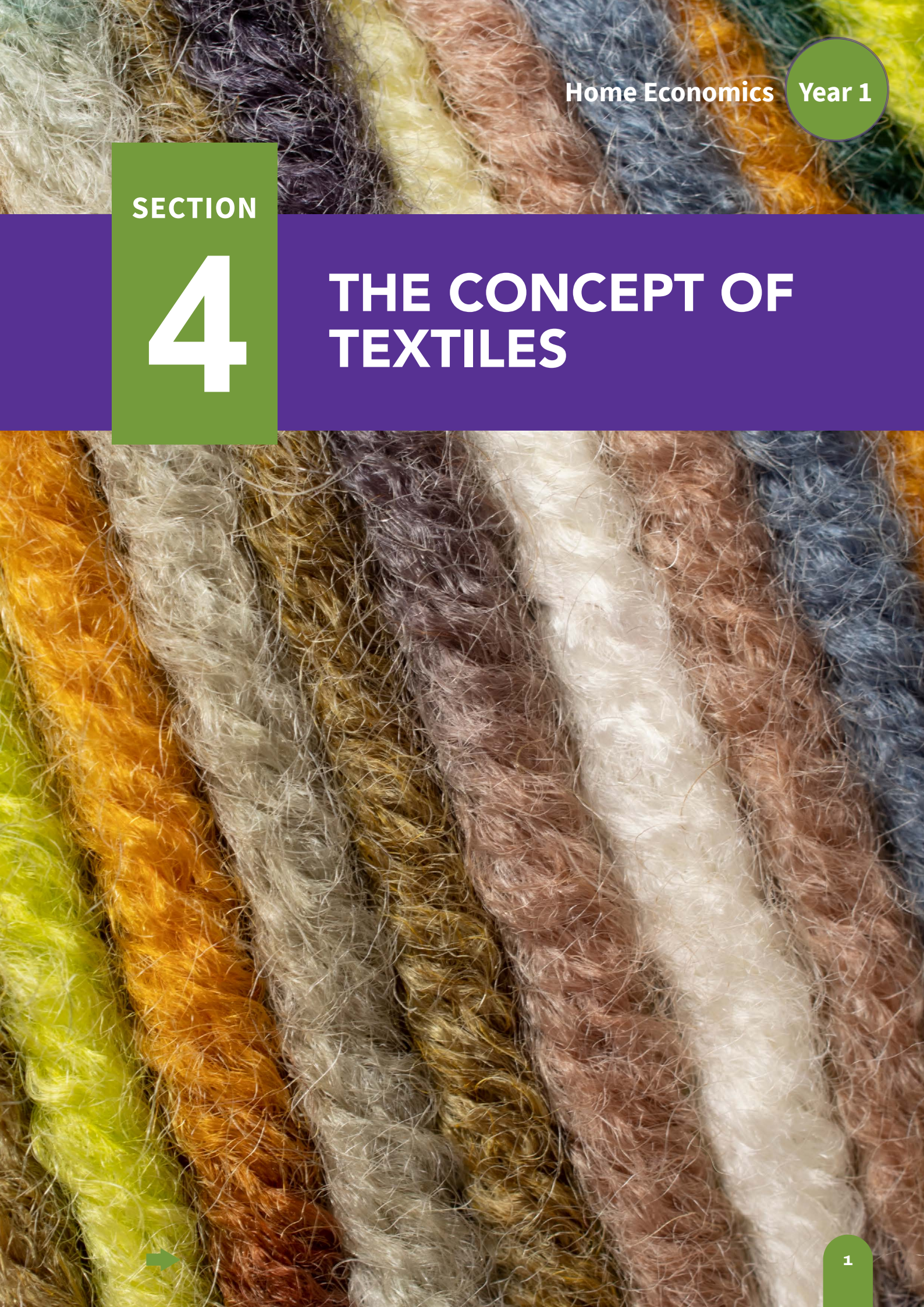
SECTION

4

THE CONCEPT OF TEXTILES



TEXTILE IN CLOTHING

Fibres

INTRODUCTION

We all wear and enjoy different types of clothes. There are some special types of clothes which are worn on certain occasions, and some are season-based clothes. For example, cotton clothes are worn during summer to keep us cool, woollen clothes are worn during winter to keep us warm, and raincoats are worn to protect us from rain. These different types of clothes are prepared from fibres.

This section will introduce you to the role and significance of textiles concerning clothing. You will understand what fibres are, their sources, classification and characteristics. You will learn how to select, care for and maintain clothes. This knowledge will help you select appropriate fabrics and be able to take good care of them to prolong their life span.

