CHAPTER

2

# Dyeing

5UP8S1

**LEARNING OBJECTIVES**

- **To understand the classification of dyes**
- **To get an insight into the applicability of individual dyes**
- **To learn about the different stages of dyeing**

## 2.1 Introduction

Man has known colour since his creation. Nature has been like **Art** with an inexhaustible colour palette with beautiful compositions that inspire man to capture colour on cloths that adorn his body. Primitive man coloured the caves and smeared his body with pigments that he discovered. Ancient people extracted dye from roots, stems, leaves, fruits, berries, flowers, nuts, vegetables, minerals, animals and insects.

Colour plays a vital role in **Human** life. Nature's colour changes with changing season. The colourful wall paintings of Ajanta during the first century AD (CE) and description of natural dyes in *Atharvaveda* provides evidence for the use of dyes in ancient period. People liked to colour everything they use, especially clothes. So they extracted colour from different natural sources such as plants, animals, insects and minerals and applied it on to fabric. The quest for new colours led to the discovery of synthetic dyes which later on became a full-fledged industry.

## 2.2 Classification of Dyes

Dyes are organic compounds with two components namely Chromophore, which imparts colour and Auxochrome that help in substantivity of dyes. They are classified into natural dyes and synthetic dyes.

### 2.2.1 Natural Dyes

Natural dyes are colour substances obtained from natural sources. Natural dyes are used for all types of textile dyeing and printing until the middle of nineteenth century. The use of natural dyes were reduced due to the advent of synthetic dyes, though they were economical and posses excellent fastness properties. However, the growing consumer awareness on the harmful impact

of synthetic dyes, concern for environment worldwide and stringent environmental laws lead to the revival of natural dyes.

#### 2.2.1.1 Advantages of Natural Dyes

- Natural dyes are extracted from natural sources and hence they are eco-friendly
- Produces soft and soothing colours
- These dyes provide excellent protection from UV rays
- Natural dyes like turmeric have anti-microbial properties and hence protect the fabrics and wearers from microbial attack
- Some natural dyes possess mosquito repellent and flame resistant property
- They can be obtained from the natural sources which are abundant in a particular area. Hence supply of raw materials will be continuous and transport charges will be lower

#### 2.2.1.2 Disadvantages of Natural Dyes

- Natural dyes are difficult to store
- Dye extraction is a time consuming process
- Reproducibility of the same colour shade is difficult
- Impurities in natural dyes fades away the colour produced
- Availability of these dyes depends on the seasons
- Natural dyeing process is difficult to standardize

### Classification of Natural Dyes

Natural dyes are classified in to three types based on the source of origin namely vegetable dyes, animal dyes and mineral dyes.

### 2.2.2 Vegetable Dyes

The earliest dyes were of vegetable origin, discovered by accidentally staining garments with juices of fruits or plants. Vegetable dyes are obtained from different parts of plants such as leaves, flowers, fruits, pods, bark etc. These vegetable dyes can be applied directly or with different mordants.

- **Indigo:** Indigo (blue dye) is called as the king of all natural dyestuffs. It imparts blue colour. It is extracted from the leaves of the leguminous plant, *Indigofera tinctoria*. It is suitable for dyeing cotton and wool.
- **Indian Madder:** It produces shades of red on textile fabrics. It is used for dyeing cotton and woollen fabrics. It is extracted from roots of *Rubia tinctoria.*
- **Turmeric:** It produces shades of yellow on fabrics. It is suitable for dyeing cotton, silk and wool. The yellow dye is extracted from the ground root (rhizome) of turmeric plant (*Curcuma longa*).
- **Marigold:** It is extracted from lemon or orange coloured marigold (*Calendula officinalis*) flower. It is suitable for dyeing both silk and wool fibres.
- **Henna:** The dye is extracted from the dried leaves of Henna plant, *Lawsonia inermis*. It produces yellowish orange colour. It is suitable for dyeing wool and silk fibres.
- **Tea:** Leaves of tea plants (*Camellia sinensis*) or tea powder is used to extract dye. It produces different shades of brown.
- **Onion:** The dye is extracted from the outer most skin or peel of the onion (*Allium cepa*). The onion skins if properly dried can be used for one year.

