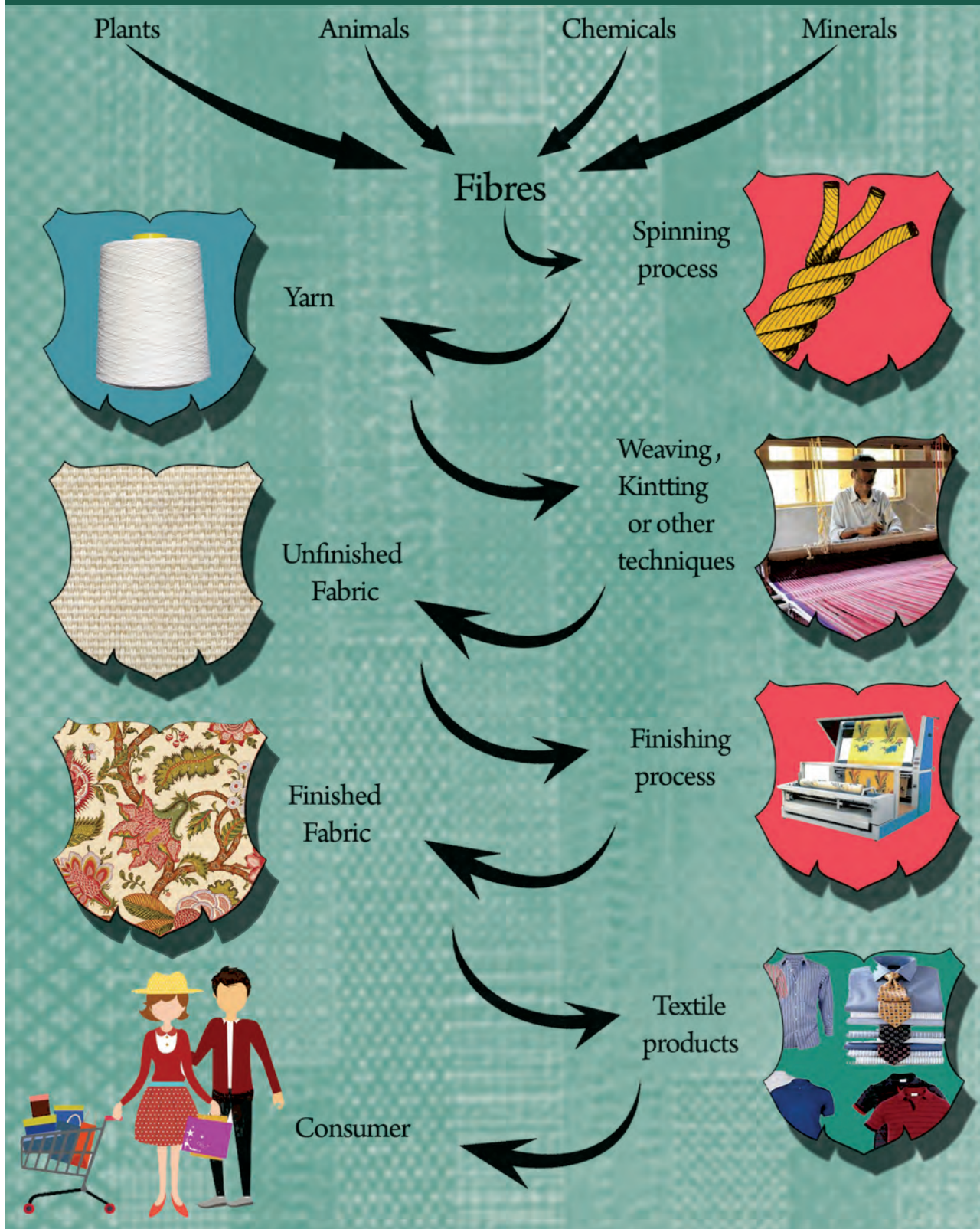


# Textiles



## Unit 1

# INTRODUCTION TO TEXTILES

### What do you think ?

- Do you think prehistoric man used to wear clothes?
- When did mankind started using clothes and why?
- How do we come to know that mankind has been using clothes since very ancient times?

You will find the answers to all such questions in this Section.

### 1.1 HISTORY OF TEXTILES

Food, clothing and shelter are three basic necessities of our life. Out of these three, clothing is used only by mankind. When mankind was uncivilized, clothing was not needed. Clothing in a way is a symbol of civilization..

Till 18th century, India was one of the leading countries in the field of textiles. (see Pic. No. 1.1 and 1.2) made on handloom with very simple and primitive tools were world famous because of their artistry and finesse. You will learn more about various traditional textiles made in different parts of our country in chapter no. 10.