At the end of this section, you should be able to:

- Explain the Concept of fibres.
- Classify Fibres according to sources.

Key Ideas

- Fibres can be generally defined as thread-like structures that are thin, long, and flexible.
- Fibres are obtained from two main sources natural, or man-made.
- Fibres are processed into fabrics; they are spun into yarns and then woven into the best fabrics.
- The natural fibres are those, which are formed by natural processes, and manufactured or man-made are those which are made in factories from chemicals and other materials.

The Concept of Fibres

Fibres

Fibres are natural or manufactured substances, which are fine and flexible (like hair or thread) and can be processed into fabric. Fibres can be separated into two major groups. One is natural fibres, or those fibres which are formed by natural processes. The second one is man-made also called manufactured fibres which are made in factories from chemicals and other raw materials. Each fibre has individual characteristics which make it suitable for certain uses.

Natural sources: Refer to plant and animal-based materials that are used to produce fabrics and textiles for clothing.

Man-made sources: Refer to manufactured fibres using chemical processes.

Examples of Natural Sources and Man- Made Sources are listed in the Table 4.1 below

Natural sources	Man-made sources
Animal	Regenerated
Plant	Synthetic
Mineral	Inorganic

Table 4.1: Examples of natural sources and man-made sources of fibres

Classification of Fibres

As stated earlier, fibres are classified into two main groups: Natural and Man-made.

Natural fibres

Natural fibres are obtained from plants, animals or the earth (minerals). The major natural fibres used in clothing are cotton, wool, flax and silk. These fibres are produced naturally from plants and animals.

1. ***Animal Fibres:*** Wool and silk are fibres produced from animals (protein). Wool is the coat of sheep and goats which can be sheared from the animals. Silk fibres are the filaments produced by silkworms (cocoons).
2. ***Plant fibres:*** Cotton and flax are fibres produced by plants (Cellulose). Seed hair such as cotton, stem fibres, such as flax and hemp, leaf fibres such as sisal, and husk fibres, such as coconut, are examples of plant fibres.
3. ***Mineral fibres***: refer to naturally occurring fibres that can be obtained from rocks. An example of a mineral fibre is Asbestos which occurs naturally as fibres found in rocks; it is the only natural mineral fibre.

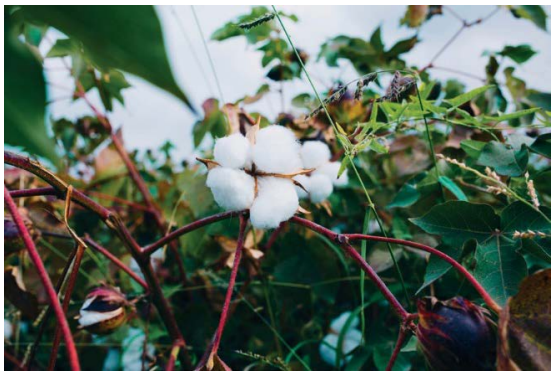


Fig 4.1: Silkworm

Fig 4.2: Cotton boll

Man-made/manufactured/artificial fibres

These are made in factories from chemicals and other raw materials. These man-made fibres are grouped into: Regenerated and Synthetic fibres.

1. ***Regenerated fibres*** are made from materials produced in nature such as wood pulp, cotton waste, and other plant-based materials including animal-based materials.

Classification of Regenerated fibres and some examples:

- Regenerated cellulosic – Rayon, viscose
- Regenerated protein – Casein, azlon
- Mineral - Glass

Fig 4.3: Acetate

Fig 4.4: Viscose/rayon

2. ***Synthetic or man-made fibres*** are synthesised from chemical compounds such as polymers based on petroleum or natural gas, they are synthesised (produced) through a process called polymerisation, in which the raw materials are liquefied and then passed through a spinneret to create continuous filaments. Examples of synthetics - include polyester, nylon, acrylic, and spandex.

Fig 4.5: Polyester

Fig 4.6: Nylon

Some characteristics of common fibres used for textiles

Characteristics of Cotton

1. Cotton can absorb moisture up to 40% of its weight.
2. The absorbed moisture evaporates quickly so that the material dries rapidly and makes cotton cool to wear.
3. Cotton is a fibre, which becomes stronger when it is wet. Consequently, it can be rubbed, scrubbed and boiled during laundering. It is not harmed by alkalis (soap and soda), by heat or by bleach if they are used with due care. The extra strength when wet makes it particularly suitable for towels.
4. If cotton is left damp in a heap it is attacked by mildew.
5. Cotton is resistant to moths.
6. Cotton has no resilience hence fabric wrinkles badly unless finished for recovery.
7. Cotton fabrics can withstand high temperatures.
8. Cotton ignites quickly and burns freely.
9. Cotton is slightly resistant to sunlight.

