

13

INTRODUCTION TO FABRIC SCIENCE

13.1 Introduction

Clothes are as important as food and shelter. You use them for covering, protecting and even decorating yourself. You must be having different types of clothes for different occasions like your casual attire, office wear, party dresses, your night suit and so on. All of these clothes are made of many different types of materials called *fabrics*.

Today, in the market so many types of fabrics are available. Do you know what these fabrics are made of, how do they come in so many different varieties? Why do some fabrics shine more than the others? Some fabrics are light in weight where others are heavy. In this lesson you will find answers to these and many other related questions.

13.2 Objectives

After reading this lesson you will be able to do the following:

- state the meaning and establish the scope of fabric science;
- define a fibre;
- classify fibres according to their origin and length;
- explain the properties and uses of different types of fibres;
- identify a fibre type by means of a simple test.

13.3 Definition and Scope of Fabric Science

Just look around you and pin point all the fabrics in your room. You will find that you are not only wearing a fabric, but also sitting on it and perhaps, have a piece of fabric hanging on the wall as a wall hanging or as curtains on the doors. This means that fabrics not only make your clothes but are also used at home and outside. Can you think of some more uses of fabric? Yes, you are right. Some of the other uses of fabrics at home are – in the kitchen

as napkins, in the bathroom as towels, on the beds, sofas, and even on our floors as carpets. Fabrics also offer many uses in industry, medicine and even in automobiles.

What is a fabric?

A fabric is any piece of cloth.

A study of all the aspects of a fabric is called *fabric science* and it explains the behaviour of a fabric under different conditions.

You must have realised that different fabrics are not only different in their appearance but also in their properties, uses and their care procedures. Silk is smooth and shiny, cotton is smooth but dull, and wool is rough, wool keeps you warm and cotton is cool to wear. Cotton can be washed easily but needs to be ironed after washing for a neat look. Nylon and polyester also are washed very easily and need almost no ironing after washing. Silk is either dry cleaned or washed with special soaps. These and many more concepts of fabrics are explained in fabric science. The market today is flooded with a variety of fabrics in all types of colours, textures and designs. They all vary in their price range as well. To be an intelligent consumer, an exposure to fabric science is important as it helps us to understand a fabric better.

To understand a fabric better, its basic unit and origin needs to be studied.

13.4 Fibre: The Basic Unit

Have you ever wondered what makes a fabric? Find out yourself. Pull out a thread from a fabric and then open it out. You will find that this thread is made of small hair like strands. This single hair like strand is called a fibre. In other words, *the basic unit of a fabric is a fibre.*

13.5 Classification of fibres

Fibres come as short fibres and long fibres and their length is an important property of fibres. To see a short fibre, take a ball of cotton and pull out fibres from it. Notice that these fibres are quite small. Now try and pull out fibres from a nylon fabric. These, you will see, are longer fibres. The short fibres are called staple and the long ones are called filament. So fibres can be classified as follows.

Short fibres — Staple fibres
Long fibres — Filament fibres

Fibres also can be classified according to their origin. Some fibres obtained from natural sources i.e. from plants, animals or minerals are called *natural fibres*. The other fibres are *manmade*.

1. Natural Fibres

a) Vegetable Fibres

Fibres that come from plants are called vegetable fibres and can be obtained from different parts of a plant. You must have seen the white cotton fibres growing on plants. These are the seed hair. Similarly, fibres can be obtained from the stem of a plant e.g. jute and flax, and from the leaves like pineapple fibres. Fibres are also obtained from the outer covering of a fruit, like coir from coconut husk.

All these *plant fibres are cellulosic in nature.*

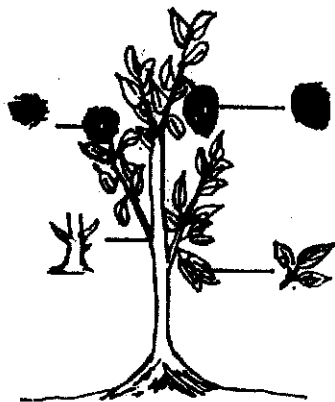


Fig. 13.1 Vegetable Fibres

b) *Animal Fibres*

Can you name the animals which give us fibres?

Sheep is the most common animal whose hair is used as wool. Some other animals are camel, goat, and rabbit.

