is obtained from the cocoon of bombyx mori whose larvae feeds on mulberry leaves. The cocoons are boiled in hot water to suffocate the moth inside. Once the moth is allowed to grow it pierces the cocoon to escape hence its life cycle in terminated inside the cocoon itself reducing the length of the only naturally occurring filament fiber. Cultivation is called sericulture. Silk produced from other species of moth is known as Wild Silk like Tussah silk, Muga Silk etc.

Favourable Properties: Silk has rich subdued lustre, is porous, which allows the skin to breathe, provides warmth without the weight or itch of wool. It is one of the strongest natural fiber but loses strength when wet.

Unfavourable Properties: Silk is sensitive to heat. A warm iron should be used. The fiber has poor resistance to prolonged exposure to sun light and can be attacked by moth. Curtains and draperies should be protected from direct light as silk weakens faster than cotton or wool. Silk is damaged by alkalis but resistant to acids.

End Uses: Dresses, blouses, lingerie, scarves, men’s ties, upholstery and draperies.

1.2.3 Man Made Fibers

Rayon

Rayon was the first manmade fibre created from cellulosic raw material. Because of its luster and soft hand feel, it resembled silk and came to be known as ‘artificial silk’. However, it is more like cotton in its chemical properties.



Properties: It is very absorbent, and creases very easily, but unlike cotton it is very weak, further loses strength when wet. It burns rapidly with a yellow flame and an afterglow, and emits the smell of burning paper. It should be washed carefully with gentle action in warm water and detergent. The ironing temperature is about 190 degrees Celsius.

End Uses: Rayon is used alone and is often blended with other fibres like silk, linen etc. It has an excellent drape, and so is ideal for drapes and curtains, apparel and other household textiles.

Lyocell

Described as an environmentally friendly fiber, Lyocell is a manufactured fiber produced from wood pulp. The fiber is produced from wood harvested from tree farms specifically developed for this end use. The properties of lyocell fibers are more like those of cotton than any of the other regenerated cellulose fibers. Lyocell can be used by itself or blended with any natural or manufactured fiber. It can be processed in a variety of fabrications and finishes to produce a range of surface effects.

Properties: Lyocell fabrics possess a soft, flowing drape that attracts designers. It will wrinkle but not as severely as rayon, and it performs more like cotton than rayon. It has a soft hand and high absorbency.

End Uses: Hosiery, casual wear, upholstery and window treatment fabrics. Used as blends with wool, cotton and other manufactured fibers.

Nylon

Invented in 1938, this synthetic fibre was used to first make stockings that were cheap and durable and other products as varied as ropes, parachutes, tyre chords, mosquito nets and tent. Nylon is thermoplastic in nature, which means that when it is heated it softens and can be remoulded to any shape, which it retains on cooling. This affords it greater design flexibility as pleats, puckers etc. can be permanently set into the fabric.

Properties: Nylon is known for its high strength, both in wet and dry state. It does not crease or wrinkle, and is very light in weight. It is not absorbent, and also has a problem of static build-up that cause garments to cling to the body, and attract dust and dirt. It pills easily, i.e., the fibres break and form small balls that adhere to the surface of the fabric. It is highly resistant to micro-organisms, and mild acids and alkalis. Nylon is an easy-care fabric-machine washable and drip dry, and requires very little ironing. It is heat sensitive and so should be ironed at very low temperatures (not more than 135 degrees Celsius) to prevent scorching.

End Uses: Socks, ropes, parachutes, tyre chords, mosquito nets and tents

Nylon is used for lingerie, hosiery and laces. Carpets, rugs, ropes swimwear, upholstery are some other uses of nylon.

Polyester

Polyester, also known as Terelene, is one of the most commonly used synthetic fibres.



Polyester is thermoplastic in nature. It is also an easy care fibre and can be made into wash and wear fabrics. Polyester fabrics should be ironed at 145 degrees Celsius.

Properties: It has good strength, which does not decrease on wetting. The fibres are light in weight and do not show wrinkling and creasing either. They are not absorbent, which makes them difficult to dye and remove stains from. For this reason and also because they are poor conductors of heat, they are unsuitable for warm weather wear. They show pilling and static build up. Polyester is resistant to weak acids and alkalis, and is not damaged by organic solvents used in dry-cleaning. They are also not damaged by insects or micro-organisms. It melts in the flame, and forms a grey hard non-crushable bead. It emits a dark acrid smoke simultaneously.

End Uses: It is used for outerwear, lingerie, swimwear, and for home furnishings.

Acrylic

Acrylic is used most commonly as a wool substitute. As it is a thermoplastic fibre, it can be given crimp like wool and also be cut to the same staple length as wool. Acrylic can be dry-cleaned or washed, and it dries much faster than wool. Ironing should be done at low temperatures of 135 degrees Celsius.

Properties: it is stronger, lighter and more resistant to microbes than wool. Acrylic does not crease easily. It has better moisture absorption than polyester, but less than nylon. It shows static build up and pilling. Acrylic fibers shrink away from the flame and decompose before melting. This fiber burns with a yellow flame and produce a gummy residue that drips away to form a hard brittle black colored bead.

End Uses: It is used in apparel, blankets and other home furnishing. It can also be blended with wool.

Spandex

Spandex has come to be a very popular fabric not just for sports and exercise wear but also day to day clothing, because of its excellent elasticity. Spandex can elongate 5 to 8 times its original length, and yet return to its original length on releasing. This not only camouflages its low strength but also contributes to its durability. Garments are not made of 100% spandex, rather it is blended with other fibres. Even a small percentage of spandex changes the performance and appearance of a fabric and enhancing its shape retention, crease recovery, and smooth appearance.

