



FIBRE TO FABRIC

You know that fibres are what fabrics are made of. Just look at the fabric of the dress you are wearing. It is made of the thread prepared from small fibres. Just pull out a thread from a piece of fabric and open it up by untwisting. You will see those small fibres. You do know that there are a large number of fibres available to us and from which a variety of fabrics are made. This is why in any cloth shop you find such a variety of fabrics on the shelves of cloth shops in the market.

In this lesson we want you to get all the knowledge and acquire skills needed to recognize the fabric you want to buy by associating it with its specific properties and assessing its suitability to specific uses. You are familiar with the variety of uses various fabrics have in our daily life. The study of fibres and fabrics gives us the complete knowledge of properties and uses of various fabrics available in the market. This knowledge will help us to choose wisely the fabric we require and make the best use of it after purchase.



OBJECTIVES

After studying this lesson, you will be able to :

- discuss the functions of clothing and other household uses of fabrics;
- explain that the basic unit of a fabric is fibre which can be obtained from many sources;
- state typical characteristics of different fabrics;
- identify fibres and fabrics on the basis of visual examination and non technical tests;
- elaborate the process of yarn making and fabric construction;
- differentiate fabrics made from different yarns and tell their end uses;
- select fabrics for personal and household use.

10.1 FUNCTION OF CLOTHING AND HOUSEHOLD USES OF FABRICS



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Why do we wear clothes? Our clothes are rightly recognized as “the second skin.” At every stage of life and in every ceremony, clothes play an important role. They cover our body and protect it from adverse climatic conditions.

Clothes enhance our personality. These are made from various kinds of materials and sewn in several forms called **dresses or garments**. A well-fitted dress, worn according to the occasion and time speaks a lot about the person’s habits, taste, social status, behaviour and many other traits. Generally, men, women and children dress up differently and they also have sets of dresses for different purposes and occasions, for example, dresses for formal, casual occasions, sports and nightwear.

Colour of our clothing, in our country, is decided according to season, climate, age, occasion, marital status, gender, community, happiness and sorrow. The religion and occupation of a person can also be judged by the clothes a person wears. Lastly and most importantly, clothes also tell us about the habits of the wearer and his / her approach to hygiene. If the clothes are dirty and crushed we tend to think the person is careless, shabby and poor. Crisp, freshly washed and well ironed clothes lend a well groomed appearance to the wearer.

You have just learnt about the functions of clothes. Two examples are given below. List three more functions of clothes.

i	To look smart.
ii.	To show individuality.
iii	
iv	
v	

Other Uses of Fabrics

Think and write some of the other uses of fabrics in your house. Besides clothing, you are using fabrics in the house for bed linen, curtains, upholstery, cushion covers, etc. In the kitchen, you need dusters, mops, covers, etc. which are also produced from fibres. You use old cloth for dusting, wiping and covering, etc. So you see you have varied uses of fabrics in the house. Generally cotton fabric is suitable for most of the purposes. Once you learn about the properties of various fibres available, you will know why cotton is preferred to other fibres.



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10.2 FIBRES AND THEIR SOURCES

We have talked about fibre as the basic unit of fabric. Do you know what a fibre looks like? To understand, this take a small amount of cotton and pull out the smallest part from it. Study carefully. These may be long or short strands with a smooth structure that looks like white hair. Actually, these are fibres. A single fibre of cotton is difficult to locate but can be easily recognized in a mass of cotton.

Now, consider the structure of wool fibres. You know these are hair of animals like sheep, goat, rabbit, camel etc. Sweaters, socks, gloves, scarves, shawls and coats etc., are made from these hair/fibres. You can check this by opening a thread pulled out from a pure woollen fabric, or knitting wool. What do you see?

Similarly, there are many other fibres available to us, which can be used to make cloth and we will learn about these in the next section. A fibre is a fine hair like strand and is the basic unit of textiles from which we make yarns and then the fabric.



ACTIVITY 10.1

Take out some of your garments, pull out a yarn from the inner side of each and try to take out fibres. Study the similarities and differences among fibres in respect to their length and feeling.

The actual widthwise and lengthwise structure of fibres cannot be seen with naked eyes but can be recognized easily under the high power microscope. Here is the longitudinal (lengthwise) shape of some of the common fibres as visible under the high power microscope. Fig. 10.1 shows the longitudinal view of some fibres.

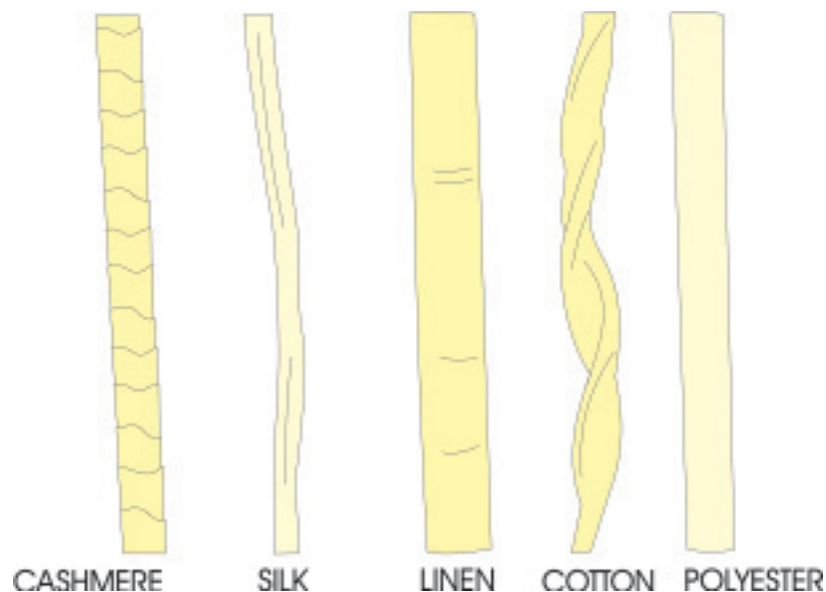


Fig. 10.1 The longitudinal view of cotton, wool, silk and polyester fibres.

10.2.1 Sources of Fibres and their Classification

There are many different sources from which we can obtain fibres and therefore, we classify them accordingly.

- i) **Fibres from Natural Sources:** All the fibres obtained from nature, i.e., plants or animals, are known as **natural fibres**. e.g. cotton, wool, linen, silk, etc. Fibres obtained from plant source are called **cellulosic fibre** e.g., cotton and linen. The fibres that come from **animal sources** are also known as **protein fibres**, e.g., wool and silk.

Sources of commonly used natural fibres are shown below in Fig. 10.2.

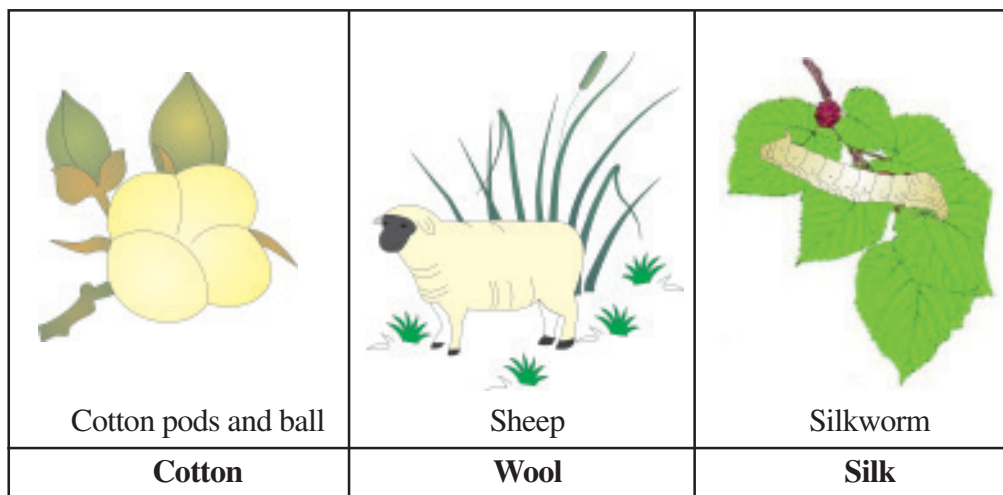


Fig. 10.2: Sources of natural fibres – Cotton, Wool and Silk

- ii) **Man-Made fibres:** The fibres which are made in laboratories using chemicals are known as man-made fibres and these are of following two types:
- Regenerated fibres** – These fibres are made from extremely small cotton fibres or any other fibre source such as wood pulp, milk protein, etc. Chemicals are used to dissolve these and the solution is then converted into solid fibres. Examples are rayon (cellulose out of viscose/acetate/triacetate) of different types, casein fibre (from milk) and soya bean fibre.
 - Synthetic fibres** - These are made using various petrochemical products. Nylon, acrylic and polyester are all synthetic fibres.

It is advisable to use garments made of natural fibres which are eco-friendly in nature. Sometimes synthetic fibres may cause allergies if worn next to skin. Sources of commonly used natural and man made fibres are presented in Table 10.1.



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Table 10.1 Commonly used natural and man-made fibres

Type of fibres	Name of fibre	Sources
NATURAL FIBRES		
Plants (cellulosic)	cotton	cotton ball
	linen	bark of flax stalk
Animal (protein)	wool	hair of sheep, goat, rabbit, llama etc.
	silk	silk worm
MAN-MADE FIBRES / MANUFACTURED		
Regenerated	rayon (viscose, acetate)	cotton linters or wood pulp + chemicals
Synthetic	nylon	chemicals
	polyester	chemicals
	acrylic	chemicals

10.2.2 Classification according to the Length of Fibres

The fibres we have listed above are short or long. The short length fibres are called **staple fibres** and are measured in inches or centimeters, e.g., cotton, wool and linen. The long fibres are known as **filaments** and are measured in yards / meters, e.g., silk and all man-made fibres.