### A peek in the History!

There is archeological evidence of a cotton textile industry at Mohen-jo-daro in the Indus Valley around 3000 B. C., and a few fragments of textiles, parts of handloom and some spinning tools have been found. Based on these evidences, history of Textiles has been documented. These evidences suggest that Linen, Wool Silk and Cotton have been used by mankind since very ancient times. Old Indian scriptures like **Vedas**, **Ramayan**, **Mahabharat**, Buddhist Jain Literatures provide information about the kind of different textiles at that time. All these suggest a very rich and advanced culture of Textiles in our country.



Pic no. 1.1 Handloom weaving



Pic. No. 1.2 Hand woven saree

### Development of Textile industry

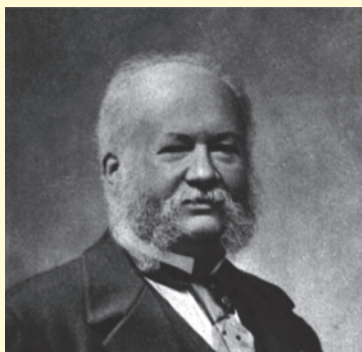
- Can you believe that less than a 100 years ago, people did not know about nylon socks, polyester sarees and terricot shirts?



- Who were the pioneers in development of Textile industry?
- Why did scientists invented new kind of fibres?
- How their discoveries changed the way we use textiles today?

### Know your scientists!

In 1884 Count Hilaire de Chardonnet successfully made an artificial fibre using natural raw material. This fibre was highly lustrous and so was named **Rayon** which means 'reflecting sun rays'. Later many other varieties of rayon were discovered.



Pic. No. 1.3  
Count Hilaire de Chardonnet

Due to industrial revolution, the machinery and technology for making fabrics also underwent a lot of change. A number of machines were invented and manufacturing fabrics became a huge textile industry in place of the small cottage industry.

### Internet my friend!

Find out which other scientists have contributed in the development of textile industry .

### Can you tell !

- What is used as raw material for making clothes?
- Can you name a few fibres?

As population grew, use of textiles increased. Production of natural fibres was not enough to meet the ever growing demand and so scientists started finding out different alternatives for the limited natural fibres.

### Know your scientists!

In 1940 a brilliant scientist called **W. H. Carothers** and his team invented the first synthetic fibre called **Nylon** using chemicals as raw materials. A few years later, English scientists came up with another fibre made from a different set of chemicals which became popular as **Polyester**. A number of other man-made fibres have been made ever since.



Pic. No. 1.4  
W. H. Carothers

## 1.2 MEANING AND SCOPE OF TEXTILES

The term 'textile' comes from the Latin word 'textilis' which comes from the verb 'texere'. The verb 'texere' means **to weave**. Thus the word textiles means –

**Any product made from yarns which are spun or made of fibres.**

Thus, the term 'textile' covers a large area which includes any material that can be worked into fabric, such as fibres and yarns, including woven, knitted, bonded, felted, needle punched fabrics, crocheted goods etc.

**Chart No. 1.1 Sequence of Fabric Construction**



### **Importance of Studying textiles :**

As textiles is such an integral part of our lives, we must learn how to select and buy fabrics wisely. We must have some knowledge about the different kinds of textile fibres and their properties. This will help us to know how to use them correctly and how to take care of them so that they can serve us well. The study textiles help us to know about the following.

#### **❖ Importance of studying textiles**

As textiles is such an integral part of our lives, we must learn how to select and buy fabrics wisely. We must have some knowledge about the different kinds of textile fibres and their properties. This will help us to know how to use them correctly and how to take care of them so that they can serve us well. The study of textiles help us to know about the following –

- 1. Different types of textile fibres, their properties and uses.*
- 2. Techniques of making yarns and different types of yarns.*
- 3. Different ways of making fabrics, different weaves and their characteristics.*
- 4. Various finishing processes done on fabrics to improve their quality and performance.*
- 5. Selection, use, care and maintenance of different types of textiles.*

### **❖ Uses of Textile Fibres :**

As population grew, use of textiles increased. Production of natural fibres was not enough to meet the ever growing demand and so scientists started finding out different alternatives for the limited natural fibres.

Due to industrial revolution, the machinery and technology for making fabrics also underwent a lot of change. A number of machines were invented and manufacturing fabrics became a huge textile industry in place of the small cottage industry.