Properties: Spandex is not very absorbent and is a poor conductor of heat. It is resistant to body oils and perspiration, and also to chlorine, which makes it suitable for swim wear and exercise wear. Garments with spandex content should not be washed or ironed at very high temperatures as it reduces its elasticity. Ideal ironing temperatures are 135 degrees Celsius.

End Uses: Spandex is used in fabrics for apparel, hosiery, lingerie, and sportswear.



1.3 YARN

What do you find when you pull a thread from a cloth and what happened when you tried opening the thread? You must have found small hair like fibers. A group of such fibers have been aligned together and twisted to form a continuous strand called the YARN. The fibers individually are small and thin and cannot be made directly into a fabric. So they have to be grouped to be made into a yarn which makes them long, strong and thick. The yarns are used to make fabrics.

Yarn is a continuous strand of textile fibers, filaments or materials in a form suitable for knitting, weaving or otherwise intertwining to form a textile fabric.

1.3.1 Yarn Making

The process of conversion of fiber into a yarn is called as Spinning. The spinning process helps to hold the fibres together and makes the yarns strong, smooth and fine. Fibers are converted into yarns by twisting them together, much in the same way as wicks are made for diyas. The direction of twist can either be in a clock wise or anti clock wise and accordingly the twist is referred to as “S” or “Z” twist. The direction of twist does not change the properties of the yarn. The properties of the yarn do depend upon the amount of twist given to the assembly of fibers. The amount of twist given to a yarn is measured as twist per inch (TPI). The amount of twist given to a yarn influences several of its properties:

- Higher the TPI, finer is the yarn
- Twist improves the strength of the yarn
- Increase in twist increases the elasticity of the yarn
- Absorbency of the yarn reduces with increase in twist
- Lustre of the yarn decreases with increase in TPI



Fig. 3 Yarn Twist

Yarns made from short length of fibers like cotton and wool are called spun yarns. Yarns that are made of long length of filament fibers are called filament yarns. The amount of twist given to spun and filament yarns is different. While spun yarns are usually given a higher twist the filament yarns require lower twist.

1.3.2 Types of Yarns

Yarns can be classified into three types:

Single yarns: a group of fibers twisted together to create a yarn.

Ply yarns: when two or more singles yarns are twisted together, they form a ply yarn

Cord Yarns: when two or more ply yarns are twisted together, a cord yarn is formed

Cord yarns are stronger than ply yarns which are in turn stronger than single yarns.



Novelty Yarns

Novelty yarns are also produced by twisting or folding. They are used for decorating fabrics or for giving fabrics a new and unusual structure. Even a simple fabric made from novelty yarns will appear appealing due to the element of interest brought in by the irregular yarn structure. These irregularities may be knots, curls, bumps or similar effects. These yarns though may not be strong or durable. Most of the novelty yarns are ply yarns, and based on the purpose, each yarn is referred to as base/core, effect, or binder.

- The **base/core** yarn provides the structure and strength.
- The **effect yarn** creates decorative detail such as knots and loops.
- The **binder yarn** is used to tie the effect yarn to the base yarn if binding is necessary.

Types of novelty yarns are:

Nub Yarns: The effect yarn is wound over the core yarn in such a way that thick and thin areas are created on the yarn

Boucle Yarns: They have large loops projecting from their surface at regular or irregular intervals

Chenille Yarns: these yarns resemble caterpillars, as tufts of fibers are inserted uniformly in the yarn twist, perpendicular to the yarn

Flock Yarns: yarns to which small tufts of fibers are added at regular intervals, and held in place by the twist

Crepe Yarns: yarns which have been given very high twist, and are exhibit a grainy feel.

Spiral Yarns: tow yarns of different colors and twist are pled together in such a manner that the loosely twisted effect yarn is wound on the core yarn which has high twist.

Ratine Yarns: is similar to the boucle yarn, but the loops projecting are held in place by the binder yarn.

Endless variation of novelty effects could be created, by varying the component yarns, color, twist, fiber content etc.

Sewing Threads: Sewing threads are special kinds of yarns. While yarn is any bunch of fibers twisted together, a thread is a yarn with high twist, smooth surface and high strength. Threads are used for stitching purposes, whereas, yarns can be used in making fabrics through the various types of processes like, weaving, knitting, crocheting etc.

SUMMARY

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Fibers are the smallest part of the fabric. They are fine hair like substances categorized as either natural or man made. Natural fibers are those that are in fiber form as they grow or



develop and come from animal, plant or mineral sources. Man Made fibers are made into fiber form from chemical compounds produced in manufacturing facilities.

Yarn is a continuous strand of textile fibers, filaments or materials in a form suitable for knitting, weaving or otherwise intertwining to form a textile fabric

The process of conversion of fiber into a yarn is called as Spinning. The spinning process helps to hold the fibres together and makes the yarns strong, smooth and fine. Fibers are converted into yarns by twisting them together, much in the same way as wicks are made for diyas. The direction of twist can either be in a clock wise or anti clock wise and accordingly the twist is referred to as “S” or “Z” twist.

Yarns made from short length of fibers like cotton and wool are called spun yarns. Yarns that are made of long length of filament fibers are called filament yarns. Novelty yarns are also produced by twisting or folding. They are used for decorating fabrics or for giving fabrics a new and unusual structure.

Test your learning:

1. From the given fibers circle the odd fiber and specify the reason why is it the odd fiber:

Cotton

Linen

Wool

Silk

2. Label the following with the correct answer:



3. Complete the classification chart.

Fibers				

4. Define the following:

Single Yarns : _____

Ply Yarns : _____

Cord Yarns : _____