	Length of fibre	Class	Appearance	Unit of measurement
FIBRE LENGTH	long	filament fibres		yards / meters
	short	staple fibres		inches/ centimeters

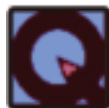
10.3 COMMON CHARACTERISTICS OF DIFFERENT FIBRES

- i) **Cotton:** Cotton fibre is the smallest of all the textile fibres. They are white, cream or light brown in colour and fine and strong. These are absorbent, porous and cool and allow the body heat to go out. Hence, fabrics made out of it are used as summer wear as cotton wrinkles very easily. Fabrics made from cotton are strong, durable and easy to wash and are used to make towels, sheets, pillow covers, etc., that require frequent washing.



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- ii) **Flax:** It is a 'bast fibre' and fabric made from it is called linen. It is a staple fibre though its length (20-30 inches) is more than the other staple fibres available. Linen fabric is shiny, smooth, durable and easy to wash. Like cotton, it wrinkles very easily, is cool, absorbent and is suitable for summer wear.
- iii) **Jute:** Like flax jute is also a bast fibre. Maximum production of jute is in India. The fibres are short and lusturous but weaker than flax. The fibres are hairy and generally rough. It is used for making gunny bags and cords.
- Jute Garments**
As jute is a rough fibre, so these days jute is mixed with other soft fibres for fabric construction. Also increasingly these days accessories like slippers and bags made out of Jute are in popular demand.
- iv) **Wool:** It is obtained from the fleece of domestic goats, sheep, rabbits, etc. The colour of wool fibres may vary from off-white to light cream. Fabrics made from wool are soft, smooth, absorbent and do not wrinkle easily. These do not allow the body heat to go out and act as insulators. This is why the fabric made out of these fibres is used as winter wear. Wool is a weak fibre and is easily affected by common washing soaps, powders and friction.
- v) **Silk:** Silk is a natural, protein filament produced by silk worm. Fabrics made from silk are soft, fine, smooth, lustrous, warm and stronger than wool. It is called 'Queen of the Fibres' and is used for formal wear.
- vi) **Rayon:** It is a man-made filament fibre which is lusturous, smooth, cool and absorbent but is weak in nature. It wrinkles very easily. Because of its close resemblance to silk, rayon is also called 'artificial silk' or 'art silk.' It is used as a summer wear. These fibres are **thermoplastic** in nature i.e., they are heat sensitive and soften and melt on application of heat.
- vii) **Synthetic fibres:** Synthetic fibres are made from petroleum products. Nylon, polyester, acrylic, etc., are the examples of synthetic fibres. Like rayon these are also thermoplastic fibres. Since these fibres catch fire easily and can stick to the body, they should not be worn while working in kitchen and near a flame. Synthetics do not wrinkle and can be made dull or shiny. They have good strength and are easy to wash and dry quickly. In other words, these fabrics are easy to care and maintain.



INTEXT QUESTIONS 10.1

1. Match column A with column B and fill in the given blanks-

A	B
<p>_____ i) Jute</p> <p>_____ ii) Cotton</p>	<p>a) Plant fibres</p> <p>b) Man-made fibres</p>



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- _____ iii) Wool
- _____ iv) Rayon
- _____ v) Silk
- _____ vi) Nylon
- _____ vii) Cellulosic fibres
- c) Bast fibre
- d) Regenerated fibre
- e) Natural fibre
- f) Animal fibre
- g) Silkworm
- h) Flax

10.4 IDENTIFICATION OF FIBRE THROUGH NON-TECHNICAL TEST

10.4.1 Identification of fibres by visual test and feel of the fabric

By now, you know the names and some basic properties of fibres obtained from different sources. On the basis of this knowledge can you identify the fabric you are buying? Yes, to some extent you can. If you remember the characteristics of a fibre then you will also know the properties of the fabric made out of it because the fabric will have the same properties. Look for these properties in the fabric and add to this your personal experiences like touch, feel and visual inspection of the fabric. Chances are that you will be able to name the fabric.

In the following Table 10.2 we are presenting to you some of the typical characteristics of different fabrics. If you examine visually, these will help you to recognize the fabric/ fibres.

Table 10.2: Characteristics of Different Fabrics which help Identification

<i>Fibres</i>	<i>Appearance</i>	<i>Touch</i>	<i>Feel</i>	<i>Care required</i>
Cotton	dull in appearance but lustrous when starched	feels smooth and soft to touch	gives a cool feeling	wrinkles easily more if it is starched
Linen	low to medium luster	soft and smooth texture	gives a warm feeling	wrinkles easily
Jute	dull	Rough and hairy texture	gives a warm and rough feeling	does not wrinkle easily
Wool	medium to low luster; poor quality has no luster	soft, smooth and absorbent; also bulky to look at.	warm to touch	does not wrinkle easily



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Silk	delicate looking and lustrous	smooth, soft and light	warm to touch	does not wrinkle easily
Rayon	can be lustrous or without it	soft and shiny but heavier than silk	gives cool feeling	wrinkles easily
Synthetic fibres	can be dull or semi dull or lustrous acrylic fibres look like wool	heat sensitive soften and melt on application of heat	most fabrics feel warm	able to withstand friction and do not wrinkle hence easy to care.

To test the information given in table 10.2, select various items of clothing you are using and observe the nature of the fibre in terms of appearance, touch and feel.

10.4.2 Identification of fibres using Burning Test

Burning test tells us about the composition of fibres. i.e., whether the fibres of a fabric are from a plant / animal source or are man-made. Follow the steps mentioned below to conduct the burning test:

Take out a few strands of fibres from a yarn or a fabric and then burn them with the help of a candle flame or a match stick. Observe the following points and record your observations :

- The behaviour of the fibres **on approaching the flame, in the flame, on burning, and the residue left after burning.** Since different types of fibres have specific burning pattern, one can recognize them accordingly.

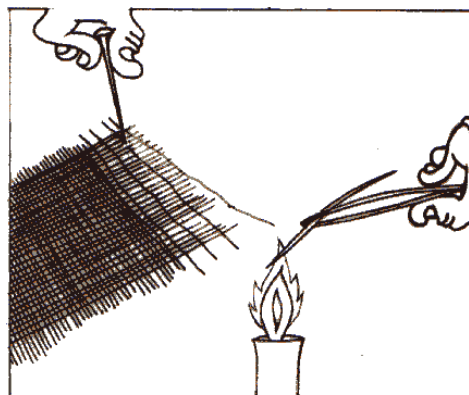


Fig. 10.3 Burning Test

Table 10.3 Describes the Burning tests for identification of fibres

<i>Fibre</i>	<i>Near flame</i>	<i>Type of burning / flame</i>	<i>Odour of burning</i>	<i>Residue</i>
cellulosic fibres – cotton, linen, jute, rayon, etc.	catches fire easily	continue to burn with a bright flame; have an afterglow	burning paper like smell	light, feathery, grayish /black smooth ash
protein fibres – wool, silk	smolder and burn	slow flickering flame; sizzle and curl	Burning hair or feathers like smell	silk-crisp dark ash; wool- dark, irregular, crushable bead



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synthetic fibres –nylon, polyester, acrylic, etc.	shrink on approaching flame	soften, melt and burn	mixed smell of chemicals	hard, black uncrushable bead
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Limitations of the burning test - The result of the burning can be confusing if the fabric is made by mixing two or more types of fibres or yarns.



ACTIVITY 10.2

Identify yarns made from different fibres by breaking test – Collect samples of fabrics made from different fibres. Take out yarns from each of these and keep each one separately. One by one, hold each yarn in both the hands and break it. You will observe the following:

1. cotton - breaks easily, has brush like tips and slightly curled fibres.
2. flex - stronger than cotton, needs more strength to break.
3. jute - yarn breaks easily.
4. wool - yarn stretches and breaks with a brush like tip.
6. silk - yarn breaks with a jerk.
7. rayon - yarn breaks easily and does not have brush like tip.
8. synthetics - yarn stretches and does not break easily.



INTEXT QUESTION 10.2

1. One evening, Geet was busy cooking dinner and her father was in the garden. Suddenly, Geet saw her *dupatta* had caught fire. She shouted loudly and ran out of the kitchen. Her father saw flames and rushed towards her with a cotton sheet. He quickly wrapped it around Geet to put off the flames.

He immediately took her to hospital. Doctor said Geet had received burns because the *dupatta*, made from polyester, had melted and stuck to her skin. Her father had received only a few scalds while wrapping Geet with cotton sheet and putting off the flames. Since he was wearing cotton *kurta*, *pyajama* he was saved.

The doctor appreciated her father's presence of mind in wrapping a sheet that helped in extinguishing the fire immediately. Fortunately the burns were not very severe and Geet recovered soon.



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Answer the following questions:

- i) Why did the *dupatta* catch fire?
 - ii) Why did the *dupatta* get stuck to the body after catching fire?
 - iii) Why was Geet's father relatively safe from burns?
 - iv) What type of fabric should you prefer to wear while working in the kitchen?
 - v) List three other fabrics which can be worn while working near fire.
 - vi) People know that synthetic fabrics catch fire easily yet most of them wear these clothes while working in the kitchen. Convince them in about 30 words about merits of changing into cotton clothes before working in the kitchen.
2. Fill in the blanks -
- i) If wool: winter, then _____ : summer
 - ii) If bark: flax, then _____ : wool
 - iii) If cotton: king of fibres, then silk : _____
 - iv) If regenerated fibres : wood pulp, then synthetic fibres: _____
 - v) If linen: cotton, then acrylic : _____
3. Put a tick mark on the right option. Justify the chosen option.
- True/False a) Cotton is a filament fibre.

- True/False b) Length of staple fibres is measured in inches.

- True/False c) Acetate is a man made fibre.

- True/False d) Natural fibres can be made from chemicals.

- True/False e) Wool is a plant fibre.