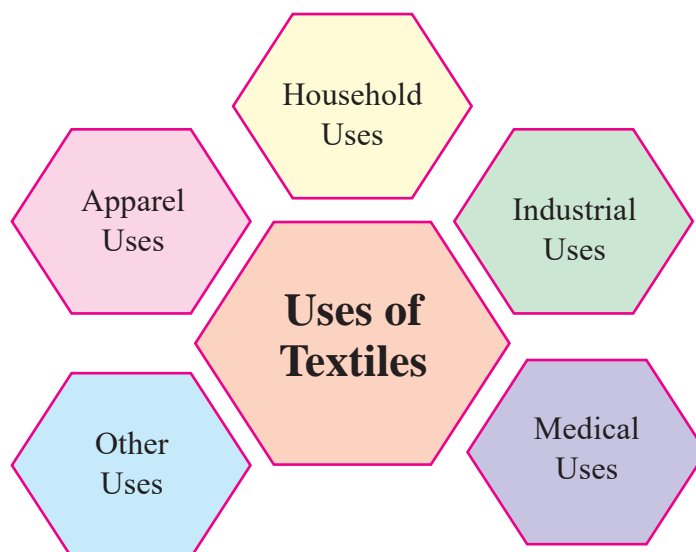
#### **Internet my friend!**

Find out which other scientists have contributed in the development of textile industry .

#### **Can you tell !**

- *What is used as raw material for making clothes?*
- *Can you name a few fibres?*

**Table No. 1.2 Uses of Textiles**



*Do it yourself : Write more example of each of the uses in the given table no. 1.3*

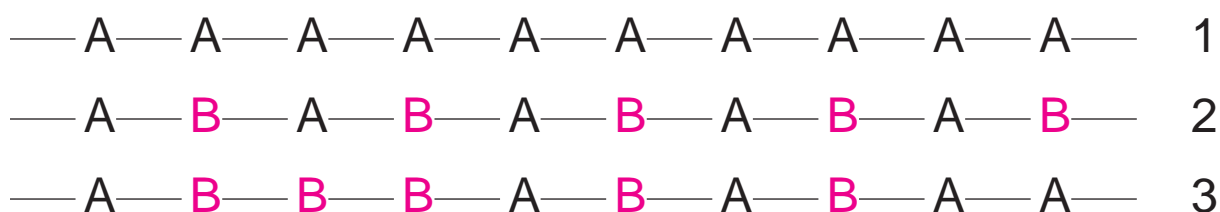
**Table No. 1.3 Uses of Textiles**

1. Apparel Use	Shirt, Saree, Pant, Salwar, Kameez Kurta Dhoti
	.....
	.....
2. Household Use	Curtains, Bed Sheets, Towels, Table mats, Draperies
	.....
	.....
3. Industrial use	Ropes, Sacks, Nets, Fire fighting suits, Threads Bags
	.....
	.....
4. Medical Use	Dressing of wounds, Sutures, Artificial arteries,
	.....
	.....
5. Other Use	Umbrella, Boots, Stitching threads, Purse, Caps
	Lace
	.....
	.....

- How many types of fibres are available to us?
- From which sources do we get these fibres?

In case of all natural fibres, this polymerisation happens in nature by itself. In case of man made fibres, polymerisation is artificially done in factories using either high temperature or high pressure or both. The polymer can be composed of single monomeric units only one type (Fig 1.5.1) or multiple monomeric units - different types (Fig 1.5 - 2 and 3) or multiple.

**Fig No. 1.5 Polymerisation**



The long chain of polymer is not visible with naked eyes or even under regular microscope. The total number of monomers joined together to form a polymer is called “**degree of polymerisation**” or **dp**.

**Do you know:**

**The longer the chain of monomers, the higher the dp of the polymer.**

**The strength of a fibre depends upon dp. The more the dp, stronger the fibre.**

**Keep in mind some important terms used in Textiles :**

- 1. Staple Fibre** - All such fibres which are short in length and can be measured in cm, inches or feet are called staple fibres. All natural fibres except silk are staple fibres.
- 2. Filament Fibre** - Fibres which are very long and can be measured in thousands of meters or yards are called filament fibres. All man-made fibres fall in this category. Amongst natural fibres, Silk is the only filament.

**3. Thermoplastic Fibre** - Certain fibres have a tendency to soften or change shape due to heat. If the temperature goes higher, they melt and so they are called thermoplastic fibre (Thermo – heat, Plastic – changing shape). All man-made fibres except Rayon are thermoplastic fibres.

**4. Non-thermoplastic Fibre** - The fibres which do not melt due to heat are called non-thermoplastic fibres. If the heat is more, they will burn and turn to ash. All natural fibres and Rayon fall in this category.

