FIBRE TO FABRIC

UNIT-I

Introduction to the field of textiles – classification of Fibres- natural and chemical –primary and secondary characteristics of textile fibre

INTRODUCTION OF TEXTILES:

The word "textile" was originally used to define a woven fabric and the processes involved in weaving.Textile refers to any material made of interlacing fibers or Yarns. The yarn is produced by spinning raw fibers of wool, flax, cotton, or other material to produce long strands.Textiles are formed by weaving, knitting, crocheting, knotting, or pressing fibers together (felt).

The production of textiles is a craft whose speed and scale of production has been altered almost beyond recognition by industrialization and the introduction of modern manufacturing techniques. However, for the main types of textiles, plain weave, twill, or satin weave, there is little difference between the ancient and modern methods.

Over the years the term has taken on broad connotations, including the following:

- Staple filaments and fibers for use in yarns or preparation of woven, knitted, tufted or nonwoven fabrics,
- Yarns made from natural or man-made fibers,
- Fabrics and other products made from fibers or from yarns, and
- Apparel or other articles fabricated from the above which retain the flexibility and drape of the original fabrics.

TEXTILE HISTORY

The term 'Textile' is a Latin word originated from the word 'texere' which means 'to weave'. Textile refers to a flexible material comprising of a network of natural or artificial fibers, known as yarn. Textiles are formed by weaving, knitting, crocheting, knotting and pressing fibers together.

History of Textile The history of textile is almost as old as that of human civilization and as time moves on the history of textile has further enriched itself. In the 6th and 7th century BC, the oldest recorded indication of using fiber comes with the invention of flax and wool fabric at the

excavation of Swiss lake inhabitants. In India, the culture of silk was introduced in 400AD, while spinning of cotton traces back to 3000BC.

In China, the discovery and consequent development of sericulture and spin silk methods got initiated at 2640 BC while in Egypt the art of spinning linen and weaving developed in 3400 BC.The discovery of machines and their widespread application in processing natural fibers was a direct outcome of the industrial revolution of the 18th and 19th centuries.The discoveries of various synthetic fibers like nylon created a wider market for textile products and gradually led to the invention of new and improved sources of natural fiber.The development of transportation and communication facilities facilitated the path of a transaction of localized skills and textile art among various countries.

CLASSIFICATION OF FIBRE

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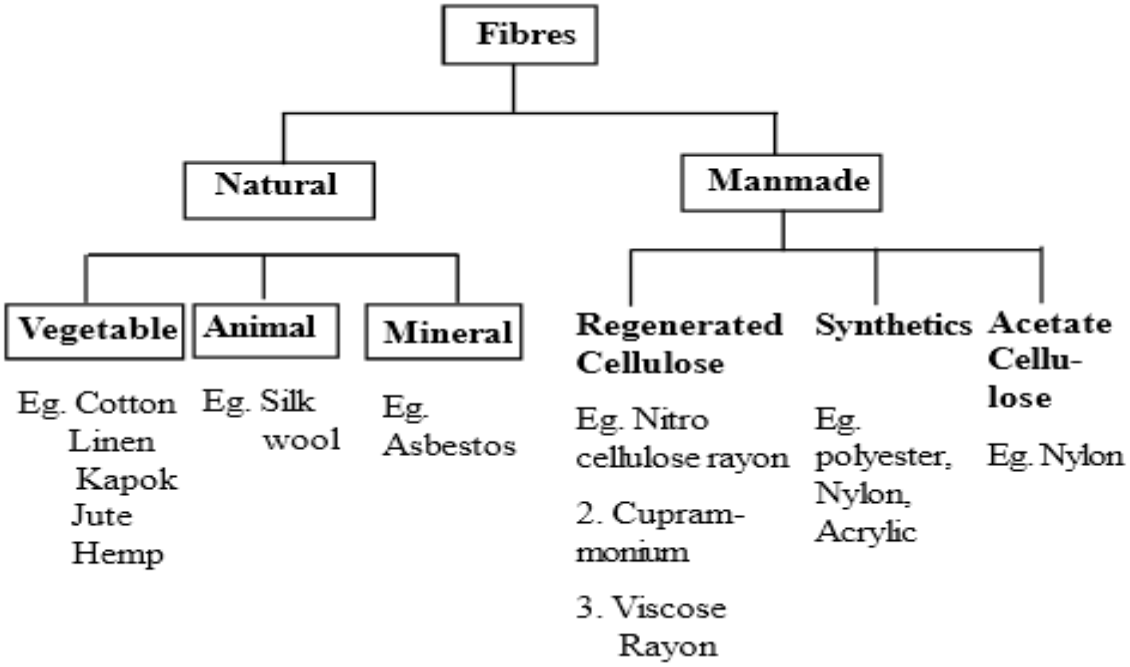

Fibers are the visible units of which yarn and then fabrics are made.