4. Search names of fibres in Wonder box. Hints are given below.
- a. I am soft and look like silk.
 - b. I become lustrous by starching.
 - c. I look like wool.
 - d. I am smooth and lustrous.
 - e. I am rough to touch.



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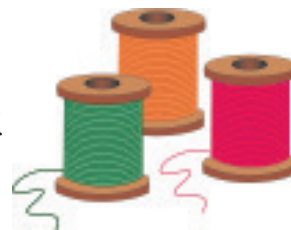
- f. I give warmth in winters.
- g. I am easily washable.
- h. I wrinkle easily.

WONDER BOX

R	A	Y	O	N	F	S	D
M	A	C	R	Y	L	I	C
N	W	Y	C	G	H	L	L
Y	T	W	O	O	L	K	I
L	Y	U	T	N	I	O	N
O	J	K	T	B	N	M	E
N	L	Z	O	Q	W	E	N
X	C	V	N	J	U	T	E

10.5 YARNS, YARN MAKING AND FABRIC CONSTRUCTION

A **yarn** is a long continuous length of interlocked fibres. Strands of fibres are brought closer to each other by twisting. Twists impart strength to the fibre strand which is then termed as a yarn. It is suitable for the production of fabrics, thread for sewing, crocheting, knitting, embroidery and/or rope making. A **thread** is a highly twisted and smooth strand of fibre. It is used for sewing, embroidery, etc.



10.5.1 Process of yarn making

a) Spinning of yarns

Do you know how a yarn is made? Yes, you guessed it right, a yarn is spun. Spinning is the process by which a group of fibres is pulled, drawn and twisted together to make a yarn. Do you remember Mahatma Gandhi and his *charkha* or the spinning wheel? Mahatma Gandhi, would daily take a hand full of cotton and spin it into a yarn on his *charkha*. He promoted *charkha* during India’s freedom struggle as a symbol of self-reliance and a source of income.

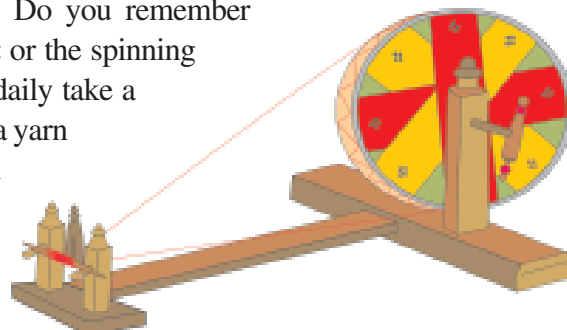


Fig. 10.4: A traditional spinning wheel (*charkha*)

A *charkha* is for hand spinning. The yarn spun on a *charkha* can have different thickness. Thick yarn is used for floor coverings, medium thickness for upholstery items and fine quality yarn is used for making dress material. Different types of fibres - cotton, wool, hemp and silk are spun on *charkha* in the villages in many states of India.

Twists given to fibre strands for formation of a yarn can be either ‘**S-twist**’ (clockwise) or ‘**Z-twist**’ (anticlockwise). The quality and strength of yarn is affected by the number of twists in inch. Lesser the number of twists per inch, bulkier and less strong is the yarn and more the number of twists, finer and stronger is the yarn. Figure 10.5 shows S and Z twists and Figure 10.6 shows number of turns in a yarn.

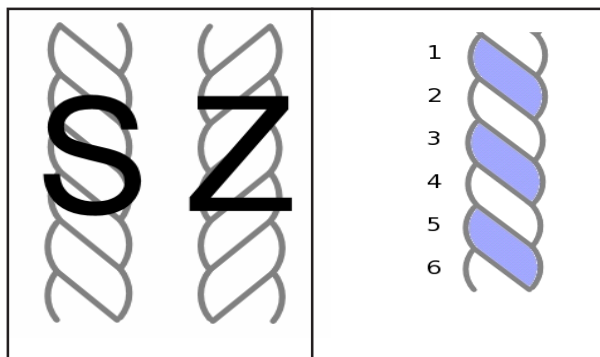


Fig. 10.5 S and Z twists

Fig. 10.6 Number of turns in a yarn

b) Spinning by Machine

Both, the fibres as well as filaments are spun into yarns that are then used for different end uses. Fibres available in the filament form are first cut into short lengths and then made into yarns called spun yarns. Various steps followed for making yarns are :

- i) **Cleaning:** When the natural fibres are harvested or collected, these contain dry leaves, stems, seeds, dirt and unwanted materials that are removed during cleaning.
- ii) **Carding:** The fibres sometimes get matted and stick to each other. Carding machine opens and arranges the fibres in a parallel manner. The carded web of fibres is turned into a soft rope called **sliver**.
- iii) **Combing:** It is an optional step used for making fine quality yarn. Carded slivers are combed to separate long and short fibres with the help of series of combs.

Cleaning, carding and combing steps are omitted while making spun yarns from cut filaments of synthetic fibres. For these synthetic fibres only spinning and winding is done.

- iv) **Spinning:** Carded and combed slivers are further drawn and spun into yarns. The yarn is a single strand but may be plied into several strands:



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v) **Winding:** The yarn is wound into various packages according to the weight or length of the yarn and its end use. Some of the common yarn packages for fabric construction are- ball (yarns for hand knitting), reels or bobbins for sewing; embroidery and hanks, cones, etc. Figure 10.4 shows some packages of yarns.

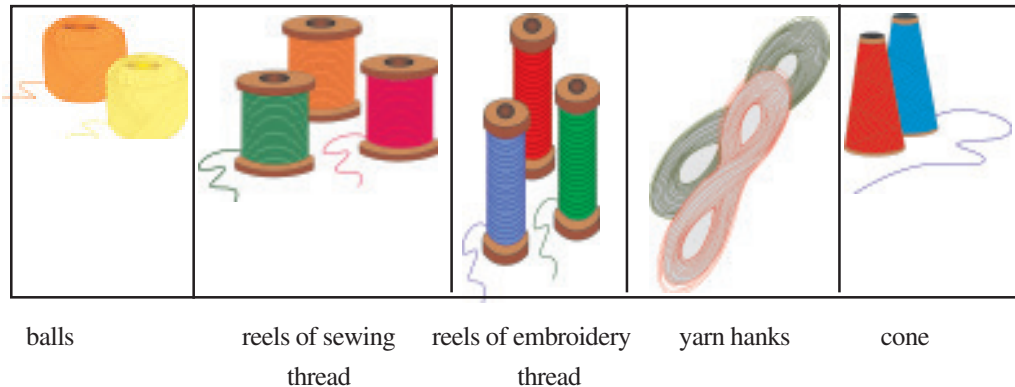


Fig. 10.7: Packaging of yarn in balls, reels, hank and cone

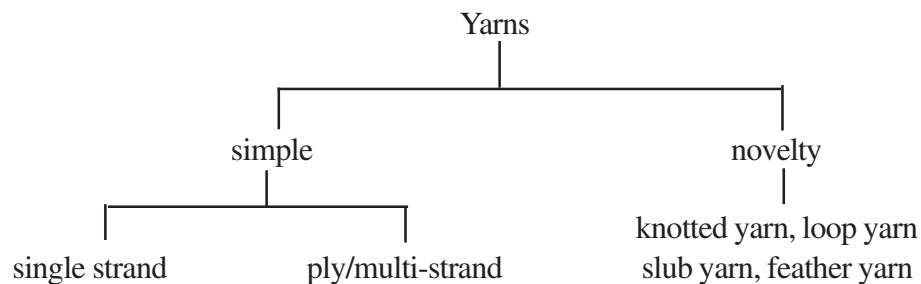
After spinning, a specific length of yarn is wound in the form of packages called balls, reels, hanks, cones, etc., depending on the weight or length of yarn and its end use.



ACTIVITY 10.3

Collect some sewing thread reels and knitting yarn balls lying at home. Check the length of the yarn printed on sewing thread reel. You can also collect reels and balls of yarn of different lengths and weights. Are some reels available with 50, 100 and 200 meters thread? You may observe that knitting yarn balls are available with the weight of 25 and 50 grams.

10.5.2 Classification of Yarns



The yarns may be classified into two groups: i) simple yarns and ii) novelty yarns

i) **Simple yarns:** A simple yarn has uniform thickness, smooth surface and equal number of twists per inch along its length. Most standard fabrics for clothing and household use are made with these yarns.

- **Single strand:** fine quality single strand is used for constructing light weight and fine fabrics. Thick and rough quality single strand is used for making thick fabrics

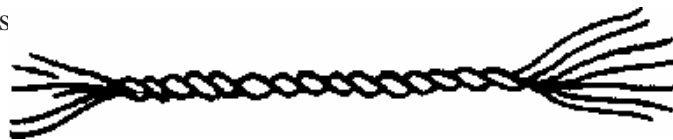


Fig – 10. 8 Simple single yarn

- **Ply yarn:** Two or more than two simple yarns are twisted together to form a ply yarn. These yarns are also known as multiple strand yarns. These can be termed as two-ply, three ply, and so on according to the number of strands used in the construction. These are more durable than simple yarns and are used for making fabrics for suiting, knitting, floor coverings, etc.



ACTIVITY 10.4

Lets make ply yarns

Follow the steps described below. Paste sample of ply yarns in the space provided.