The difference between Thermoplastic and Non-thermoplastic fibres is shown in Table no. 1.3-

❖ **Composition of Fibres**

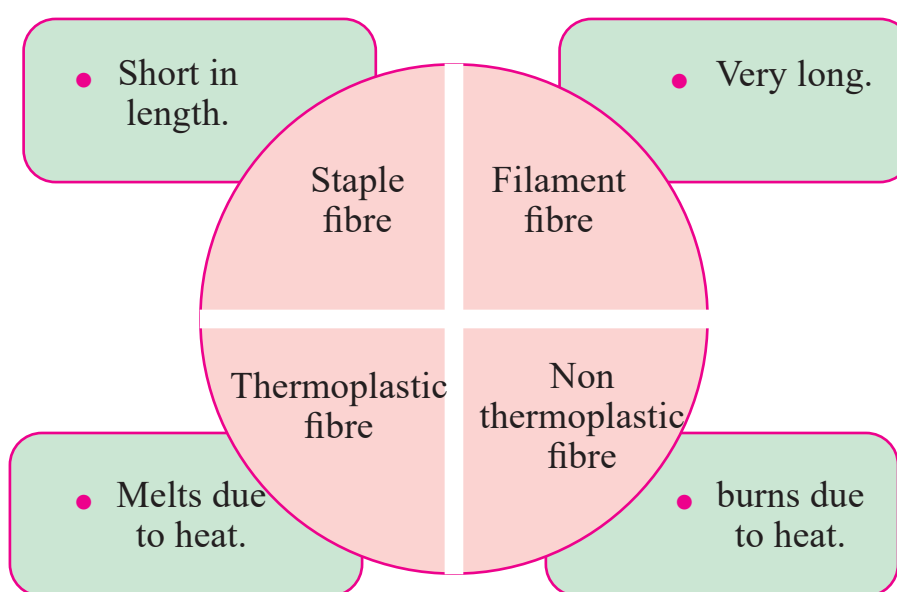
All fibres, whether natural or man-made are scientifically termed as Polymers. The word ‘**polymer**’ is derived from a Greek word meaning ‘**many parts**’. When a number of small molecules i.e. monomers link together to make a big molecule, it is called ‘polymer’.

Single unit (molecule)	-	<b>Monomer.</b>
Many units (molecules) linked together	-	<b>Polymer.</b>

In case of all natural fibres, this polymerisation happens in nature by itself. In case of man made fibres, polymerisation is artificially done in factories using either high temperature or high pressure or both. The polymer can be composed of single monomeric units only one type (Fig 1.5.1) or multiple monomeric units - different types (Fig 1.5 - 2 and 3) or multiple.

**Fig. No. 1.4 Important terms used in Textiles**

**Fig. No. 1.6**



The difference between Thermoplastic and Non-thermoplastic fibres is shown in Table no. 1.5

**Table No. 1.5 Difference between Thermoplastic and Non thermoplastic fibres**

Thermoplastic Fibres	Non-thermoplastic Fibres
1. They start softening and changing shape beyond a certain temperature.	1. They start scorching beyond a certain temperature
2. If the temperature goes higher, they melt.	2. If the temperature goes higher, they burn.
3. Upon melting they form a hard, black bead.	3. Upon burning, they turn to ash.

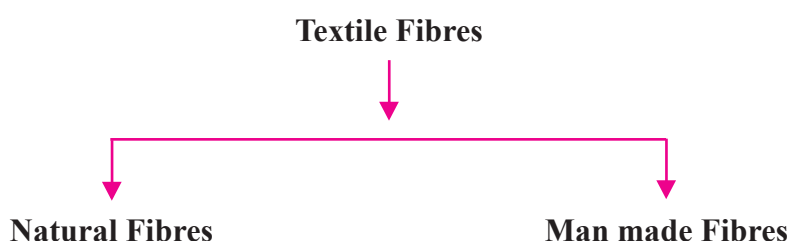
### 1.3 CLASSIFICATION OF TEXTILE FIBRES

There are many types of fibres available in nature but all of them can not be used for making fabrics. The fibres which can be made into fabrics are called **Textile fibres**. A textile fibre can be defined as follows-

*Any small thread-like structure which can be woven or otherwise made into a fabric is called Textile Fibre. It is the smallest unit in textiles.*