Fibers —-> Yarn ——> Fabrics

Some fibers are short, others very long, some are kinky, scaly and rough, others are straight and smooth. They may have high or low tensile strength or are transparent, opaque, colored, or colorless, even or uneven in diameter. Fibers may be from natural sources or man-made. The major fibers can be classified as follows.

1. NATURAL FIBERS(primary fibre)

Natural fibers are those that can be seen in nature and classified further as vegetable, animal and mineral.

(a) Vegetable fibers:

These fibers are found in the cell walls of plants and are cellulose in composition. The common vegetable fibers are cotton, linen, jute, hemp, sisal, ramie and coir etc. Cotton contains about 91 percent of cellulose, so also hemp and flax contain approximately large amount. Cellulose fibers are low in resiliency so the fabrics wrinkle easily. Because of its high absorbency nature, these fibers are comfortable for summer wear.

- **Cotton:** Cotton is most widely used natural fiber and consists of pure cellulose. It is produced in China, Brazil, India, Pakistan, USA and Uzbekistan.
- **Flax:** **Flax** is a lignocellulosic bast fiber, mostly present in European Union. This fiber is mostly used to make linen.
- **Hemp:** Hemp is also a lignocellulosic bast fiber with low quantity of lignin. The world's leading producer of hemp fiber is China.
- **Jute:** Jute is the strongest vegetable fiber from India and Bangladesh. It is also a lignocellulosic fiber.
- **Ramie:** Ramie is also a lignocellulosic bast fibre mostly available in China and Brazil. It is also known as China grass, with a silky lustre and better elasticity.
- **Sisal:** Sisal is a hard and coarser leaf fiber, mostly available in Brazil, Tanzania and Kenya.
- **Abaca:** Abaca is a leaf fiber, also known as manila hemp, extracted from leaf sheath around the trunk of Musa textiles. The world's major fi bre producer is Philippines. Lignin content in the fibre is about 15%.
- **Coir:** Coir is a hard, short and coarse fiber extracted from the shells of coconut. It is mostly present in India, Sri Lanka, Philippines, Vietnam, Indonesia and Brazil. This fibre contains highest amount of lignin making it stronger but less flexible

(B) ANIMAL FIBERS:

Animal fibers, produced by animals or insects are protein in composition. Silk and wool are the most well known animal fibers used for textile. Wool grows from the skin of sheep and silk is unwound from the cocoon of a moth caterpillar known as silkworm. Other animal fibers are hair fibers such as camel, mohair, cashmere and rabbit etc. Animal fibers are very resilient and

wrinkles go out between wearing. However, they are bad conductors of heat and build up static electricity in cold and dry weather. They are destroyed by concentrated mineral acids but the specific action of the dilute acids is not very harmful on either.

- **Alpaca:** Alpaca is a hair fiber like wool, comes from the Lama Pocos. This fibre comes in approximately 22 natural colors, produced mostly in Peru, North America, Australia and New Zealand. It is stronger than wool fiber.
- **Angora:** Angora is a rabbit fiber, very soft, fine and silky. 90% of the fiber is produced in China. Angora fabric is very suitable for thermal clothing.
- **Camel hair:** Camel hair is available from the two humped Bactrian camel mostly present with nomadic households in Mongolia and inner Mongolia, China. It is the softest and more premium hair fibre.
- **Cashmere fiber:** Cashmere fiber is available with Kashmir goats, in China, Australia, India, Pakistan, New Zealand, Turkey and USA. It is a luxurious and expensive fiber.
- **Mohair fiber:** Mohair fiber is produced from Angora goat, available in South Africa. It is a smooth and lustrous fiber.
- **Silk:** Silk is the natural filament fiber, with high lustre, mostly produced in China, Brazil, India, Thailand and Vietnam.
- **Wool:** Wool is the most important protein fiber. It is the first domesticated fiber, mostly produced in Australia, New Zealand, China, Iran, Argentina and UK.

(C) MINERAL FIBER:

Mineral fibers, like asbestos, are mined from certain types of rock. This is practically the only natural mineral fiber. This fiber is inorganic and used for fire-proof fabrics, fire-proof curtains and screens and for many industrial uses. It is also used for floor and table mats.

2. MAN-MADE FIBERS (Secondary Fibre)

Man-made fibers are otherwise known as ‘manufactured’ or artificial fibers. These are derived from various sources of different nature, like cellulose, thermoplastic, protein and minerals in nature.

(a) Cellulose fibers:

Cellulose fibers are produced by man taken from the natural material of cellulose from cotton linters and wood pulp, processed it chemically and changed its form and several other characteristics into fibers of various lengths. Examples of man-made cellulose fibers are rayon, acetate, triacetate etc.