Silk also an animal fibre. It is the secretion of an insect called the silkworm. The *animal fibres are basically protein in nature.*

c) *Mineral Fibres*

Natural fibres obtained from the earth minerals are called *mineral fibres*, eg. asbestos. You must have seen sheets of asbestos being used as rooftops. Can you think of other uses of asbestos? It is used by firefighters as clothes because it is fireproof.

Natural fibres are usually staple fibres with the exception of silk which is a filament fibre.

2. **Manmade Fibres**

There is another class of fibres called the *manmade fibres*. As the name suggests these fibres are not obtained directly from nature but are made by using chemicals. Manmade fibres are of two types:

a) Regenerated fibres

b) Synthetic fibres

a) *Regenerated fibres* are made from natural raw material eg. cellulose i.e. waste cotton fibres or wood pulp or protein depending upon the fibre to be made. This natural raw material is regenerated with the help of chemicals. Rayon is a regenerated cellulose fibre.

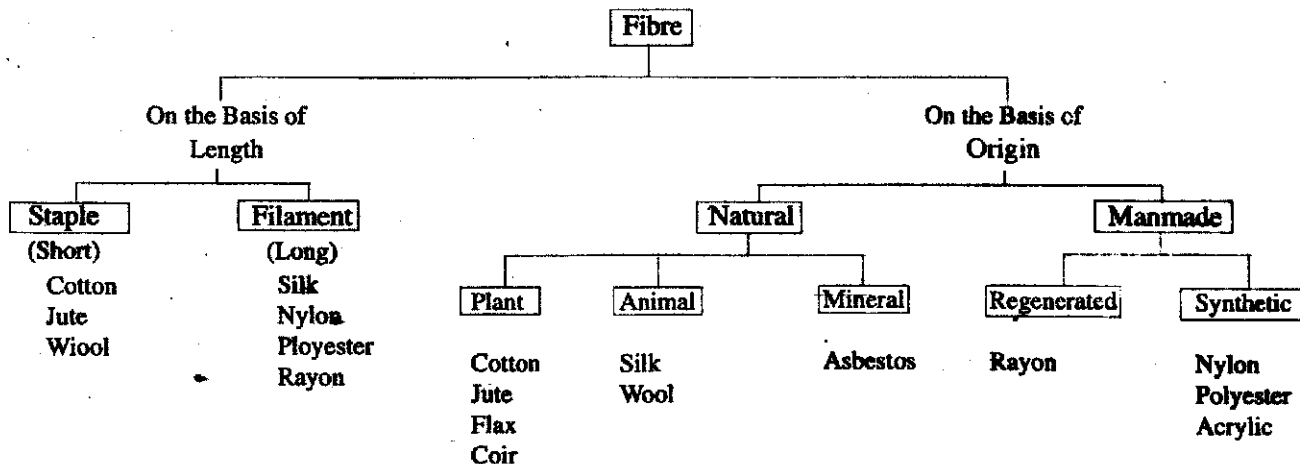
b) Synthetic fibres on the other hand are obtained from chemical substances and are totally synthetic in nature, e.g. Nylon, Polyester, Acrylic (Cashmilon). *Manmade fibres are generally filament fibres.*

Now, can you state the second way of classifying fibres ?

See the following:-

Natural Fibres	-- Plants, Animals, Mineral Sources
Manmade Fibres	-- Regenerated and Synthetic Fibres.

Let us put the two classifications together:



INTEXT QUESTIONS 13.1

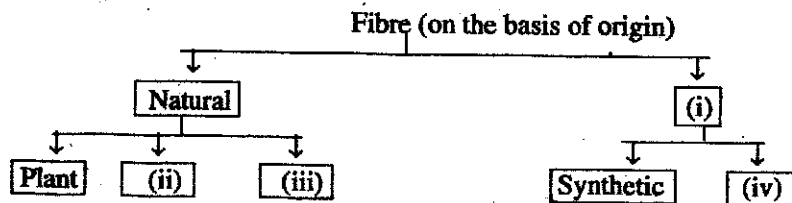
1. Fill in the blanks

- Fabrics are used for making clothes and in the _____, _____, _____ uses, etc.
- A fabric is any piece of _____.
- Fabric Science explains a _____ and it's _____ under different conditions.
- Fibres are the _____ of a fabric.
- Fibres can be classified into natural and _____.
- Manmade fibres can be _____ or synthetic.
- Wool is a _____ fibre obtained from _____.
- Polyester is a _____ fibre.
- Cotton comes from the _____ of a plant.