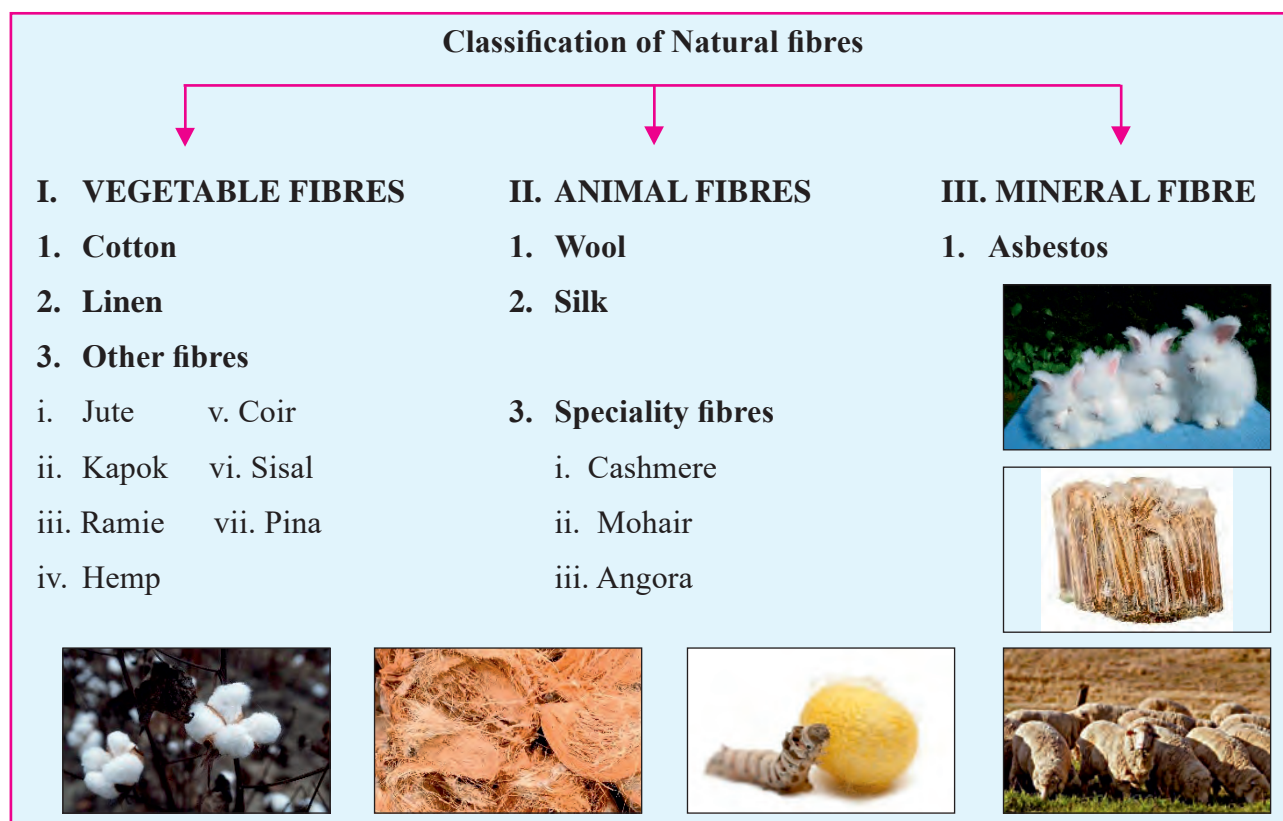
Textile fibres are traditionally classified according to their source. Thus a broad classification of textile fibres will be into **Natural fibres** and **Man made fibres**. These are further divided into specific classes. Chart no. 1.4, 1.5 and 1.7 make this classification more easy to understand.

**Chart No. 1.6 : Classification of fibres**



*The fibres which are available in nature in fibre form are called Natural fibres.* They are obtained from three major sources – Vegetable, Animal and Mineral. ( See Chart No.1.5)

**Chart No. 1.7 :**





**Vegetable Fibres :** These fibres are available from vegetable origin. Chemically they are composed of cellulose and hence are also known as **Cellulosic fibres**. These fibres are available from different parts of different plants like stem, leaves, fruit etc. Cotton and Linen are the most used fibres from this category.

**Animal Fibres :** These fibres are available from animals. Chemically they are composed of protein and hence are also known as **Protein Fibres**. These fibres are either body hair of certain animals or secretion of certain insects.

Wool and Silk are the most popular fibres from this category.

**Mineral Fibres :** There is only one fibre available in this category called **Asbestos**. It is available from certain kind of rocks and has a very special property that it does not catch fire. Because of this property it has extensive use in industrial and construction sector.

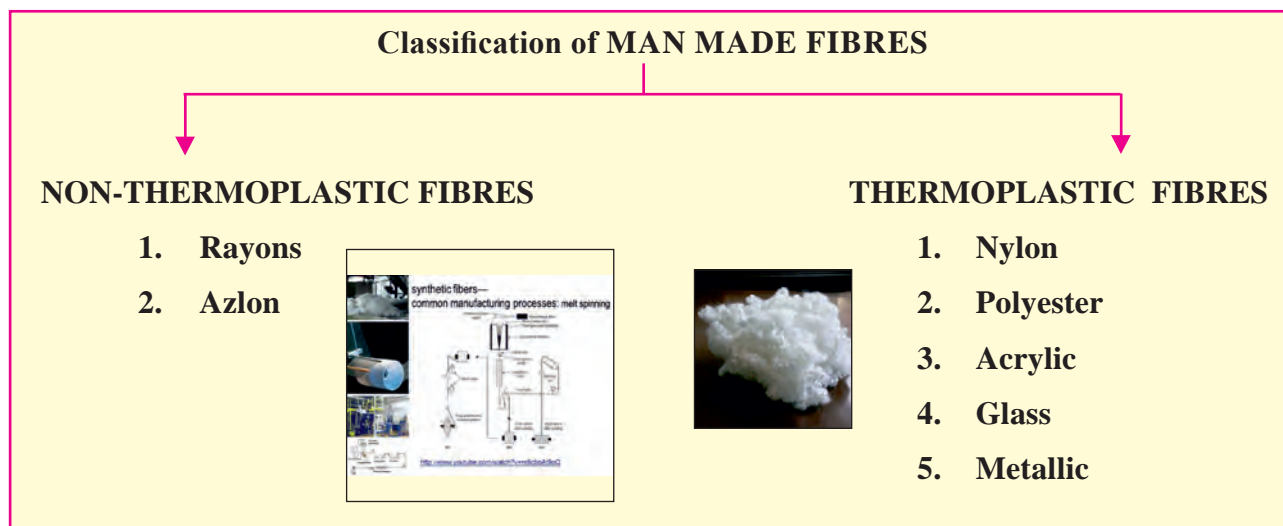
The difference between Natural Vegetable fibres and Natural Animal fibres is given in table no. 1.6 :