Uses of Cotton

- Cotton is frequently selected to blend with man-made fibres.
- Cotton is used to make bed linens, towels, table linens, curtains and upholstery.
- It is used for clothing of all kinds including heavy industrial overalls.
- It is used for sewing and embroidery threads.
- Cotton is suitable for underwear, sports clothes, summer clothes and for those worn in hot climates.

Care of Cotton

- Most cotton fabrics can be laundered and dried with home laundering equipment.
- Most detergents have no negative effects on the fibre. However, some colours and finishes may be damaged and even be destroyed by some laundry acids. It is important therefore to read care labels carefully and adhere to recommended procedures.
- If cotton requires ironing, it may be ironed easily at medium to high temperature settings.

Characteristics of Rayon

1. Rayon behaves like cotton at times.
2. It absorbs moisture.
3. It is a good conductor of heat.
4. Rayon fabrics are soft to handle.
5. It is destroyed by moths.
6. Rayon is resistant to mildew.

7. It is weak when wet.
8. Alkalis do not harm the fibres but acids weaken them.
9. The yarns are strong and can be made into many different kinds of fabrics.

Use of Rayon

Rayon is suitable for clothing, household furnishings and for industrial purposes.

Care of Rayon

- Hard wringing may cause damage, as the fibres are slightly weaker when wet.
- Follow the instructions on the care label, remembering that any lightweight fabric should be treated with care.
- Alkalis do not harm rayon fibres but acids weaken them.

Characteristics of Silk

1. Silk is smooth, soft and lustrous.
2. Silk is a good insulator and is warm to wear in the winter and cool in the summer.
3. Silk is one of the strongest natural fibres.
4. It is very elastic. The elastic quality makes it crease-resistant.
5. Silk is not destroyed by mild acids but strong acids will destroy them.
6. It is not destroyed by mild alkalis. However, strong caustic solutions will dissolve silk fibres.
7. It is affected by high temperatures.
8. It is affected by sunlight.
9. Perspiration damages silk fabrics.
10. Silk is not so likely to be attacked by moths when clean. However, if the silk is dirty, the moths will eat the dirt and by so doing will damage the fibres.

Uses of Silk

- Silk is used for underwear and lingerie.
- Silk makes lovely bridal and evening dresses.
- It is used for coats and suits as well as ties.
- It is used in making hats and trimmings.
- Silk is used for curtains, cushion covers and upholstery.

Care of Silk

- If too much heat is used when washing silk fabrics, the fibres become tender and white or yellowish.
- If silk is rubbed during washing, the fibre may break.
- Strong acids would destroy silk, so when it is necessary to use bleaches, only mild ones such as hydrogen peroxides should be used.
- It should not be dried in the sun.

Characteristics of Wool

1. Wool is a protein fibre containing keratin. (The protein of which hair and nails are composed).
2. Wool fibres have some lustre. Fine and medium wool tends to have more lustre than very coarse fibres.
3. Wool has a natural crimp or waviness.
4. Wool fibres have the unique property of being able to absorb moisture without feeling wet.
5. Wool fibres are dimensionally stable. It shrinks and falls during processing.
6. It has a good resistance to acids.
7. exposure to alkalis destroys the fibres.
8. Wool is damaged by moths.
9. Wool burns slowly when in direct flame.
10. Wool is resilient.
11. It is warm and comfortable

Use of Wool

Woollen fabrics are used to sew suits, cardigans, baby layettes, dresses, winter coats, and household upholstery.

Care of Wool

- Wool can be dry-cleaned and pressed easily, but laundering is difficult unless the fibres or fabric has been treated to be washable, even then, care must be used.
- When washing wool, the water should not be of high temperature.
- Alkalis are harmful to the fibres and should be rinsed properly after washing.
- Strong acid bleaches should not be used.

Characteristics of Glass Fibres

1. It has a silky, brittle feel.
2. It drapes well.
3. It neither shrinks nor stretches.
4. It is not attacked by mildew or moths.
5. Glass fibre is not inflammable.
6. Its absorbency rate is slow and dries within a few minutes after washing because it takes just a little water.
7. It requires no ironing.

Use of Glass Fibres

Glass fibre is used in making curtains and for protective or fire-proof clothing.

Care of Glass Fibres

Glass fibre must be washed gently by hand and not in a washing machine.