2. Match the following:

- | | |
|-----------|------------------------------|
| a) Rayon | i) Synthetic fibre |
| b) Cotton | ii) Stem fibre |
| c) Silk | iii) Regenerated fibre |
| d) Nylon | iv) Natural cellulosic fibre |
| e) Wool | v) Leaf fibre |
| f) Jute | vi) Animal fibre |
| | vii) Animal secretion |
| | viii) Mineral fibre |

3. Complete the following classifications



13.7 Identification of Fibres

The vast variety of fabrics available today, make their identification important. You know that variety is created by using different fibres in combination. Knowledge of the fibre content of a fabric is therefore necessary to know its suitability, use and care. Sometime you may have got cheated by an imitation fibre, like a fabric looking like silk but turning out to be artificial silk or imitation silk. Label and salespersons are not always able to guide you.

The following test finds the nature of the fibre by burning it. It is a simple and reliable test and can be done alongwith the visual inspection of the fabric. The burning test does not identify the fibre in particular but indicates its group. Cotton, flax and rayon will have similar results when burnt as they are all basically cellulosic in nature.

a) Visual Inspection

The appearance of a fabric can help you to identify it but accuracy in identifying comes through experience. The appearance properties of different fibres given earlier in this lesson

13.6 Fibre Properties

Characteristics	Cotton	Wool	Silk	Rayon	Nylon	Polyester	Acrylic (Cashmilon)
1. Length of the fibre	Fabric is made up of staple fibres.	It is staple as well as long fibre. Coarser fabrics like blankets, etc. are made of short fibres and finer fabric like suit length is made of long fibres.	It is filament fibre and longest of all natural fibres.	It is a man-made, filament fibre, so can be attained in any desired length.	Same as rayon.	Same as rayon.	Same as rayon.
2. Appearance	It is a dull fibre so gets dirty quickly.	Dull, wavy and rough fibre.	Smooth, shiny and straight so sheds soil and dirt easily. It does not look dirty even after many wears.	Its appearance is smooth and shiny so sheds dirty easily.	Smooth and shiny, so resistant to dirt and easy to wash.	Smooth surface so does not absorb stains and can be washed easily.	Wool appearance, but lighter in weight.
3. Moisture absorption	Cotton absorbs moisture easily and also dries up quickly. So it is useful for towels and wiping cloths. It can absorb perspiration from the body and because it also dries up quickly, it does not stick to the body and gives a cooling effect. It is suitable for summer wear and undergarments.	It is somewhat water repellent in nature. However, the fibre can absorb large quantities of water. They do not dry up quickly and can hold high amount of moisture without feeling damp.	Can absorb large amount of water, without feeling damp.	Like cotton, absorbs moisture readily and also dries up fast.	Does not absorb moisture easily. It is also warm to wear and does not absorb perspiration.	Absorbs least amount of moisture compared to other fibres. Garments appear uncomfortable in summer because it does not absorb perspiration.	Does not absorb moisture easily-this makes it difficult to dye the fiber.
4. Conductor of heat	Good conductor, i.e. conducts the heat away from the body and keeps it cool.	Bad conductor of heat, therefore conserves body heat and keeps it warm.	Poor conductor of heat making it a warm fabric. Due to smooth surface, unlike wool it cannot provide good insulation.	Good conductor of heat and therefore cool to wear, though not as cool as cotton.	Poor conductor of heat.	Poor conductor of heat.	Poor conductor of heat. Therefore it is warm to wear.
5. Strength	Stronger when wet so can be rubbed hard without any damage while washing.	Weak fibre, becomes weaker when it is wet, therefore can be damaged if it is rubbed hard during washing.	Though appears delicate, it is a very strong fibre, it loses strength when wet.	It loses strength when wet, should not be rubbed hard.	Strongest among all fibres. Excellent resistance to rubbing, does not lose any strength when wet, so is important for industrial use.	Extremely strong fibre, although not as strong as nylon.	Satisfactory strength both when dry and wet. Its strength is not as high as nylon and polyester but adequate for many uses in apparel and home furnishings.
6. Resilience (resistance of a fabric to wrinkling and creasing)	Wrinkles and creases readily during use. After washing the wrinkles need to be ironed out.	A flexible and pliable fibre, readily springs back to shape after crushing or creasing.	The creases hang out well. But not as quickly and completely as in wool. Needs ironing after washing.	Wrinkles and creases very easily.	Shows very good recovery from creasing and wrinkling-requires little ironing after washing.	Shows excellent recovery from creasing and wrinkling. It requires little or no ironing after washing.	Good resistance to wrinkling and creasing.
7. Uses	Summer wear, saris, suits, sportswear and undergarments, sheets, curtain and wiping cloth like napkins, towels.	Winter wear-knitted into sweaters, gloves, caps, suits, and coating fabrics, blankets, carpets and home furnishings.	Considered a high value fabric. Used as sarees, dress materials, suits, men's ties, scarves, etc.	Summer wear suits, dress materials. Being slippery it is used as lining for heavy coats and jackets. Also used in carpets and home furnishings.	Used in hosiery items like socks for dress materials and sweaters. Due to high strength, used for making ropes and tyre cords. Also used in carpets and home furnishings.	Dress materials for both men and women. Used for making ropes, cannary bags, fishing nets, etc., used at home for home furnishings.	Winter wear very popular substitute for wool; sportswear also used for making blankets, carpets and furnishing fabrics.