**Table No. 1.6 Difference between Natural Vegetable Fibres and Natural Animal Fibres**

Natural Vegetable Fibres	Natural Animal Fibres
1. Available from different parts of different plants. Examples – Cotton, Linen etc.	1. Available from different animals. Examples – Wool, Silk etc.
2. They are chemically cellulosic fibres.	2. They are chemically protein fibres.

*The fibres which are not available in nature in fibrous form and are produced by man with the help of either natural or synthetic materials are known as Man-made fibres or Synthetic fibres.*

**Chart No. 1.9:**



**Rayons** - The raw material for these fibres is obtained from natural cellulosic source only. Because of this reason, rayons are also known as **Regenerated Cellulosic fibres**. **Viscose rayon** is the most popular fibre amongst all rayons.

**Azlon** - The raw material for this is obtained from natural protein sources. Azlon fibres are soft to touch and are used to make blends with other fibres.

**Nylon, Polyester etc.** – The raw material for these fibres is obtained from different chemicals. All these fibres are **thermoplastic**.

**Glass & Metallics** - These are manufactured by using natural minerals and metals which are not originally in fibrous form. Hence they are also known as **Man-made Mineral fibres**. They are also **thermoplastic** but they melt or change shape at extremely high temperatures.

### Internet my friend!

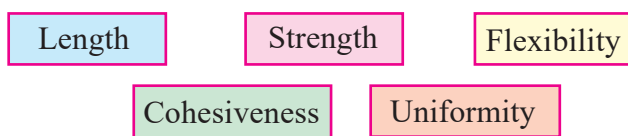
Find out about the latest man-made fibres invented and their various uses.

- *What are the properties of all these natural and man-made fibres?*
- *How the knowledge of these properties help us in selecting textiles?*

## 1.4 PROPERTIES OF TEXTILE FIBRES

A linear polymer can be called a textile fibre only if it possess certain specific qualities. The properties which are necessary for a fibre to be called a textile fibre are called **Primary properties**. Certain other properties are desirable in a textile fibre. They are called **Secondary properties**. These are properties which may not be an absolute must but their presence improves the utility of the fibre. Chart no. 1.10 shows the primary and secondary properties of textile fibres:

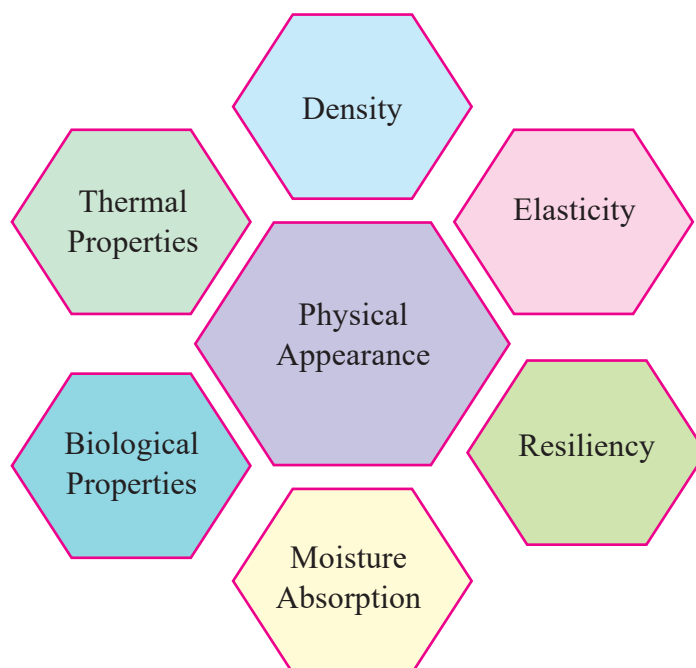
**Chart No. 1.10 Properties of Textile Fibres - Primary Properties**



**Primary properties** : These are properties that a textile fibre must possess in order to be called a textile fibre. There are five such properties-