**Table 2.1 Vegetable Dyes**

| Name of the Plant | Parts used | Dyed fabric |
|---|---|---|
| Indigo |  |  |
| Indian madder |  |  |
| Turmeric |  |  |
| Marigold |  |  |
| Henna |  |  |
| Tea |  |  |
| Onion |  |  |


**Who is Adolf Von Baeyer ?**

Adolf Von Baeyer is a German chemist, who was awarded the Nobel Price in Chemistry in 1905 for discovering the molecular structure of Indigo and developing a process to produce it synthetically.


Adolf Von Baeyer

### 2.2.3 Animal Dyes

Dyes extracted from certain insects and invertebrates are called as animal dyes. Various shades of red and purple were obtained from animal origin. Cochineal, Tyrian purple and Lac are the commonly used animal dyes.

1. Cochineal

   Cochineal dye is extracted from the dried bodies of the female red bug (*Dactylopius coccus*). It produces crimson and scarlet colours with mordants aluminium and tin oxide. This dyestuff was mostly used for dyeing wool and silk. These dyes exhibit excellent fastness properties.

2. Tyrian Purple

   This dye is extracted from the sea snails found in Mediterranean Sea. The amount of dye produced was very limited and therefore very expensive. Hence, it is called Royal purple.

3. Lac Dye

   This dye is extracted from the fluid secreted by the lac insect (*Lauifer lacca*), which lives on the twigs of the banyan trees and other varieties.

It produces crimson and scarlet colours. These dyes possess good fastness to light and washing.

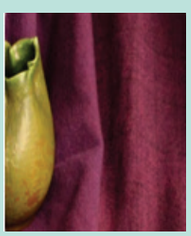
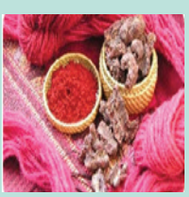
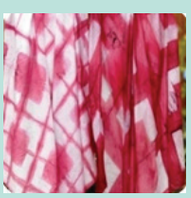
Animal dyes are also obtained from murex snail (purple colour) and Octopus/ Cuttle fish (Sepia brown).

### How invention of colour changed the world?

William Henry Perkin, in 1856 during his experimentation with coal tar to synthesize an artificial quinine as a cure for malaria invented the first synthetic dyestuff called "Mauve" which revolutionized the world in both dye making and fashion.

William Henry Perkin

**Table 2.2 Animal Dyes**

| Source Name | Insect | Dyed fabric |
|---|---|---|
| Cochineal |  |  |
| Tyrian purple |   |  |
| Lac dye |  |  |

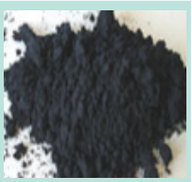
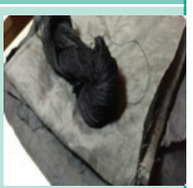
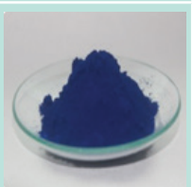
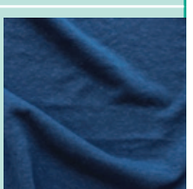
### What is Tyrian purple dye?

Tyrian purple is a natural dye obtained from shellfish. Approximately 8500 shellfish is used to produce one gram of purple dye. Hence the dye was more worth than its weight in gold.

## 2.2.4 Mineral Dyes

Dyes extracted from mineral sources are called as mineral dyes. Most widely used mineral dyes are Iron, which produces yellowish brown shades, chrome yellow, prussian blue and manganese brown. The dyes obtained from mineral sources may be poisonous and hence are not being used commercially.

**Table 2.3 Mineral Dyes**

| Source name | Dye | Dyed fabric |
|---|---|---|
| Iron |  |  |
| Prussian blue |  |  |
| Chrome yellow |  |  |
| Manganese brown |  |  |

### 2.2.5 Synthetic Dyes

Dyes that are produced chemically are called as synthetic dyes. These are classified based on the chemical composition of the dye.

#### 2.2.5.1 Direct Dyes

When a dye colours the fabric directly without the help of any fixing agent, the dye is said to be a direct dye. Direct dyes are water soluble. They are easy to produce, simple to apply and cheap in cost of production and application. Direct dyes are anionic in nature and have greater affinity for cellulosic fibres. They are used to dye cellulose fibres without a mordant in bright shades and they produce a wide range of colours. A levelling agent such as sodium carbonate is added for even dyeing. At the end of dyeing, exhaustion agent such as salt (NaCl) is added which helps the dye to leave the liquor and get attached to the fibre. Some direct dyes are used to dye wool, silk and nylon. Direct dyes can be applied to wide variety of textile materials such as apparel, upholstery fabrics, draperies, linings and automotive fabrics. Most direct dyes have good fastness to light but poor wash fastness.