can help you in identifying a fabric e.g. Silk is smooth, shiny and fine. Cotton is also smooth but looks dull, wool is most definitely rough and unsmooth to look at.

b) Burning Test

To conduct the burning test, take a small piece of fabric (2 x 2 cm) and hold it with a pair of forceps. Then do the following:

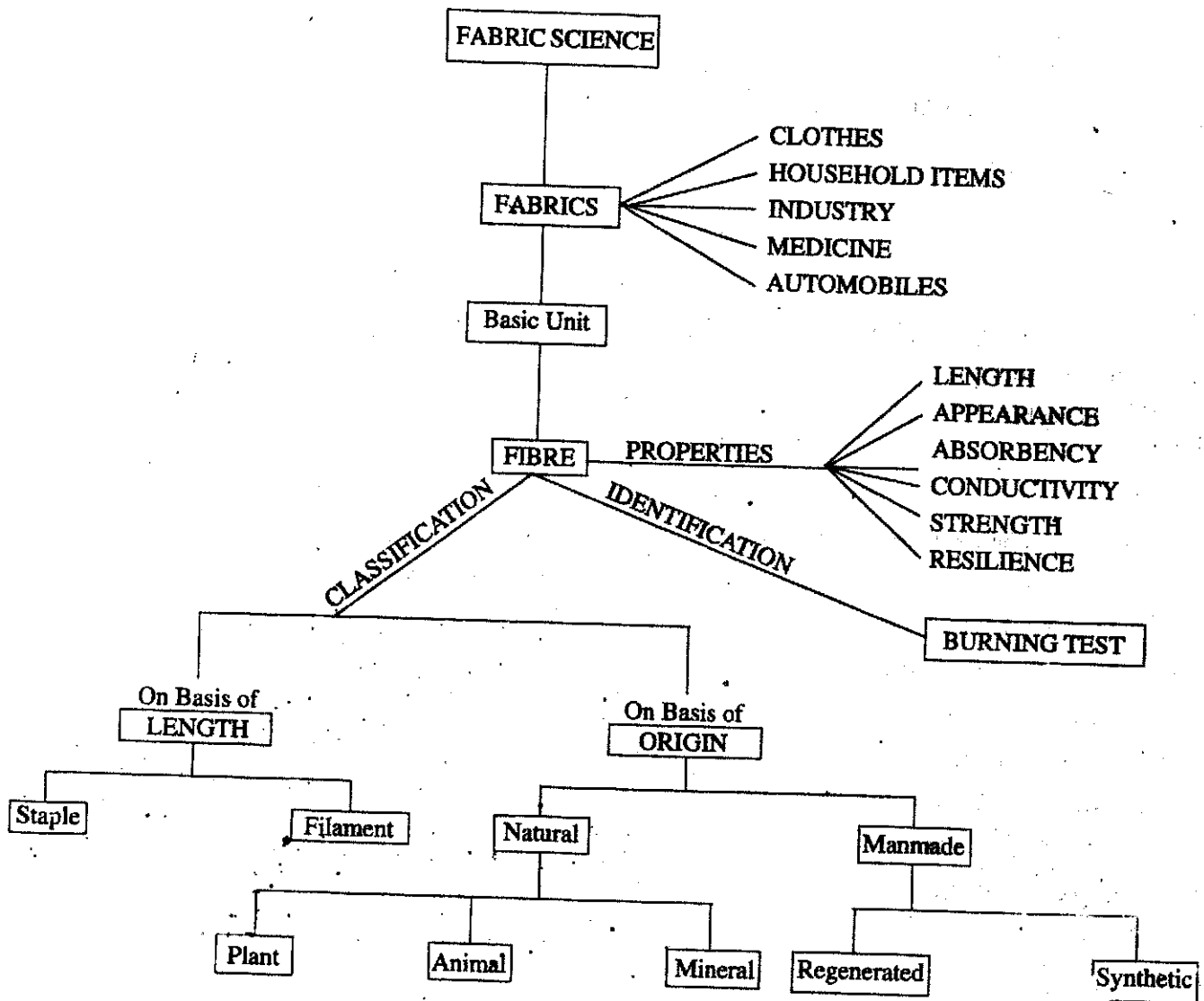
Fibre	Approaching Flame	In Flame	Removed From Flame	Odour	Residue
<i>Natural Cellulosic Fibre</i> Cotton, Linen	Does not shrink a way and catches fire on contact.	Burns quickly.	Continues burning, shows an after glow.	Like burning paper.	Light, feathery, gray in colour.
<i>Manmade Cellulose Fibre</i> Rayon	-do-	-do-	-do-	-do-	Light, fluffy very small amount.
<i>Natural Protein Fibre</i> Wool	Curls away from the flame	Burns slowly	Stops burning after removing from flame	Like burning hair.	Small black bead, brittle, crushable.
Silk	-do-	Burns slowly and sputters in flame.	-do-	-do-	Bead like, black, crushable.
<i>Manmade Synthetic Polyester</i>	Melts and shrinks away from the flame.	Burns slowly and melts	-do-	Smell of chemicals.	Bead formed, hard, tough, black-brown in colour.
Nylon	-do-	-do-	-do-	Synthetic or chemical odour.	-do-
Acrylic	-do-	Burns quickly and sputters.	Continues to burn, melts and molten fibre drops.	Acidic (Vinegar) odour	Irregular black, beads, hard but crushable.