1. **Length** : A textile fibre must have sufficient length to be made into a yarn. It should be at least 100 times longer than its width. Generally, the longer the fibre, the stronger the yarn made from it.
2. **Strength** : A textile fibre must have adequate strength to be spun into a yarn and later woven into a fabric. The strength of a fibre is measured in grams of force per denier (g/den). The strength of a fibre, should be considered in both dry as well as in wet condition. The wet strength of a fibre gives us an idea about which method to use for washing it.
3. **Flexibility** : The ability of a fibre to bend without breaking is called flexibility or pliability. Textile fibres should be flexible so that they can be spun into a yarn. Flexibility of the fibre helps in creating a fabric which has good draping ability. Draping ability helps the fabric to mould over the body and to move with the body.
4. **Cohesiveness** : This is the ability of fibres to stay together and adhere to each other. Without this property, it will be impossible to keep fibres together to make a yarn.
5. **Uniformity** : If the fibres will be similar to each other in all the above four properties, then only it will be possible to make a regular yarn and smooth fabric out of them.

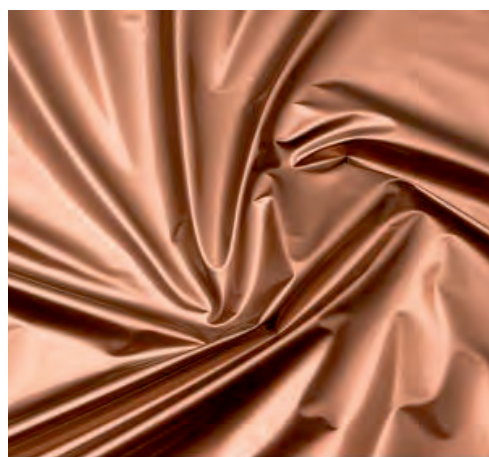
**Chart No. 1.11 Properties of Textile Fibres - Secondary Properties**



**Secondary Properties :** These are properties which are desirable in a textile fibre, but not essential. If they are present in a fibre, they help in making a better fabric. But even if they are not present in a fibre, a fabric can still be made from it. There are many such properties.

- 1. Physical Appearance :** Usually length, colour, lustre and texture are considered in physical appearance. In general, a smooth, regular looking fibre will result in a smooth, regular looking fabric.

**A. Lustre :** It is the shine of the fibre. A lustrous fibre makes a lustrous fabric which looks more attractive. Silk has the best lustre amongst all textile fibres. Cotton is not lustrous. Man-made fibres are very lustrous but their lustre can be controlled.



**Pic. No. 1.6 Lustrous Fabric**



**Pic. No. 1.7 Dull Fabric**

**B. Colour :** Most natural fibres have some or the other colour. Cotton and silk are usually off white or cream coloured, linen is cream to light brown or gray and wool is available in many colours including black. Man-made fibres are usually pure white but they can be manufactured into any colour.

**C. Texture :** It is the surface quality or the 'feel' of the fabric. Silk is very smooth in touch. Wool and cotton are slightly rough. Jute and Coir are quite rough in texture. Man-made fibres are usually very smooth but their texture can also be controlled.

**2. Density :** This means mass or weight per unit volume and is expressed in gm/cc. In plain language, it means how dense is the fibre. A high density fibre will make a heavier fabric while a low density fibre will make a light weight fabric.

**3. Elasticity :** The ability of a fibre to stretch when force is applied and come back to the original position when the force is removed, is known as elasticity. The man-made fibres in general have better elasticity than natural fibres. This is a convenience property. It helps in putting on and taking off clothes.

**4. Resiliency :** This is the ability of a fibre to save itself from wrinkling. If this property is good in fibre, the fabric will not get creased and ironing will not be required. Bad resiliency results in frequent ironing. Man-made fibres have very good resiliency as compared to natural fibres.

**5. Moisture Absorption :** If the moisture absorption of a fibre is good, it will absorb perspiration thus making the fabric comfortable to wear. It will take time to dry. If the moisture absorption is not good, fabric will not be comfortable to wear but will dry quickly. Man-made fibres usually have low moisture absorption than natural fibres.

### Have you ever wondered?

1. It is a common experience that it is easier to wear or take off a leggings as compared to a cotton churidar. Why?
2. You generally have to iron your dresses but not your dupattas. Why?
3. Synthetic clothes dry quickly while cotton clothes take a lot of time to dry especially in monsoons. Why?
4. At times synthetic clothes start sticking to the iron while ironing. Why?
5. We prefer to wear cottons during summers and woollens during winters. Why?
6. Towels start smelling bad during monsoons. Why?

**Hint:** The answers lie in the properties.

**6. Thermal Properties :** These are properties related to heat:

**A. Effect of Heat :** The ability of a fibre to tolerate heat without getting damaged by it. This property helps us to know how to wash and iron fabrics made from different kinds of fibres. Man-made fibres being thermoplastic can easily get damaged by heat.