Pictures of ply yarn	Method	Sample of ply yarn
<p>Fig – 10.9 Double or Two ply yarn</p>	<p>Two ply or double ply yarn can be made by knotting two separate single yarns at both the ends or one long single strand plied by holding both ends together.</p>	
<p>Fig – 10.10 Three ply yarn</p>	<p>Three ply can be produced by twisting a long single strand yarn. Fold it twice to get three parallel strands. Twist these together and put small knots at both the ends.</p>	
<p>Fig – 10.11: Four ply yarn</p>	<p>Four ply are also known as cable yarns. These are usually made by plying two strands of two-ply yarns together.</p>	
<p>Fig –10.12 Cord yarn</p>	<p>Cord yarn is a multiple strand yarn. Take 3/4/5 ply yarns and twist together and knot both the ends to get cord yarn. These are generally used for making ropes.</p>	



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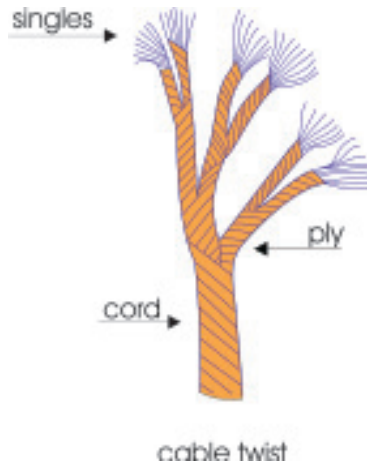


Fig –10.13 Types of yarns

ii) **Novelty yarns:** Carefully observe the curtains, upholstery (sofa) material or sweaters. Take out the yarns from these and study the construction of an individual yarn. You will see that these are of a complex nature and have unusual appearance and texture which are produced during spinning.

Depending upon their appearance, these are given different names like: loop yarn, knot yarn, slub yarn, feather yarn, etc. different types of novelty yarns are shown in figure 10.4 – 10.7

Types of Novelty Yarns

Yarn	Diagram
Loop yarn has loops, placed continuously along its length. Example- woolens	Fig. 10.14
Knots/knops are made along the length of a yarn. Example- woolen and scarves	Fig. 10.15
Slub yarns have ornamental effects in the form of soft untwisted (thick and thin) and twisted areas at frequent intervals throughout the length. Example- curtains	Fig.10.16
Feather yarn also called chenille yarns, these have soft and fuzzy surface. Example- rugs	Fig.10.17

Fabrics made from novelty yarns are bulkier, softer to touch and have beautiful unusual textures but are not as durable as fabrics made from simple yarns.



INTEXT QUESTION 10.3

- State whether the following statements are true or false. Encircle the right answer.

True / False i) Silk yarn breaks easily.

True / False ii) Bulky yarns need less number of twists in one inch length.

True / False iii) Slub yarns have thick and thin places.

True / False iv) Cord yarn is made from single yarn.
- Fill in the blanks with appropriate words. Choose the words from the box given along.

i) A simple yarn has uniform _____ in per inch length. ii) Cord yarn is a _____. iii) Flex is stronger than _____. iv) Synthetic yarns stretch and _____.	cotton multiple strand yarn fibres do not break easily thickness synthetic
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10.6 FABRIC

Fabric is a pliable, strong sheet made from fibres or yarns. You must have heard names such as poplin, *khadder*, *mulmul*, denim, rubia, terricot, etc. All these are fabrics are prepared by weaving the yarn. Human beings learnt to weave by taking inspiration from nature by observing the nests of birds and entangled branches of trees.

Fabrics are manufactured by many techniques such as weaving, knitting, felting, nets, etc. However, **weaving and knitting, the two most popular methods of fabric construction** have been discussed in detail here.

10.6.1 Weaving

Weaving is interlacing of two sets of yarns –warp and weft at 90° angles to each other. Straight yarns in fabric are known as **warp** yarns. Horizontal yarns are known as **weft** yarns. Along the length of the woven fabric, on both sides, end yarns are woven very densely and the portion is named as **selvedge**. It does not allow the fabric yarns to come out from the lengthwise edge. The portion between the two selvedges is the body of the fabric.

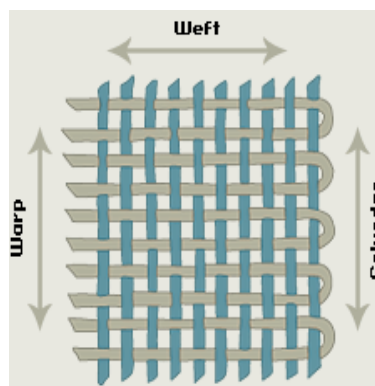


Fig. 10.18 Woven fabric



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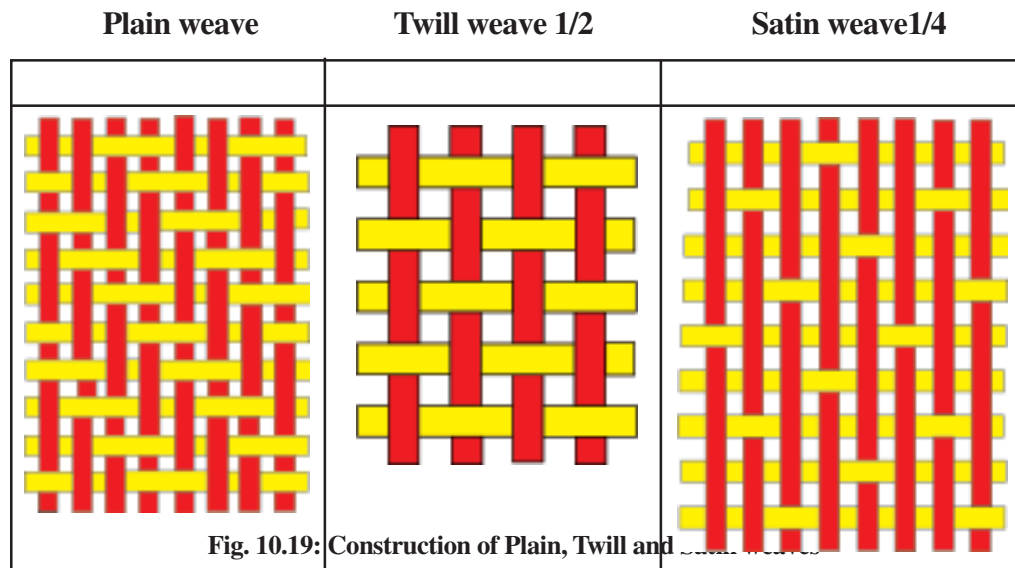
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Merits of weaving

- Weaving gives a firm fabric.
- Woven fabrics do not stretch and are thus easy to handle.
- Woven fabrics are easy to print and embroider.
- Weaving is most commonly used method of fabric construction.

10.6.1 i) Basic Weaves

Weaves are broadly classified as **basic and novelty weaves**. Most of fabrics are produced in **basic weaves**, which are of three types- **plain, twill and satin weave**. Their construction is explained in figure 10.19



- a) **Plain weave** - Plain weave is also known as homespun, tabby or taffeta weave. It is the easiest to weave where one weft yarn alternatively moves over one and under another warp yarn. Maximum production of fabric is done in plain weave. It is inexpensive weave, most suitable for printing and embroideries. To see the variations of the weave, note the fabrics like muslin, cambric, hand spun and hand woven khaddar, organdy, poplin, voile, etc.
- b) **Twill weave** - It is woven on three to four harness loom. In this, one weft yarn moves over two and under one warp yarn. Twill woven fabric is distinguished by a continuous diagonal line called wale. Variation in diagonal lines produces various designs of twill. Twill weave is woven tightly, that is why it is suitable for work clothes and for men’s clothes. Examples of Twill woven fabrics are gabardine, tweed, denim, jean, etc.
- c) **Satin weave** - It is woven on five to twelve harness loom. If woven on a five harness loom, one weft yarn passes under 4 warp yarns and goes over one warp

yarn. It differs from Twill weave as it has long yarns floating on the surface. There is no design visible on the face of the fabric but it has a smooth and shiny surface. Satin fabric is an example of satin weave. Fabrics woven in this weave are suitable for making formal wear garments.

Handlooms are the second largest employer of the rural population in India, next only to agriculture. Handloom fabrics are made from either hand spun or mill spun yarn that has been woven on a handloom. In India, do you know *khadi* is a term given to a fabric which is made from hand spun yarn and is woven on a handloom. *Khadi* has a coarse texture and rough feel. However, many varieties of *khadi* like *khadi* cotton, *khadi* wool, *khadi* silk, heavy and light weight *khadi* are available on retail outlets of *khadi*. These fabrics always remain in fashion with consumers and have a large export market. *Khadi* movement in India was started by Mahatma Gandhi during the freedom struggle primarily as a symbol of self-reliance and a means of livelihood for the unemployed rural population.



Notes



ACTIVITY 10.4

Interview the weavers in your area to know how do they weave and what do they weave? What type of yarns do they use? What is their average daily/monthly income? Where do they sell their products? Are they able to sell their products easily?

OR

Visit a tailor in your area and ask which type of fabrics does he or she stitch most often? Which fabric is easy to handle while stitching and why? How does he or she decide on the type of needle and thread to be used for stitching? How does he decide on the cost of stitching a garment (salwar kurta/blouse/shirt/trousers)?

10.6.2 Knitting



Fig.10.20 Formation of loops

Knitting is the process of formation of loops of yarns and drawing of new loops through those formed previously (interlooping). Depending on the types of knitting, it either moves right to left or left to right (weft knitting) or the yarns run lengthwise (warp knitting). Hand knitting is the most common example of weft knitting, though it is also done on machines to make many types of sweaters, T-shirts, and socks, etc. Warp knitting is only possible on machines. Knitted fabrics are



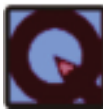
Notes



Fig. 10.21 Knitted fabric

used to make casual wear, party wear, sportswear, undergarments as well as household articles such as bed sheets, bed covers, blankets, etc. See figure 10.20 which shows the formation of loops while knitting. Figure 10.21 shows a knitted fabric.

Knitted fabrics are well known for their fit, comfort, stretchability, warmth, absorbency, and wrinkle resistance.