#### 2.2.5.2 Reactive Dyes

Dyes that react with the fibres and form covalent bonds are called as reactive dyes. They become an integral part of the fibre. They are water soluble and are used to dye cellulose, protein and polyamide fibres. They produce full range of bright shade across the spectrum. They exhibit excellent wash fastness and good light fastness properties. Dyeing of fibre with reactive dyes involves 3 steps, namely exhaustion of dye (NaCl or Glauber's salt), fixation of dye (sodium carbonate or sodium hydroxide) and washing off.

#### 2.2.5.3 Basic Dyes

Basic dyes have cationic or basic groups (positively charged) and hence they are also known as cationic dyes. Basic dyes react with the acidic groups present in the fibres and form electrovalent bonds. Basic dyes are soluble in alcohol but not easily soluble in water. Basic dyes exhibit brilliant shades of colour which is not shown by other dye classes. Basic dyes are suitable for dyeing wool, silk and acrylic, but they have no affinity towards cellulosic fabrics. Basic dyes are used along with a mordant for fibres such as cotton, linen, acetate, nylon and polyester. Basic dyes show moderate light and wash fastness. For dye preparation, the dyestuff is mixed with equal amount of acetic acid followed by warm water under constant stirring.

#### 2.2.5.4 Acid Dyes

Water soluble dyes that require acid (sulphuric, acetic, formic acid etc.,) in dye bath to dye silk or wool are called as acid dyes. These acid dyes are mostly sodium salts of organic acids. When dissolved in water, acid dyes produce negative ions (anions or acidic groups) which react with positive ions of protein fibres and get attached to the fibre through electrovalent bonds. Acid dyes are similar to direct dyes however they cannot be applied to cellulosic fibre due to slight variations in structure. Acid dyes have greater affinity for protein and polyamide fibres. They posses very good fastness to washing and good fastness to light. A large colour range is available with acid dyes. They are inexpensive.

### 2.2.5.5 Mordant or Chrome Dyes

Natural dyes and some synthetic dyes do not have affinity towards fibres. With the help of some chemicals, they can be used to dye fibres. These chemicals are called mordants or mordant dyes. Mordant dyes have affinity for both fibre and dye and form a linkage between the dye molecule and the fibre.

### 2.2.5.6 Disperse Dyes

Disperse dyes are insoluble in water. Their solubility is increased by increasing temperature and by adding dispersing agents. They are suitable for dyeing hydrophobic fibres like nylon, polyester, acrylic and other synthetic fibres. Disperse dyes are non-ionic or neutral in nature. They have an excellent fastness to washing and sunlight exposure.

### 2.2.5.7 Vat Dyes

These dyes were initially fermented in a large wooden vessel known as vats and hence the name **"vat dyes".** They are insoluble in water but soluble in alkali. Vat dyes are accepted into the fibre in a reduced or vatted form. When it is re-oxidized, it is then fixed to the fibre firmly. The dyes are treated with a reducing agent that converts them into leuco compounds, which is soluble in alkalis. The process of making the dyes soluble is known as Vatting. The leuco compounds are either colourless or exhibit a colour that is different from the colour of final product, which is achieved after oxidation. Once the dye is attached to the fibre, it gets oxidised and changed into an insoluble colour product that gets trapped inside the fibre. Indigo, an example of vat dyes has been used in India for long periods.

In the soluble form, vat dyes have excellent affinity for cellulosic fibres. Vat dyes are the fastest dyes for cotton, linen and rayon. They may be also applied to wool, nylon, polyester and acrylics with the use of a mordant. Vat dyes are resistant to light, acids and alkalies.