(b) Synthetic fibers:

These are another group of man made fibers. Synthetic fibers have been and are still being created by research chemists imitating properties of other fibers, to develop other characteristics, or to combine certain properties. These fibers are synthesized by combining carbon, oxygen, hydrogen and other simple chemical elements into large, complex molecular combination or structures called 'Polymers'. Examples of synthetic fibers are nylon, aramid, polyester, acrylic, vinyon etc.

(c) Man-made protein fiber:
Some fibers have been produced from the products as corn, processed it chemically and converted into man-made protein fibers, such as ardil, vicara and caslen etc.

(d) Minerals, Metallic and Rubber fibers:
Man-made fibers created from other sources are mineral fibers, metallic fibers and rubber fibers. Glass fibers are produced by mining and refining such metals are aluminum, silver and gold. Rubber fibers are made from the sap tapped from the rubber tree.

There are various types of fibers and not all fibers can be used in the manufacture of fabrics. The fibers intended for clothing must have the following primary properties.

1. Staple:
It is the dimension of the fiber, such as the length and diameter. A fiber has to be long and fine enough for satisfactory use. The longer the fiber, the more will be the strength of the yarn. Silk is a long fiber, but wool and cotton are short. Hence, silk produces fine, smooth and uniform fabrics with better draping qualities than the coarser fibers.

2. Elasticity:
Fibers must be pliable enough to wrap round each other to produce a yarn, producing a better fabric. The fabric must resist crushing by bearing impacts and spring back to their original state. This property makes the fabrics droppable, wrinkle resistant and helps to maintain their shape and size.

3. Strength:
The fiber must also be strong enough to be spun into yarn and subsequently into durable fabrics. The strength of the textile fibers is very much influenced by the moisture in the atmosphere. In general, vegetable fibers are stronger when they are wet, while some man-made fibers like rayon and acetate are weaker in that state.

4. Uniformity to staple:
Fibers of uniform staple (dimension) spin better and make a smoother and uniform yarn.

5. Spinning quality:

In order to have good spinning quality, fibers must have cohesiveness as this prevents fiber slippage. Four main factors contribute to cohesiveness between fibers and yarn is fineness of staple, nature of surface, pressure through twisting and length of the fibers.

Besides these above mentioned properties, there are also other required properties such as: density or specific gravity, luster, moisture regain, flammability, resistance to heat, alkalis, acids and bleaches etc. The durability of a fabric is more or less determined by the fiber from which it is made. A strong fiber produces strong cloth and long fibers tend to make strong yarns.

Manmade fibers, such as nylon, polyester, and rayon, are produced by chemical reactions controlled by people, rather than occurring naturally. The term synthetic fibers is often used to designate manmade fibers; however, to many people, this term has a negative connotation, meaning inauthentic, artificial, or fake. TFPIA classifies manmade or manufactured fibers by generic names. Currently, TFPIA recognizes 26 generic groups of manmade fibers. Three conditions must be met before a new generic group is established:

• The chemical composition must be radically different from those on the list, and that chemical constitution must produce significantly different physical properties.
• A new proposed classification must have importance to the majority of consumers and not just to a small group of professionals.
• The fiber must be in active commercial development. Manmade fibers are identified as being made from a natural polymer base, made from a synthetic polymer base, or mineral- or specialty-based.

2.2.1 Natural-Polymer-Based Fibers

Natural-polymer-based fibers include cellulose-based, protein-based, alginate, rubber, and starch fibers.
Cellulose-based fibers include rayon, acetate, triacetate, and lyocell.

2.2.2 Synthetic-Polymer-Based Fibers

Synthetic-polymer-based fibers are those made from chemical polymers not found in nature. These fibers are mainly insoluble and are not chemically reactive. The most common synthetic polymer-based fibers are acrylics, aramids, modacrylics, nylon,
olefins, polyester, and spandex.

2.2.3 Manmade Mineral-Based and Specialty Fibers

Manmade mineral-based and specialty fibers include special-use fibers such as glass fibers and metallic fibers.

Man-made fibres account for 68% of all fibres produced worldwide, and for 82% in Europe,

including Turkey.

Their principal end-use is in clothing, carpets, household textiles and a wide range of technical products - tyres, conveyor belts, fillings for sleeping bags and cold-weather clothing, filters for improving the quality of air and water in the environment, fire-resistant materials, reinforcement in composites used for advanced aircraft production, and much else. Fibres are precisely engineered to give the right combination of qualities required for the end-use in question: appearance, handle, strength, durability, stretch, stability, warmth, protection, easy care, breathability, moisture absorption and value for money, for example. In many cases, they are used in blends with natural fibres such as cotton and wool.

Man-made fibres come in two main forms: **continuous filament**, used for weaving, knitting or carpet production; and **staple**, discontinuous lengths of fibre which can be spun into yarn or incorporated in unspun uses such as fillings or nonwovens.