INTEXT QUESTIONS 10.4

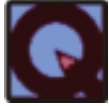
1. Fill in the blanks with appropriate words.
 1. Hand knitting is known as _____
_____ (warp knitting / weft knitting)
 2. *Khadi* Movement in India was started by _____
_____ (Mahatma Gandhi / Jawaharlal Nehru)
 3. Selvedge refers to _____
(width / length of fabric)
 4. Woven fabrics _____
(stretch / do not stretch)
2. Unscramble the following jumbled words to identify the names of some fabrics—
 - i) _____ niemd
 - ii) _____ bargadine
 - iii) _____ ydnaorg
 - iv) _____ twelo

10.7 END USES OF DIFFERENT FABRICS

When you go to a shop, you give specification of the fabric you want, to the salesperson. Often you go to different shops to buy fabric or ready made garments. In other words, shops usually specialize in the type of items they sell. This way it is easy for you to find what you want and the shop can also stock good variety of related products.

Since you have already studied about the properties of various types of fibres, yarns, fabrics and weaves, it will be easy for you to use this knowledge to recognize fabrics and choose them for the end use in your mind.

Cotton fabrics are available in the form of muslin, khadi, poplin, rubia, organdy lawn and denim. Similarly, wool is available in the form of felt, knits and woven fabric silk fabric is available as raw silk, crepe and satin silk.

**INTEXT QUESTIONS 10.5**

Choose the correct answer of the four given at the end of each statement

1. 1. Muslin is a fabric which is _____.
 - (a) light weight and loosely woven
 - (b) transparent and crisp
 - (c) heavy weight and thick
 - (d) medium weight and plain
2. 2. Denim is a fabric which is _____.
 - (a) light weight and loosely woven
 - (b) transparent and crisp
 - (c) heavy weight and thick
 - (d) medium weight and plain
3. 3. Organdy is a fabric which is _____.
 - (a) light weight and loosely woven
 - (b) transparent and crisp
 - (c) heavy weight and thick
 - (d) medium weight and plain
4. 4. Poplin is a fabric which is _____.
 - (a) light weight and loosely woven
 - (b) transparent and crisp
 - (c) heavy weight and thick
 - (d) medium weight and plain



Notes



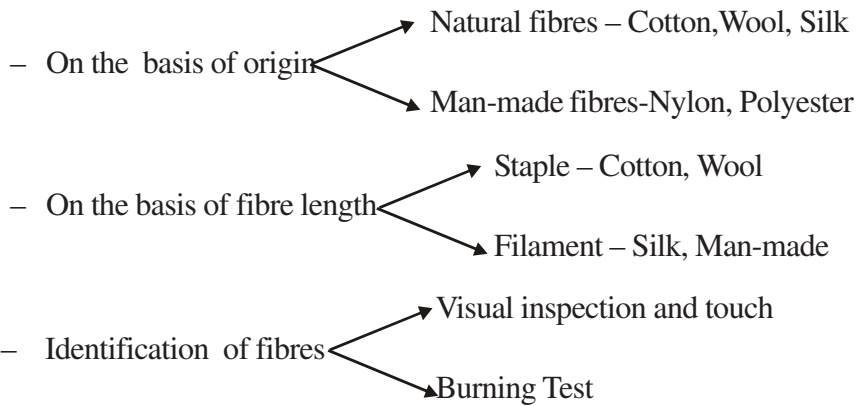
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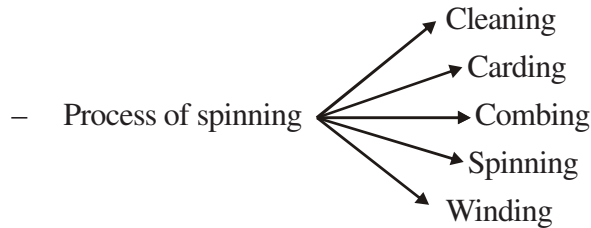
WHAT YOU HAVE LEARNT

- Clothes → Their functions and importance
- Fibre → Yarn → Fabric
- Textile Fibres

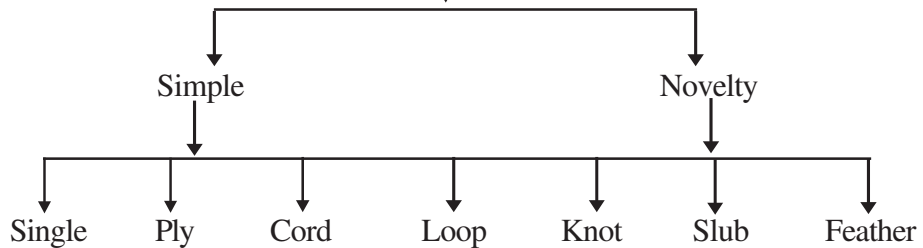
Classification of fibres



• Yarns



Classification of Yarns



• Fabric

Weaving Basic weaves – Plain, Twill and Satin
 Knitting Warp and Weft knitting

- End uses of different fabrics



TERMINAL EXERCISE

1. Give one difference between the following-
 - i) Coarse and fine yarn
 - ii) S and Z twist
 - iii) Four ply and cord yarn
 - iv) Spun and filament yarns
2. Why do Nylon, Polyester and Acrylic catch fire easily?
3. Read the case study given below and answer the questions given at the end:

Ginni was extremely unhappy because a red rash was spreading all over her body and was very painful. She had tried many local applications to get rid of them, but nothing helped. The rash was causing irritation and made her feel uncomfortable.

She discussed her problem with her friend Shyama who suggested her to consult a doctor in the village dispensary. In the dispensary the doctor looked at her skin problem and noticed the fabric of her dress. She asked Ginny if she wore the same dress often. Ginni said yes because she liked the dress very much. It was a fashionable dress, easy to wear, carry and maintain.

The doctor advised Ginni not to wear the dress again for sometime. In warm climate it did not allow the skin to breathe fresh air, caused sweating which led the skin to become irritable and cause the red rash.

But Ginny was not convinced. She thought, everybody wore dresses made from similar material and had no complaints. If nobody else had any problem in wearing such clothes why she should have any. Surely she thought that her problem could not be due to the clothes she wore. So she did not stop wearing her favourite dress.

Some questions to ponder (if possible discuss with peer group or with people at home)

If you were Ginni's friend what would you advise her to do? How would you convince her?



ANSWER TO INTEXT QUESTIONS

- 10.1** 1. i) c ii) a iii) f iv) d
 v) g vi) b vii) e.



Notes



Notes

- 10.2
2. i) Cotton ii) Fleece iii) Queen of fibres iv) Petroleum products
v) Wool.
 3. a) False – Cotton is a staple fibre
b) True
c) False – Acetate is a Regenerated fibre
d) False – wool is a protein fibre
e) True.
 3. Wonder box -

R	A	Y	O	N	F	S	D
M	A	C	R	Y	L	I	C
N	W	Y	C	G	H	L	L
Y	T	W	O	O	L	K	I
L	Y	U	T	N	I	O	N
O	J	K	T	B	N	M	E
N	L	Z	O	Q	W	E	N
X	C	V	N	J	U	T	E

- (a) RAYON
- (b) COTTON
- (c) ACRYLIC
- (d) SILK
- (e) JUTE
- (f) WOOL
- (g) NYLON
- (h) LINEN

10.3

1. i) False - Silk yarn breaks with a jerk.
ii) True
iii) True
iv) False - Cord yarn is made from 3/4/5 ply yarns. It is multiple strand yarn.
2. i) Thickness ii) Multiple strand yarn
iii) Cotton iv) Do not break easily.

10.4

1. i) Weft knitting ii) Mahatma Gandhi
iii) length of fabric vi) do not stretch
2. i) Denim ii) Gabardine
iii) Organdy iv) Towel

10.5

1. a 2. c 3. b 4. d

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Component-I (B) Description of Module

Items	Description of Module
Subject Name	Home Science
Paper Name	Front Office and Housekeeping
Module Name	Pest Control in Hotel
Module ID	H04FO036
Pre-requisites	Knowledge on pests and its characteristics
Objectives	The various types of pests and means to control the pests
Keywords	Contamination, infestation, sporadic, poisoning, eradication, suppression, crevices, sanitation, resistant, tolerant, pesticide, insecticide, fumigation, rodenticide, fungicide, treatment.

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PEST CONTROL IN HOTEL

1. INTRODUCTION

Pests are enemy to human beings. They are always considered to be unwanted guests. Pests will cause a lot of damage and economic loss to the hospitality industry and often cause serious damage to the health by spreading disease causing micro organisms. You cannot avoid these uninvited guests however clean you keep the premises. It not only will speak bad of the hotel but also will embarrass the guests utilizing the facility. Thus, pest control is a very important job of the housekeeping department. If anything buzzes, squeaks or eats your food and has more legs than yours and creeps around, we don't like them creeping around the rooms. Using pesticides might give a solution to the problem, but you always have to remember that the stuff that is toxic to pests is toxic to humans and other living and non-living things too.

2. LEARNING OBJECTIVES

At the end of this lesson, students should be able to demonstrate appropriate skills, and show an understanding of the following:

- ✓ The various types of pests and
- ✓ Means to control the pests.

Pests generally enter inside the building seeking food, shelter and for the right temperature and humidity. Good housekeeping personnel should be vigilant enough in spotting signs of infestation and report immediately to the housekeeping manager so that action can be taken. You might see a variety of pests, but majority of them will be attracted to the food premises. Some of the common pests which can be seen are:

- a. Pests causing physical damage- bed bugs, carpet beetles, mosquitoes, rats, mice, etc
- b. Pests which contaminate the foods- cockroaches, rats, mice, flies, mosquitoes, etc
- c. Pests in food stores- flour beetle, ants, etc.

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3. IDENTIFICATION OF PESTS

Accurate identification of pests is required for effective pest management programme. Unless you know the pests, never ever attempt a pest control programme. The pest control will be easier and cost effective if you know about the pest, its growth and development and the means by which it spreads.