The basic principles of vat dye application can be summarized as follows:

- Conversion of the insoluble vat dye into the soluble leuco form by reduction or "vatting".
- Absorption of the soluble reduced dye by the fibres
- Conversion of the absorbed dye back to the insoluble state by oxidation
- After treatment of the dye or printed material in a hot detergent bath to produce the true and stable shade with maximum fastness

### 2.2.5.8 Sulphur Dyes

Presence of sulphur is the characteristic feature of sulphur dyes. Like vat dyes, sulphur dyes are water insoluble and made soluble by the addition of reducing agents and alkali as solubiliser. They are converted into soluble leuco compounds by using sodium sulphide or sodium hydrosulphite as reducing agent. The leuco compounds have high affinity for cellulosic fibres. After dyeing the fabric, the dye is converted into insoluble form by the addition of potassium dichromate and acetic acid. Sulphur dyes do not produce brighter shades. They are cheap and produce colours like navy blue, black, khaki and olive green. They are used for black more than any other colours. They have excellent wash fastness property. The fabric loses its softness after dyeing with sulphur dyes.

#### 2.2.5.9 Azoic Dyes or Napthol Dyes

Unlike other colouring matters, the azoic dyes are not prepared as dye stuffs but have to be produced directly in the fibre by the combination of their constituents. The first component, napthol in presence of sodium hydroxide give colourless or faintly yellow or brown colour when applied on cotton at room temperature. The naptholated fabric when immersed in the second bath containing the second component base along with the acid and sodium nitrite at ice cold temperature produces bright colour which is insoluble in water. The two components form azo group during coupling. So the dye is known as **azoic dye**. Since it is formed inside the fibre, it is called **ingrain dye.** Azo dyes are also called as **ice colours** since their application involves use of ice to lower the temperature. They are widely used on cellulosic fibres and have limited application on acrylic, nylon and polyester. Azo dyes exhibit bright colours. They have good colour fastness to washing and light.

#### 2.2.5.10 Pigment Dyes

Pigments are not true dyes because they have no affinity for the fibre. They are applied and held to the fabric with the help of adhesives and resins. Pigments are commonly used in dope dyeing and printing. Use of pigments saves both time and cost. Vat dye is called as dye when applied on fabric in solubilized form and is termed as pigment when applied on fabric in insoluble form using a binder. Pigment dyes exhibit excellent light fastness.

#### 2.2.5.11 Optical Brightners

These dyes are also called as colourless dyes or fluorescent whiteners. These dyes absorb light at UV-region and emit blue light in visible region. It may be applied during bleaching or with the final finish. These dyes have affinity for cotton but are also used for wool, nylon, acetate and acrylics.

## 2.3 Dyeing Methods

The art of dyeing dates back to pre-historic times. It is practised from ancient time and it is as old as human civilization. Dyeing is the process of imparting colour to the fibre/yarn or fabric by the application of dyes or pigments. Colour is produced between the dye molecule and the fibre or fabric. The bond between dye molecule and fibre may be strong or weak depending on the dye used. Dyeing enhances the aesthetic look of the fabric. It is one of the surface ornamentation methods.

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### 2.3.1 Stages of Dyeing

Dyeing can be done at any stage of textile production process such as at fibre stage, yarn stage, fabric or finished product.

**Table 2.4 Stages of Textile Dyeing**

| Stage | Method of dyeing |
|---|---|
| Fibre | Stock dyeing |
| Wool sliver | Top dyeing |
| Manmade | Dope dyeing |
| Yarn | Skein dyeing, Package dyeing, Warp-beam dyeing, Space dyeing |
| Fabric | Beam dyeing, Beck/Winch dyeing, Jig dyeing, Jet dyeing, Pad dyeing |
| Finished product | Product dyeing |
| Blended fabrics | Union dyeing, Cross dyeing |

### 2.3.1.1 Dyeing at Fibre Stage

The process of dyeing at fibre stage is called as fibre dyeing. It includes stock dyeing, top dyeing and dope dyeing.

#### Stock Dyeing

Fibres are dyed by the process of stock dyeing. In this method, dyeing is carried out in a large enclosed vessel called kiers. Fibres are placed loosely in perforated containers and kept inside the kiers. The dye liquor is circulated through the fibres at high temperature until the desired colour is obtained. Excess dye solution is removed after dyeing process. The dyed fibres are washed and dried.

Figure 2.1 Stock Dyeing

#### Advantages

- Produces varied colour effects by blending different coloured fibres
- Large quantities of fibres can be dyed at one time
- Produces uniform colour
- Colour fastness ranges from good to excellent
- Dye easily penetrates the fibres and hence crocking is prevented.