**B. Heat Conductivity :** The ability of a fibre to pass heat through itself. Fibres with good heat conductivity pass our body heat to the outer atmosphere and make us feel comfortable in summers. Fibres with bad heat conductivity does not pass our body heat to the outer atmosphere and thus give us comfort in winters.

**Use Your Brain Power**

1. Some important properties of textile fibres got jumbled below. Find out the property and write it in the given space.

a) Y C I T A S E L I T -

b) C R I L E N Y S E I -

c) T U R E S L -

d) S E D I N Y T -

e) G S T E R N H T -

f) H E L G N T -

**7. Biological Properties :** These are properties related to damage and durability.

**A. Effect of Moth :** Certain fibres can get damaged by small insects called Moths. In general, Natural Animal Fibres get easily damaged by moths.

**B. Effect of Mildew :** This means whether the fibre will get affected by Mildew i.e. fungus. Natural Vegetable Fibres get easily damaged by mildew. Man-made Fibres are least affected by either Moth or Mildew.

2. Use the letters given below to fill in the blank spaces. Use each letter only once. Read the filled space from top to bottom to find a hidden word.

X T L F R I E T B S E I E

J U	_____	E
L I N	_____	N
F L E	_____	I B I L I T Y
D E N S I	_____	Y
P	_____	N A
S I	_____	K
P O L Y	_____	S T E R
	_____	I L A M E N T
S	_____	S A L
A S	_____	E S T O S
A C	_____	Y L I C
H	_____	M P
G L A	_____	S

3. In the table given below, a few categories of fibres / properties and their examples are given. Unfortunately, some places have been left blank. Can you fill them up?

Fibres / Properties	Examples 1	Examples 2
Primary Properties	Cohesion	
Cellulosic Fibres		Linen
	Silk	Wool
Other Uses of Cotton	Bandage	
Filaments		Silk
Staple Fibres	Cotton	
Thermoplastic Fibres		Nylon

### EXERCISE

#### Objective Type Questions

#### I. Match the following :

(i)

A		B	
1.	Cotton	a)	Protein fibre
2.	Rayon	b)	Man made protein fibre
3.	Asbestos	c)	Regenerated cellulosic fibre
4.	Nylon	d)	Speciality fibre
5.	Silk	e)	Thermoplastic fibre
		f)	Vegetable fibre
		g)	Natural mineral fibre

#### II. Select and write the most appropriate answer from the given alternatives for each question :

- Non-thermoplastic man-made fibre is  
a) Polyester b) Azlon c) Rayon
- Viscose rayon is  
a) Man-made fibre  
b) Natural fibre  
c) Mineral fibre

- Thermoplastic fibre is  
a) Cotton b) Wool c) Nylon
- Regenerated cellulosic fibre is  
a) Silk  
b) Viscose rayon  
c) Polyester
- This is a Primary property of textile fibres  
a) Density  
b) Uniformity  
c) Resiliency

#### III. Write whether the given sentences are True or False :

- Asbestos is the only natural mineral fibre.
- Linen fibres are composed of protein.
- Asbestos is a metallic fibre.
- Moisture absorption is a primary property of textile fibres.

5. Lustre is a secondary property of textile fibres.

**IV. Name the following :**

1. The only natural mineral fibre.
2. The ability of a fibre to save itself from wrinkles.
3. The only natural filament.
4. Regenerated Cellulosic fibre.
5. Fibre made from natural proteins.

**V. Classify the following into following categories :**

- i. **Natural fibre and Man made fibre**  
jute, acrylic, kapok, polyester.
- ii. **Primary Property and Secondary Property**  
uniformity, density, elasticity, strength

**Short Answer Type Question**

**I. Define following terms:**

1. Polymerization
2. Thermoplastic fibre
3. Filaments
4. Staple fibres
5. Regenerated fibre
6. Density
7. Resiliency
8. Primary properties

**II. Differentiate between :**

- i. Thermoplastic fibres and Non thermoplastic fibres
- ii. Natural Cellulosic fibres and Natural protein fibres

**III. Give Reason :**

1. Fabrics made from man-made fibres dry faster.
2. Towels start smelling bad in monsoon.
3. Synthetic fabrics do not require ironing.
4. Rayon is also called regenerated cellulosic fibre.
5. Cotton is used in summers.
6. Woollens are preferred in winters.
7. If the iron is hot, synthetic fabrics start sticking on it.

**IV. Write short notes on the following :**

1. Primary properties ( any two).
2. Resiliency and Density.
3. Heat conductivity and Lustre.
4. Classification chart of Natural fibres.
5. Classification chart of Man-made fibres.

**Self Study / Project**

- Make a list of all textile products we use in our daily life.
- Find out samples of fabric made from various natural and man-made fibres