I hope you have enjoyed learning about the classification of fibres according to sources and their characteristics. Now you are going to learn about how to test for fibre composition, which includes visual, touch/ feeling, burning test, absorbency test and chemical test.

Tests for the Characteristics of Fibres

1. **Visual Inspection or (Identification of Fibres)**

   Visual testing for fibre characteristics involves examining fibres using the naked eye or magnifying devices to assess their characteristics. It is always the first step in fibre identification, but it is not very reliable because manufactured fibres can resemble natural fibres or other manufactured fibres.

How to test fibres visually

a. *Colour:* Observe fibre colour, shade, and intensity.

b. *Lustre:* Observe fibre shine, gloss, or dullness. Cellulose fibres generally tend to be dull while protein fibres tend to be shiny. Manufactured fibres may however be shiny or dull depending on how their manufacturers want them to look.

c. *Length:* Measure fibre length, either manually or using a fibre length tester.

d. *Diameter:* Use a microscope or magnifying glass to check the thickness or diameter of the fibre.

e. *Shape:* Observe fibre cross-sectional shapes, such as circular, oval, or irregular.

f. *Surface texture:* Examine fibre surface features, like smoothness, roughness, or scales.

g. *Crimp:* Look for natural or induced crimps, which affect fibre flexibility.

h. *Strength:* Perform simple tests like stretching or bending to determine fibre strength.

i. *Flexibility:* Assess fibre flexibility by bending or folding.

j. *Other visual features:* Note any unique features, such as fibre ends, defects, or impurities.

Touch/ feeling

The hand is the ‘feel’ of a fabric or qualities that can be ascertained by touching. Touching a fabric, yarn and a mass of fibres will help you to feel the texture and body or weight. Fibre texture may range from soft- to hard, rough to smooth, warm to cool, or stiff to flexible. For example:

i. Cotton feels cool, inelastic, soft and dry.

ii. Nylon feels cool, elastic, smooth and slick.

iii. Wool feels warm, springy, rough and dry.
iv. Polyester feels cool, elastic, smooth and dry.
v. Linen feels cool, leathery, stiff and dry.
vi. Glass feels warm, stiff, smooth and dry.
vii. Acrylic feels cool, elastic, smooth and dry

2. **Burning test**

A burning test, also known as a flame test, is a simple experiment to identify and characterise fibres. This involves burning a few yarns of fabric and observing the results when the yarn is approaching the flame, when it is in the flame, when it is out of the flame, its odour and the residue.

How to conduct a burning test

Materials Needed

- Fibre samples (natural and synthetic)
- Bunsen burner or candle flame
- Metal or ceramic crucible (ceramic container).
- Tongs/forceps/scissors/tweezers
- Paper and pencil for observations

Safety Precautions

- Conduct the experiment in a well-ventilated area.
- Wear protective gloves and safety goggles.
- Keep a fire extinguisher nearby.
- Ensure the fibre samples are completely extinguished before disposing of them.
- Remove paper and all flammable materials from the area.

Procedure

a. Prepare the fibre samples: Cut the fibres into similar lengths (about 2-3 cm) and clean them.
b. Hold the fibre: Use tongs or forceps to hold one end of the fibre, keeping the other end free.
c. Expose to flame: Hold the free end of the fibre in the Bunsen burner or candle flame.
d. Observe and record: Note the fibre's behaviour, such as:

- Ignition time
- Burning rate
- Flame colour
- Smell or odour
- Residue or ash formation

Note: Conduct the test with various natural and synthetic fibres.

Observations and Inferences

a. **Natural fibres (cotton, wool, silk)**

- Ignite easily
- Burn rapidly
- Produce a yellow or orange flame
- Smell like burning paper or wood
- Leave a soft, greyish ash

b. **Synthetic fibres (nylon, polyester, acrylic):**

- Melt or shrink away from the flame
- Drip or form beads
- Produce a sweet, chemical-like smell
- Leave a hard, shiny residue

3. **Chemical test**

A chemical test for fibre characteristics is a laboratory procedure that uses chemical reagents to identify and analyse the properties of fibres. These tests help determine the:

a. Type of fibre (natural or synthetic)
b. Chemical composition (protein, cellulose, polyester)
c. Structure and properties (crystallinity, orientation)

Common chemical tests for fibre characteristics include

i. Sodium Hydroxide (NaOH) Test: Identifies protein fibres (wool, silk)
ii. Acetic Acid Test: Identifies cellulose fibres (cotton, linen)
iii. Iodine Test: Identifies starch-based fibres (cotton, rayon)
iv. Shirley Test: Distinguishes between polyester and acrylic fibres
v. Nitric Acid Test: Distinguishes between wool and silk
vi. Copper (II) Sulphate Test: Distinguishes between cotton and linen