#### Disadvantages

- Expensive and time consuming
- Fibre wastage if not consumed immediately
- Dyed fibres loses its flexibility and hence not readily spin as undyed fibre
- Cannot withstand rapid changes in fashion

#### Top Dyeing

Wool that has been combed to remove short fibres is called as **top**. Top is wound on perforated spools and dye solution is passed through it. Top dyeing method results in even dyeing.

Figure 2.2 Top Dyeing

#### Advantages

- Uniform dye uptake
- Dye penetrates into the fibre therefore good colour fastness

#### Disadvantages

- Flexibility is reduced
- Time consuming

#### Dope dyeing

Manmade fibres such as polyester and polypropylene are dyed by this method. In this method, dye is mixed with the spinning solution before the filament is extruded through the spinneret.

Figure 2.3 Dope Dyeing

### Advantages

- Dyeing is uniform
- Dyed textiles have good to excellent colour fastness to washing and light

### Disadvantages

- The strength of solution dyed filaments are slightly lesser
- Expensive method

### 2.3.1.2 Dyeing at Yarn Stage

The process of dyeing at yarn stage is called as yarn dyeing. Yarn dyeing is preferred to create interesting checks, stripes and plaids in the fabrics. Yarn dyed fabrics are deeper and richer in colour. Fabric with dyed warp and undyed weft are example for chambrays. This includes techniques like skein dyeing, package dyeing, warp-beam dyeing and space dyeing.

Figure 2.4 Yarn Dyeing

### Skein Dyeing

In this method, the yarns are loosely wound in hanks or skein form. The hanks or skeins are hung on perforated rods and immersed in a dye bath. The dye solution is circulated in and out of the yarn to achieve an even shade. This method is commonly used for dyeing acrylic and wool yarns.

### Advantages

- Loose arrangement of yarn permits excellent dye penetration
- Yarns retain softer feel

### Disadvantage

- Most expensive yarn dyeing method

### Package Dyeing

Yarns are wound on cones, spools or similar units. These yarn packages are arranged on perforated rods in a rack and immersed in a tank. The dye solution is forced outside from the rods and forced back to the centre under pressure through the packages so that, the dye penetrates the entire yarn.

### Advantages

- Dyeing capacity is higher (550 kg) when compared to skein dyeing (200 kg)
- Material to liquor ratio is less
- Uniform dyeing

### Disadvantages

- Package dyed yarns do not retain softness and loftiness feel
- Not suitable for high twist yarns which will not allow dye to penetrate

### Warp-Beam Dyeing

This method is similar to package dyeing. In warp-beam dyeing, the yarn is wound onto a perforated warp beam and placed in a tank containing dye solution. Dyeing is

carried out under pressure for deeper and uniform penetration of dye. This method is used for the manufacturing of denims, in which warp yarns are dyed with indigo and weft yarns are left undyed.

### Advantage

- Economical than other yarn dyeing methods

### Disadvantage

- May not produce high fashion fabric since warp yarn will be dyed in specific colour

### Space Dyeing

In this method yarn is not completely dyed, but it is dyed at intervals. Space dyeing is done by two methods namely, Knit-de-knit method and OPI space -dye applicator method. In knit-de-knit method, the knitted fabric is dyed and de-knitted, which results in appearance of alternating dyed and un-dyed spaces. In OPI space-dye applicator method, the yarns are allowed to pass through space dye baths at very high speed which results in intermittent dyeing.

### Advantages

- Produces brighter and deeper shades.
- Create interesting checks, stripes and plaids.

### Disadvantages

- Costly and time consuming
- May not create designs to match current fashion

### 2.3.1.3 Dyeing at Fabric Stage

The process of dyeing woven or knitted fabric is called as **piece dyeing**. Piece dyeing methods include beam dyeing, beck or winch dyeing, jig dyeing, jet dyeing and pad dyeing.