To identify and control pest you need to know: the physical features of the pests, characteristics of damage, their development, whether they are continuous, sporadic or potential pests and what are your control goals. Always control a pest only if it is causing more harm than the reasonable limit, and use a control strategy that will reduce the number of pests causing as little harm as possible.

3.1 Factors which encourage pests:

1. Uncovered foods
2. Unclean tables and work areas
3. Unclean floors and cupboards
4. Blocked or unclean toilets
5. Pools of water due to leaking taps
6. Overflowing drains

3.2 Indications for pest infestation:

- a. Live or dead bodies including eggs and larvae
- b. Insect or rodent droppings
- c. Damage to food stuffs, packaging cardboard, etc
- d. Slipped foods next to stacks/ cartons
- e. Pungent odours, bad smell (mice/ cockroaches)
- f. Leg prints on spilt flour
- g. Black greasy smears on the walls or around pipes

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- h. Apparent loss of small amount of foods
- i. Fur, droppings, eggs and dead bodies
- j. Flies vomit on food during feeding and might have just visited refuse site or animal feces before landing on food.

4. GOALS OF PEST CONTROL:

The three main goals of pest control are:

4.1 Prevention- Keeping a pest away from becoming a problem

4.2 Suppression- Reducing the number of pests or reducing it to an acceptable level

4.2 Eradication- Destroying the entire pest population from the premises

Now let us learn the goals of pest control in detail:

4.1 Prevention should be the first goal when the pest's presence or abundance is predicted in advance. Prevention can be done by following certain basic measures such as;

- a. Sealing of all wall and floor openings or crevices
- b. Ensure that all doors and windows are tightly fitted
- c. Rodent proof doors, windows, pipes and ducts
- d. Fly screen doors and windows
- e. Clean the store areas, preparation and service areas thoroughly at the end of each working day.

Continuous pests can be easily predictable. Sporadic and potential pests may be predictable if you know the circumstances or conditions that favour their growth and development. For example flies are usually seen during the summer season.

4.2 Suppression- the intent of suppression is to reduce the number of pests after detection. Prevention and suppression are joint goals. This will help to suppress the pests already present and prevent them from coming up again into the surroundings.

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4.3 Eradication- this is a very rare situation as it is difficult to achieve. This method is generally used when any foreign pest enters the establishment. Often these types of strategies are supported by government.

Thus, indoor environments can be easily safe guarded against pests than the outdoor areas, as they are smaller, less complex and more easily controlled than outdoor areas. Eg: schools, offices, kitchen, etc.

5. METHODS OF PEST CONTROL

The various methods of pest control are discussed below:

5.1 Natural controls certain natural forces help in increase of certain types of pests. These forces work independently of human beings and help or hinder the growth of these pests. Ex: climate, natural barriers like enemies, water/ moisture, availability of shelter, etc. so you should be aware of the natural influence on pest and take advantage of them.

5.1.1 Climate and weather conditions such as temperature, day length, and humidity, affect pest activity and rate of reproduction. Rain, freezing temperature and drought, kill / suppress the pests by affecting their growth and development.

5.1.2 Natural enemies- birds, reptiles, amphibians, fish, mammals feed on pest and help control their number . Pathogens often suppress pest population.

5.1.3 Geographical barriers- Mountains and large bodies of water restrict spread of many pests.

5.1.4 Food and water supply- pests can survive only if food and water are available. Once it is exhausted it dies or becomes inactive.

5.1.5 Shelter- wintering sites and places for hiding are essential for survival of some pests.

5.2 Applied controls- these do not control quickly or completely.

EG- Host resistance-some plants, animals and structures resist pest better than others. It works on one of the three ways: chemicals in the host prevent the pests from completing its life cycle; the host is tolerant than other varieties and thus less likely to be seriously damaged by pest attack; the host has physical characteristics that make it more difficult to attack.

1.2.1 Biological control- introduction of natural enemies like parasites and predators. More of pest enemies can be released into the target area, which were not present before. But these does not assure of pest eradication. The degree of control fluctuates .But sufficient control can be achieved to certain extent though there might be a lag between the increase of pests and corresponding increase in natural control.

Pests can also be biologically altered by making the pests sterile and use of phremones/ juvenile harmones. Phremones can be useful in monitoring pest population. Sometimes it is also used as a control tool. A manufactured copy of a phremone that a female insect uses to attract male can be used to confuse males and prevent mating, resulting in lower number of pests.

1.2.2 Cultural control- cultural practices like altering the environment, the condition of host plant, or the behavior of pest to prevent or suppress the infestation. They disrupt the normal relationship between the insect and the host and makes it less likely to survive, grow or reproduce. Eg: rotating crops, planting trap crops, pruning, thinning, etc.

1.2.3 Sanitation- good sanitation like improving cleanliness, eliminating pest harbourage, and increasing the frequency of garbage picks, decontaminating equipment, materials and other possible carriers helps in creating a pest free area. Proper design of kitchen and food storage area helps in reducing access and shelter for pests.

1.2.4 Mechanical/physical control- these are the devices or machines like traps, screens, barriers, nets, fences, electricity, radiation,, etc used for preventing the spread of pests. Change in environmental conditions like, refrigeration, light, heat, humidity can also help in controlling certain pests like insects and disease agents.

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1.2.5 Chemical control- chemical agents like pesticides help to either attract or repel pests. They are generally the fastest way to control pests.

6. COMMON PESTS AND METHODS TO CONTROL THEM

S.NO	PEST	CHARACTERISTIC	PREVENTION
6.1	Ants	<p>These insects generally invade in large numbers in search of food especially sweets.</p> <p>They enter by crevices, along a definite track in procession and can be systematically trapped where it enters the establishment.</p>	<p>Vulnerable areas must be emptied, thoroughly cleaned and borax (which repels them) should be spread over the shelf until it ceases to come.</p> <p>If nest is seen, it can be destroyed by placing 2 tbsp of carbon bisulphide at the entrance (vapour kills ants), but highly inflammable should be used with great care.</p> <p>Boiling water poured over the nest repeatedly also kills ants.</p>
6.2	Flies	<p>Filthy insects which are very dangerous to health as they contaminate food.</p> <p>It causes diseases such as typhoid, cholera, dysentery and so on.</p> <p>It also carries disease germs on their legs and saliva and transfer to food on</p>	<p>Try to destroy all possible breeding grounds before egg laying begins.</p> <p>Burn all garbage</p> <p>Keep dustbins covered.</p> <p>Maintain good standard of cleanliness in the surrounding.</p> <p>Fly poison concocted of 3 tsp of</p>

		which they sit.	formalin in 1 pint of milk/ water with sugar added in saucers should be kept in susceptible areas to trap and kill flies. Aerosol fly killer sprays are also effective.
6.3	Cockroaches	Nocturnal insect They are present in drains and dark secluded places. Types- (a) German cockroaches- 10-15mm in length, lighter yellowish brown, can climb smooth vertical surfaces, prefers warm and humid condition. (b) Oriental Cockroaches ó 20-22mm in length, dark brown, found in cooler less- humid areas such as drains. Generally cause diseases such as desentry and gastroenteritis. Feeds on: fecal matter and food	Most difficult pest to eradicate. Proprietary cockroach killer preparations can be used in infested areas. Pest control experts need to be called if it persists.
6.4	Mosquitoes	Transmits diseases such as malaria, filarial and yellow fever Life cycle begins in water.	Do not allow water to stagnate in and around the surrounding of the hotel. Repair and fill all pits and puddles. Cover drains and pour kerosene to prvent larvae from thriving and growing into adult

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			mosquitoes. Eco friendly method- place water around the property. Allow mosquitoes to lay eggs. Before the eggs develop, discard the water.
6.5	Bed bugs	Tiny parasitic creature that feed on blood of humans. Presence- beds, cloths, furnitures, upholstery, etc Activity is seen only at night Size varies from 4 to 5 mm Long, flat head with oval body Colour- yellow to white, light red/ brown (mature) Gives unpleasant odour	Fumigation Thick application of kerosene oil Pouring boiling water in crevices (temporary)
6.6	Rats and mice	They are potentially hazardous Mice- smaller, slender, big ears with respect to their bodies, brown colour with grey underbellies, thin tail equal to the length of their head and body. Causes- food poisoning, infection, jaundice, etc Nibbles and contaminates food stuffs, utensils, worktops with urine, dropping and fur which spreads disease and some are fatal to humans. Droppings- black and look like apple pips but smaller	Poisoning Trapping Fumigating Rat proofing buildings Proprietary infestation

		They also tend to gnaw on everything from electrical appliances to floorboards.	
6.7	Silver fish	Silvery grey insect looks like minute fish without fins 1cm long Nocturnal, found in moist areas Feeds on cellulosic materials (paper and fabrics)	Should keep moist areas clean Treatment with insecticides Pyrethrum and sodium fluoride crystals are effective
6.8	Termites	Social insects. Also called as white ants. There are 2 types- dry wood and ground termites. Both feed on cellulose found in wood and wood products for nutrition. Ground termites damage more by creating mud tubes from soil to wooden portion of the building. It may access through construction joints, cracks, plumbing, electrical joints, etc.	Use treated lumber for construction Coat any untreated exposed wood with insecticides. Seal all cracks and crevices. In case of infestation, kick out holes, inject with appropriate insecticide (orthodichlorobenzene), finally wax and varnish and coat with linseed oil to cover the pores.

7. TYPES OF PESTICIDE

There are three different forms of pesticides. They are **solids** (powder, crystal and granular form), **liquids** (milky water) or **aerosols** (sprayed out in a fine mist).