How to conduct a chemical test

Materials needed

- Fibre samples (natural and synthetic)
- Chemical reagents (e.g., sodium hydroxide, acetic acid, iodine)
- Test tubes or small containers
- Droppers or pipettes
- Paper and pencil for observations

Procedure

a. Prepare the fibre samples: Cut the fibres into similar lengths (about 2-3 cm) and clean them.

b. Choose the chemical test: Select a suitable chemical test based on the fibre type, such as:

- Sodium hydroxide (NaOH) test for protein fibres (wool, silk)
- Acetic acid test for cellulose fibres (cotton, linen)
- Iodine test for starch-based fibres (cotton, rayon)

c. Add the chemical reagent: Use a dropper or pipette to add a few drops of the chemical reagent to the test tube or container.

d. Add the fibre sample: Place a small portion of the fibre sample into the test tube or container.

e. Observe and record: Note the fibre's reaction, such as:

- Colour change
- Dissolution
- Swelling
- No reaction

f. Repeat with different fibres: Conduct the test with various natural and synthetic fibres.

Observations and Inferences

a. **Natural fibres:**

- Protein fibres (wool, silk): Turn yellow or brown with NaOH
- Cellulose fibres (cotton, linen): Turn blue or black with acetic acid

b. **Synthetic fibres**:

Show little or no reaction

Safety Precautions

- Wear protective gloves and safety goggles.
- Handle chemicals with care.
- Follow proper disposal procedures.

4. **Absorbency Test**

The absorbency test is a method used to evaluate the ability of a fibre or fabric to absorb and retain liquids supporting various industrial and commercial uses.

How to conduct an absorbency test

Materials Needed

- Fibre or fabric sample
- Distilled water
- Dye (optional)
- Dropper or pipette

- Stopwatch or timer
- Paper towels or blotting paper

Procedure

a. Prepare the sample: Cut the fibre or fabric into a uniform size.
b. Add water: Use a dropper or pipette to add a known volume of distilled water to the sample.
c. Add dye (optional): If desired, add a few drops of dye to the water to enhance visibility.
d. Start timer: Begin timing how long it takes for the water to be absorbed.
e. Observe and record: Note the time it takes for the water to be completely absorbed and the amount of liquid retained.
f. Repeat with different fibres: Compare the absorbency of various fibres or fabrics.

Results

a. Absorbency rate: Calculate the time it takes for the water to be absorbed.
b. Liquid retention: Measure the amount of liquid retained by the fibre or fabric.

Interpretation

a. High absorbency: Fibres with high absorbency rates and liquid retention are suitable for articles like towels, absorbent pads, or medical dressings.
b. Low absorbency: Fibres with low absorbency rates and liquid retention are better suited for articles like water-resistant clothing or upholstery.

Activity 4.1

Collect pieces of fabric from a dressmaker or a tailors' workshop and conduct the following tests to identify the characteristics of different types of fibres:

a) Chemical test
b) Burning test
c) Absorbency test

Activity 4.2

Make a specimen album on fibres with the various classifications: *natural* and *man-made*. Present specimen album in class for appraisal.

Extended Reading

Below are some recommended reading materials and a link that you can visit or consult for more information.

Gavor, E. M., Ampong, I. & Tetteh-Cofie, D. (2014). *Clothing and Textiles for Schools and Colleges.* Legon-Accra, Ghana: Adwinsa Publications (Gh) Ltd. Pages 18-26

Foster, P. (2021). *Clothing and Textiles*. Winmat Publishers Ltd. Accra, Ghana. Pages 24-52

Link: https://byjus.com/biology/fibre

References

Gavor, E. M., Ampong, I. & Tetteh-Cofie, D. (2014). *Clothing and Textiles for Schools and Colleges.* Legon-Accra, Ghana: Adwinsa Publications (Gh) Ltd. Pages 18-26

Foster, P. (2021). *Clothing and Textiles*. Winmat Publishers Ltd. Accra, Ghana. Pages 24-52.

Review Questions

1. Explain with examples, the concept of fibre in your own words.
2. Differentiate between natural and man-made fibres. Give at least two examples in each case.
3. In the table below, match the following fibres with their respective sources:

Fibre	Source
Polyester	Animal
Cotton	Mineral
Glass	Plant
Silk	Synthetic

4. Complete the table below by indicating three characteristics for each of the following fibres:

Fibre	Characteristics
Cotton	
Rayon	
Silk	
Glass	

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