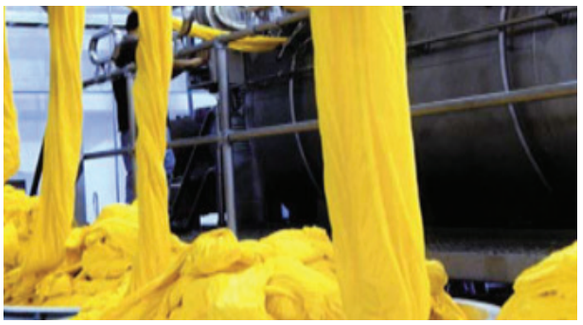

Figure 2.5 Piece Dyeing

### Advantages

- Uniform dyeing
- Inexpensive than fibre or yarn dyeing
- Versatile and flexible in accommodating changing fashion trends.
- Faster and easier

### Disadvantage

- The ends of the fabric does not have some colour as the remaining fabric

### Beam Dyeing

This process is similar to warp-beam dyeing of yarns. In this method, the woven or knitted fabrics are wound on perforated beams and immersed in dye solution. Dye is circulated through the fabric

### Beck / Winch Dyeing

This method is done to dye the fabrics of longer length. The fabric is circulated through the dye bath in tensionless rope form. The ends of the fabric are tied together to form a loop. The fabric moves over a rail onto a winch reel which immerses it into the dye bath and draws the fabric up. The process is repeated till the fabric is dyed uniformly and to the desired colour shade. About 1000 m or 900 kgs of fabric can be dyed at a time. The dyed fabrics retain its original softness feel. This method is widely used for woolen woven and knitted fabrics.

### Jig Dyeing

In this method, the fabric is held on rollers at full width and passed through the dye bath. The fabric is let off from one roller into the dye bath and wound on to the other roller. After one cycle, the process is reversed and the fabric is let off from the second roller to the first. The process is repeated till the desired colour strength is achieved. About 250 kg of fabric can be dyed at a time. This method is preferred for heat-sensitive thermoplastic fabrics that cannot be dyed in rope form as they will form permanent crease or colour streaks in the fabric. This method is not suitable for knitted or stretch fabrics which should not be subjected to tension and also to fabrics where a soft feel is required.

### Jet Dyeing

In this method the fabric is dyed in a rope form. It is placed in a heated tube or column where jets of dye solution are thrown on the fabric at high pressure. The fabric also moves along the tube. The dye solution is circulated faster than the fabric while colouring it thoroughly. About 500 kg of fabrics can be jet-dyed at a time. This method of dyeing is suitable for both woven and knitted fabrics made up of wool, cotton, viscose rayon, polyester and its blends.

### Pad Dyeing

In pad dyeing, the fabric at full width is passed through a trough containing dye bath. The fabric is then passed between two heavy rollers which force the dye to penetrate in to the fabric and squeeze out the excess dye solution. For the dye to set, the fabric is passed through a heat chamber. Then the dyed fabric is rinsed and dried.

#### 2.3.1.4 Dyeing at Product Stage

This is the last stage of dyeing. When the finished product such as garment is dyed, it is called as product dyeing or garment dyeing. The fabric undergoes pre-treatments such as desizing, bleaching and mercerization before dyeing. The most widely used method for garment dyeing is paddle dyeing. In this method, garments are packed loosely in net bags. Ten to fifty of such bags are kept in large tubs containing dye solution. The dye is agitated by a motor driven paddle which increases the penetration of dye. Garment dyeing is suitable for products such as sweaters, T-shirts, casual clothing and hosiery.

#### Advantages

- Economical
- No shade variations

#### Disadvantages

- Colour bleeding and fading.
- Not suitable for products with zippers, sewing, threads, lining etc.

### 2.3.2 Dyeing of Blended Fabrics

When a fabric is made of one type of fibre/ yarn, dyeing process is simple but when it is composed of more than one kind of yarn as in a blend, dyeing process is complex. Special procedures are carried out where different dyes that are suitable for each fibre need to be selected.

#### 2.3.2.1 Union Dyeing

In this method, blended fabrics are dyed to the same shade to get a solid-coloured fabric. Fabrics can be dyed by one or two bath process. In one bath process, dyes appropriate for each fibre is added in same dye bath. In two bath process, dyes are added separately to each fibre subsequent to one another.

### 2.3.2.2 Cross Dyeing

In this method, fabrics are dyed in such a way that different fibres produce different shades with the same colour. Sometimes, one of the fibre components is left undyed. Cross dyeing results in checks, plaids, striped and multi-coloured fabrics. Cross dyed fabrics are similar to fibre or yarn dyed textile materials. If one of the yarns of the fabric is vegetable fibre and the other is from animal fibre, then the fabric is dyed in two separate baths, suitable for each fibre. This produces colourful effects.