INTEXT QUESTIONS 13.2

- State whether true or false—
 - Cotton is good conductor of heat.
 - Wool is soft and smooth to look at.
 - Silk fabric gets dirty easily.
 - Polyester does not wrinkle or crease much during use and care.
 - Nylon is used to make ropes.
 - Acrylic absorbs moisture easily.
 - Cotton and flax have the same burning characteristics.
 - Synthetics burn with the smell of burning hair.
- Choose the correct answer—
 - Which of the fabrics is most suitable for winters?
 - Cotton
 - Nylon
 - Acrylic
 - Polyester

- ii) Which is the strongest fibre?
- a) Silk
 - b) Nylon
 - c) Acrylic
 - d) Polyester
- iii) Which of the fabrics will require least ironing after washing?
- a) Cotton
 - b) Rayon
 - c) Silk
 - d) Polyester
- iv) When cotton burns the odour is that of—
- a) Burning paper
 - b) Burning hair
 - c) Acid
 - d) Chemical
- v) Synthetics, when brought near the flame will—
- a) Curl away
 - b) Melt and shrink
 - c) Catch fire but not melt
 - d) Remain unaffected.
- vi) Residue of burnt rayon is—
- a) Hard bead like, not crushable
 - b) Crushable bead like
 - c) Light grey, feathery
 - d) Fluffy, small amount.

13.8 What Have You Learnt



13.9 Terminal Exercises

1. Define a fabric and elaborate on its various uses.
2. Classify fibres on the basis of their origin.
3. Name the fabric which is suitable for summer wear and state its important properties.
4. How will you identify a rayon fibre?

13.10 Answers to Intext Questions

- 13.1 1. a) Household, automobile, medical b) cloth c) fabric d) behaviour
 d) Basic unit e) Manmade f) Regenerated g) animal, sheep
 h) Synthetic i) Seed hair

2. a) and (iii)
b) and (iv)
c) and (vii)
d) and (i)
e) and (vi)
f) and (iii)
 3. i) Manmade (ii) Animal (iii) Mineral (iv) Regenerated
- 13.2 1. i) True (ii) False (iii) False (iv) True (v) True (vi) False (vii) True (viii) False.