## 2.4 SUMMARY

Dye is a chemical compound that produces colour when applied on the fabric. Dyes are classified in to natural and synthetic dyes based on their source of origin. Synthetic dyes are further classified based on their application conditions and affinity towards certain fibres namely direct dyes, reactive dyes, basic dyes, acid dyes, mordant dyes, disperse dyes, vat dyes, sulphur dyes, azo dyes, pigment dyes and optical brightners. Dyeing is the process of imparting colour to fibres, yarns or fabrics using dyes. Dyeing involves the transfer of colour from the dye bath to fibre surface and diffusion from the surface into the fibre. Dyeing can be done at different stages of textile manufacturing process such as fibre, yarn, fabric or finished product stages.

### POINTS TO REMEMBER

- Dyes are organic compounds that are used to impart colour to fibre / yarn or fabric
- Dyes are classified into natural and synthetic dyes
- Dyeing is the process of imparting colour to fibres, yarns or fabrics using dyes
- Dyeing can be carried out at different stages of textile manufacturing processes such as fibre, yarn, fabric or finished product
- Blended fabric can be dyed by union dyeing and cross dyeing

### ACTIVITIES FOR TEACHER

- To show different types of dyes.
- To arrange for field visit to dyeing units.

### ACTIVITIES FOR STUDENTS

- To motivate students to collect different natural dye sources
- To ask students to dye a fabric using any one synthetic dye

### INTERNET RESOURCES

| | |
|---|---|
| https://www.youtube.com/watch?v=ThPhBpsRHQo | Garment dyeing process |
| https://www.youtube.com/watch?v=ILoZophnHfs | Natural dyeing |
| https://www.youtube.com/watch?v=UEMcjmyjoOY | Indigo dye extraction |

## GLOSSARY

| | |
|---|---|
| Stock dyeing | Dyeing at the fibre stage |
| Dope dyeing | Dyeing of man-made fibres by adding the dye to the spinning solution |
| Piece dyeing | Dyeing at the fabric stage. |
| Chromophore | A part of a dye molecule that is responsible for the production of colour with the substrate. |
| Pigments | Coloured insoluble substances that don't have affinity towards fibre |
| Levelling agents | Enhances even distribution of dye throughout the fibre. |
| Mordants | Compounds that link dye molecule and the fibre by reacting with both of them. |
| Reactive dyes | Dyes that form covalent bonds with the fibre. |
| Leuco Compounds | Colourless compounds which are produced when vat dyes are subjected to reduction reaction. |
| Colourfastness | Resistance of a textile material to change in colour. |
| Exhaustion Agents | Compounds that enhances the absorption of dye molecule by the textile substrate. |

## QUESTIONS AND ANSWERS

### PART – I
### Objective Questions

1. Skein dyeing is done at
   a) Yarn stage
   b) Fibre stage
   c) Fabric stage
   d) Garment stage
2. Which of the following dye is called as 'ice colours'?
   a) Direct dyes
   b) Reactive dyes
   c) Azoic dyes
   d) Sulphur dyes

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3. Dyeing of wool fibre is called as
   a) Dope dyeing
   b) Top dyeing
   c) Skein dyeing
   d) Package dyeing
4. The dye that forms covalent bond with the fibre is
   a) Reactive dye
   b) Sulphur dye
   c) Direct dye
   d) Acid dye

5. Which of the following dye is used to produce black colour?
   a) Direct dye
   b) Acid dye
   c) Basic dye
   d) Sulphur dye

## PART – II
### Answer in Three (Or) Four Points

1. List the stage of dyeing.
2. What are natural dyes?
3. Write the basic principles of vat dyeing.
4. Define union dyeing.
5. What are optical brighteners?

## PART – III
### Answer in a Paragraph

1. How are natural dyes classified?
2. Explain the various method of yarn dyeing.
3. Differentiate union dyeing and cross dyeing.
4. Write a note on direct dyes.
5. Discuss the properties of sulphur and vat dyes.

## PART – IV
### Answer in One Page

1. Explain in detail about the classification of synthetic dyes.
2. Describe the different methods of fabric dyeing.
3. Elaborate on the various methods of fibre dyeing.

**Answers For Objective Questions**

1. (a) 2. (c) 3. (b) 4. (a) 5. (d)