Pesticides are classified based on the pest they control. They differ according to their effect on various organisms. Some are selectively toxic to the target pests. They don't affect other organisms. Hence these types of pests are mostly preferred by hotel industries. Non-selective

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pesticides which generally harm the other organisms should be avoided as far as possible. The commonly used pesticides are:

- 7.1 Insecticides
- 7.2 Herbicides
- 7.3 Fungicides
- 7.4 Rodenticides

Now let us see in detail about each pesticide:

7.1 Insecticide: insecticides are used to protect plants from insect damage. Eg: mosquitoes, ants, flies, termites, etc

7.2 Herbicides: these are used to control weeds or other unwanted plants in the gardens, ponds and lakes. Eg: weeds, crab grass, dandelions, etc

7.3 Fungicides: these are sprayed or dusted to kill certain fungus that are pathogenic and may infect human beings, plants and animals.eg: smuts, mildew, moulds, etc. Most of the disinfectants used in hotels are fungicides. Fabrics are also treated with it to prevent rotting.

7.4 Rodenticides: rats generally carry diseases such as rabies, fever, tularemia, typhus, etc. they also destroy the dry storage areas and rodenticides help in eliminating such animals in areas such as kitchen and storage.

8. COMMON PESTICIDES USED

- 7.5 Chlordane: household pest, termites and cockroaches.
- 7.6 Diazinon- cockroaches, ticks, ants, silver fish spider, etc
- 7.7 DDVP- cockroaches, housefly, etc
- 7.8 Kelthane- mites, red spider mite, carpet beetle
- 7.9 Malathione- mites, household pests, centipede, millipede
- 7.10 Methoxychlor- lice, fleas, bed bugs, silverfish
- 7.11 Gama HCH- wood boring insects
- 7.12 Oimethoate- flying insects
- 7.13 Warfarin- rats and mice
- 7.14 Methyl bromide- for fumigants

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- 7.15 Permethrin, dieldrin- for textile pests
- 7.16 DDT (Dichloro Diphenyle Trichloroethane)- for various household insects.

ADVANTAGES OF USING PESTICIDES

1. Modern pesticides are very effective
2. Results are quick
3. Economical way of controlling pests
4. Cost effective and does not require high labour.

DISADVANTAGES

1. If pesticides are not used correctly, it may affect human health and cause serious injury or death.
2. It can affect other non- target animals directly. Eg: spraying of a particular pesticide to kill caterpillar might kill other harmless insects like lady bird.
3. If not properly disposed, may contaminate or poison the water beds and soil.
4. Pesticides can also enter the food chain.

AVOIDING HARMFUL EFFECTS OF PEST CONTROL

As we know pest control involves control tactics to control the pests more than simple identifying. The treatment site (indoor or outdoor) usually involves other living organisms (human beings, animals, plants, etc) and non- living things (air, water, work surfaces, etc). all these will be affected when pesticides are used. This could affect the entire system in which the pest exists. Hence proper judgment has to be made before using pesticides without harming anyone or anything. The precautionary measures and instruction has to be studied from the labels of the pesticides to prevent any new pests from entering.

8. USE OF PESTICIDES

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- All the pesticides sold commercially are relatively safe. But always the guidelines provided by the manufacturer should be followed with respect to handling and storage.
- Never exceed the recommended concentration and dose rate as these are researched and are the safest limit.
- Time and method of application
- First aid procedure in case of accident
- Special instructions or warning
- Always store these pesticides away from, children, food, pets, flammable items, etc and also after treating a place for pests.
- Always wear gloves when handling pesticides. If reusable gloves are used wash it thoroughly as soon as possible.
- It is also advisable to use face mask, to prevent from inhaling the pesticides (sprays/ powders).
- Always wash hands after spraying pesticides
- Never dispose unused chemicals in drains or toilets or in water courses.
- Take care to protect wild life and natural habitats from pesticide contamination.

9. NEED TO CONTROL PESTS INFESTATION:

- a. To prevent spread of diseases
- b. To prevent loss of business- contaminated food
- c. To prevent safety hazards caused by damage of electrical cables, pipes, etc
- d. To prevent overall spoilage and wastage of foods
- e. To comply with local hygiene regulations

10. PEST CONTROL FAILURE:

Sometimes the pest might not be controlled even after applying pesticides. The situation should be reviewed to determine what went wrong. There are several possible reasons for failure of chemical pests, such as

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- a. **Pest resistance-** Sometimes the pests may be resistant to certain pesticides. Each time a pesticide is used it selectively kills the most susceptible pests. Some pests avoid the pesticide. Others withstand the effects and may pass on their traits to their offsprings allowing them to survive. The opportunity for resistance becomes greater if the same type of pesticide is used repeatedly. Using different pesticides (rotating pesticides) will help reduce the development of pest resistance.
- b. **Other reasons for failure-** sometimes it may be because of wrong pesticide, wrong dosage and wrong application. It might not be applied at the appropriate time or location.

11. PEST CONTROL CONTRACT

Now we know that pests are a nuisance to the hotel. Hence a housekeeper must consider the following precautionary measures before providing the contract outside.

- Ensure all the areas are covered in the agreement for contract including gardens and lawns.
- Ensure the contractor uses grade 1 or ISI certified pesticides.
- Make sure he follows the schedule and deputed efficient and well groomed staffs.
- Ensure minimum disturbance and inconvenience caused to the guests, while the pest control activity is going on.

12. SUMMARY

In any hospitality business, nothing will chase away your guests like making them stay with the unwanted guests. Pest control is not a one time job. It is an on-going problem that needs continuous management. Pest control is very important for maintaining a safe environment. It is one of the major duties of the housekeeping department. Some of the common pests are flies, ants, mosquitoes, bed bugs, lizards, rats, mice, cockroaches, etc. It should always be remembered that different pests intrude at different times of the season and years. Prevention should be the first goal on identification of pests. Successful pest control starts with good sanitation. But it

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should always be remembered that some pesticides can cause harm to the human being, other organisms and environment. Sporadic and potential pests can be identified if you know the environmental condition or circumstances under which it comes. Appropriate pest control measure has to be taken. Wrong products may lead to unsatisfactory control. Hence it has to be used only if the pests are properly identified.



Subject: Tourism & Hospitality

Production of Courseware

 -Content for Post Graduate Courses



Paper 06: Hotel Housekeeping

Module 29: Ecotels



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ITEMS	DESCRIPTION OF MODULE
Subject Name	Tourism & Hospitality
Paper Name	Hotel Housekeeping
Module Title	Ecotels
Module Id	Module no – 29
Pre- Requisites	Basic knowledge on eco-friendly practices
Objectives	To understand the concept of green/environment friendly hotels, their certification, housekeeping practices.
Keywords	Ecotel, Green Hotels, Certification, Green Building, Housekeeping

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LEARNING OUTCOMES

After completing this module students will be able to:

- I. Understand the concept of ecotels/green hotels
- II. Learn about the Ecotel Certification
- III. Understand the considerations while selecting an eco-friendly site
- IV. Discuss green building concept and practices
- V. Basic understanding of green housekeeping practices
- VI. Practical implication of Ecotel through case study of The Orchid Hotel, Mumbai

INTRODUCTION – CONCEPT OF ECOTELS

Ecotels or green hotels are environment-friendly hotels that make crucial environmental improvements to their structure in order to minimize or reduce their impact on the environment. These hotels feature innovative programmes for conserving natural resources, reducing waste, minimizing pollution and maximizing sustainability. Traditionally these hotels were built near forests, hill stations called as Eco Lodges because of their location. However, now a days, many properties are designed and constructed with a concern for environment quality.

Some ecotels consist of recycled or renovated buildings with upgrades to conserve energy and water, minimize waste, incorporate natural landscaping, or utilize recovered building materials. Various properties support local environment efforts or groups and/or offer environmental education or expeditions. Ecotel hotels can also be said as hallmark for environment sensitive hotels. They follow the three “Rs” of environmental conservation – Reduce, Reuse and Recycle.

Popular ecotels in India include The Orchid Mumbai; RODAS, Mumbai; Fern Hotels & Resorts; The Raintree, Chennai. There are other hotels in India which, though not Ecotel-Certified, have been following eco-friendly practices.

Following table highlights the key differences between an ecotel hotel and any other normal hotel.

	ECOTEL HOTELS	NORMAL HOTELS
MEANING	Ecotels are hotels that have made significant environmental improvements to their structure in order to minimize their impact on the environment.	A regular hotel basically provides paid accommodation usually on a short-term basis.
MAIN AIM	Ecotels' main aim is to build clean, environmental friendly hotels along with profit maximization & customer satisfaction.	Hotels' main aim is to get maximum profit with customer satisfaction.
PRODUCTS USED	Ecotels mainly use products that are safer to the environment & cause minimal harm to the society & environment.	Normal Hotels prefers branded or known products in order to maintain their image.
WASTE MATERIALS	The generated waste, is differentiated as dry and wet garbage & they are recycled & used properly.	Usually the waste which is generated in hotels, are thrown away as garbage & no recycle systems are adopted.
CONSTRUCTION OF HOTEL	Ecotel hotels are constructed based on eco- friendly aspects and eco norms	Constructed based on posh look or outside appearance
EFFECT TO THE ENVIRONMENT	No or minimal harmful effects on environment, ecotels always protects the ecology	Normal hotels indirectly cause harm to the environment

Source: Ecotel Concept for Energy Conservation and Waste Reduction in Hotel Industries, NCPSIA (2015)

ECOTEL CERTIFICATION

The 5 Globes

Ecotel hotels can also be said as hallmark for environment sensitive hotels. Having an Ecotel Certification states that the hotel is completely environment friendly. Any hotel applying for the certification need to fulfil certain criteria & norms set by the authorities before they are awarded the 5 Globe Certification Award. The Ecotel Certification is based on five areas of environmentalism, each of which is designated by a Globe award. These five areas are referred to as the 'cornerstones of environmental responsibility' or simply as 'Globes'. These Globes are:

1. *Energy Conservation*: This requires the existence of a formalized framework to actually reduce the energy consumption of the hotel. For instance, whether the hotel has been designed and constructed keeping in mind maximum energy conservation. Factors like whether minimum lighting is being used, the extent of involvement of the guests as well as the employees etc. also make a difference to the final score.
2. *Water Conservation*: Evaluates the effective conservation of water in all departments of the hotel, across all levels. The extent to which water is recycled and utilized is also considered an important factor. Again, all employees are expected to be well-versed with the water conservation operations of the hotel. Water is an increasingly scarce resource in most parts of the world and the United Nations estimates that more than half the world population could be living in severely water stressed areas by 2032.
3. *Solid Waste Management*: The hotel must effectively recycle and manage waste wherever generated. Proper systems for collection, recycling and disposal of these wastes in all departments of the hotel are a must for the Ecotel certification. Moreover, all employees of the hotel must undergo training in the basic solid waste management techniques.
4. *Employee Environmental Education*: Evaluates how involved the employees are in the efforts of the hotel to contribute towards the environment. The hotel should

have
place
at all
them
friendly
hotel.



training
modules in
for employees
levels to
familiarize
with the eco-
initiatives of the

5. *Environmental Commitment*: The hotel or lodging property must demonstrate the existence of a formalized commitment towards the preservation and enhancement of the natural environment. It must, through all operations, activities and written statements, communicate its commitment to the environment. For e.g. the mission statement of the hotel must mention its environmental dedication. Additionally, every hotel should have a green team headed by a member of the top management ensuring that all departments are working in consonance with the hotel's mission of environmental responsibility.

Figure 1. Energy

Inspection & Scoring

The inspection for each globe involves three levels of criteria and scoring- Primary, Secondary and Tertiary. Hotels applying for certification must satisfy the primary criterion before an inspection is scheduled. Once it is evident that all the primary criterion have been satisfied, inspections – unannounced as well as

guided by the hotel staff - are conducted throughout the lodging facility to determine if the environmental programs that the hotel reports to have in place are actually part of the daily operations.

Each department or function area of the hotel (i.e. main restaurant kitchen, banquet kitchen, kitchen, front desk and office area, executive office areas, etc.) is inspected and scored individually. A percentage score is calculated for the inspection of each department and each department must score above a certain level to be awarded the certification.

If any department scores below that level, but above a minimum threshold, the tertiary criterion can boost that department's score so that the hotel becomes eligible for the certification. The tertiary criterion is simply described as a bonus system. The hotel receives bonus points for environmental programs discovered in operation that are not part of the primary criteria, and are considered to be above ordinary levels of environmental responsibility.

An example of a program that would earn tertiary points would be the concept of the 'green button' in The Orchid, New Delhi. This button is a unique interactive approach that enables the guest to participate in energy conservation by increasing the temperature of his room by 2 degrees and thus conserving energy utilized for air-conditioning. Based on the hotel's score in each category, the lodging facility can be awarded from zero to five 'Ecotel Globes', corresponding to each of the five cornerstones. Hotels that are awarded one or more globes qualify as Ecotel certified hotels for a period of two years, but have to agree to re-inspections (announced and unannounced) at any time during that period.

If the hotel falls short of achieving the certified status, the Hospitality Valuation Services (HVS) International inspection team prepares an action plan to help the management make the necessary changes and prepare for re-inspection.

SELECTING AN ECO-FRIENDLY SITE



The site chosen for building a hotel property can greatly affect the comfort and energy efficiency of the hotel built upon it. Like, for example, a south facing plot that allows for the long sides of the building to face north-south will facilitate the utilization of prevailing summer breezes for cooling during hot weather and can aide in solar energy utilization during winters. Similarly, a hot bare site will require a greater investment in wide overhangs, shading devices such as pergolas or awnings, and shade trees to keep the utility bills down and comfort levels up. Following considerations can be kept in mind while choosing an eco-friendly site:

- *Outdoor Space:* The prospective building site should be examined for existing tree groupings, landforms, and structures that will aid in creating pleasant, usable outdoor spaces. Off-site conditions that may affect outdoor activities or indoor living with open windows – like traffic noises, pollution, odors – should be considered before selecting a site.
- *Topography:* It is important to examine the topography of the prospective site. The top of a hill may be too windy, dry and exposed to the hot sun. a valley may be too damp, windless and prone to flooding. The location and type of trees in the area should be evaluated for their suitability.
- *Disruption to natural vegetation & drainage patterns:* The plot should be ideally located on a relatively flat area with natural clearing to minimize the disruption to the natural vegetation. This will avoid erosion, discourage the growth of invasive exotic vegetation, and be less expensive than massive landscaping exercises. Also, minimizing the disruption of natural drainage patterns is generally less expensive upfront and avoids the costly maintenance of elaborate artificial drainage systems.
- *Minimizing Heat Island Effect (HIE):* HIE occurs when developed urban areas have significantly higher average temperatures than the rural areas surrounding them. It is recommended by the environmental agencies that

80 percent of the parking should be underground and that at least 75 percent of the terrace area be insulated and coated with reflective, high-albedo roof paint.

High Albedo Paint: Albedo is the measure of reflectivity of a surface. This a high-albedo paint refers to a paint having high reflectivity

GREEN BUILDING PRACTICES

An ecotel should be a green building, also known as an ecologically sustainable building. The structure should be designed, built, renovated, operated, or reused in an eco-friendly and resource-efficient manner. Some key objectives of green buildings are:

1. Protecting occupants' health,
2. Improving employee productivity,
3. Efficient use of water, energy and other resources, and
4. Minimalistic impact on the environment

Hence, green building can be defined as any building that is sited, designed, constructed, operated and maintained for the health and well-being of the occupants, while minimizing its impact on the environment. Green building practices offer an opportunity to create environmentally sound and resource-efficient buildings by using an integral approach to design. Such buildings promote resource conservation by including design features that encourage energy efficiency, use of renewable energy, and water conservation.



MAJ

OR GREEN BUILDING PRACTICES AND THEIR POTENTIAL BENEFITS

CATEGORIES	MAJOR PRACTICES	SPECIFIC BENEFITS
SUSTAINABLE SITE	<p>Sustainable site planning and landscaping</p> <p>Solar orientation of building</p> <p>Public transportation</p> <p>Rain-water management</p>	<p>Reduce environmental impacts</p> <p>Efficiency of site use</p> <p>Heat island effect</p> <p>Reduction of civil infrastructures</p>
ENERGY EFFICIENCY	<p>Solar orientation</p> <p>High efficiency envelopes (efficient windows and high R-value insulation)</p> <p>High efficiency HVAC system</p> <p>Building automation</p>	<p>Energy saving</p> <p>Reduction in greenhouse gases</p> <p>Lower operating costs</p>

	<p>systems</p> <p>Daylighting and high efficiency lighting</p> <p>Onsite renewable energy sources (photovoltaics)</p>	
WATER EFFICIENCY	<p>Water saving fixtures and technologies</p> <p>Rainwater harvesting system</p>	<p>Water saving</p> <p>Lower operating costs</p>
INDOOR ENVIRONMENT QUALITY	<p>Daylighting & high efficiency lighting</p> <p>Adequate air filtration</p> <p>Low Volatile Organic Compounds (VOC) materials</p> <p>Mould prevention</p> <p>Enhanced acoustical performance</p>	<p>Productive and healthy indoor spaces</p> <p>Provide optimal indoor environment to building users</p> <p>Improved occupant health and wellbeing</p>
BUILDING OPERATION & MAINTENANCE	<p>Green cleaning supplies</p> <p>Indoor pest prevention and control</p> <p>Waste reduction and recycling</p> <p>Energy and water</p>	<p>Reduced environmental impacts</p> <p>Reduced operational and maintenance costs</p>

	conservation Green grounds keeping Electronic versus paper communication Guest education/communication program	
DEMOLITION	Exposed ceiling Nylon 6 recycled carpet	Reduce construction waste

(Source: Green Luxury, Journal of Green Building, 2013)

Various Green Certification agencies exist in the modern world. The following table highlight a few of such certifications specific to hospitality industry.

Type of Program	Name	Organization
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Environmental Certification Programs Specific to Hospitality	<p style="text-align: center;">Green Globe</p> <p style="text-align: center;">Sustainable Tourism Eco-Certification Program (STEP)</p> <p style="text-align: center;">Green Globe Certification Standards</p> <p style="text-align: center;">Earthcheck Assessed and Earthcheck Certified</p> <p style="text-align: center;">Ecotel</p> <p style="text-align: center;">Global Sustainable Tourism Criteria</p>	<p style="text-align: center;">Green Key Global, Hotel Association of Canada, LRA Worldwide, Inc</p> <p style="text-align: center;">Sustainable Travel International</p> <p style="text-align: center;">Green Globe International</p> <p style="text-align: center;">EarthCheck</p> <p style="text-align: center;">HVS</p> <p style="text-align: center;">Global Sustainable Tourism Council</p>
Green Building Certification Programs	<p style="text-align: center;">Leadership in Energy and Environmental Design (LEED)</p> <p style="text-align: center;">BRE Environmental Assessment Method</p> <p style="text-align: center;">Green Globes</p>	<p style="text-align: center;">U.S. Green Building Council</p> <p style="text-align: center;">Building Research Establishment (BRE)</p> <p style="text-align: center;">Green Buildings Initiative (U.S.) and BOMA BEST / ECD Jones Lang Lasalle (Canada)</p>
Product Specific Standards & Certification Programs	<p style="text-align: center;">Energy Star</p> <p style="text-align: center;">Green Seal</p> <p style="text-align: center;">Green Tag</p> <p style="text-align: center;">Greenguard</p>	<p style="text-align: center;">U.S. Environmental Agency</p> <p style="text-align: center;">Green Seal</p> <p style="text-align: center;">Ecospesifier</p> <p style="text-align: center;">Greenguard Environmental Institute</p>

(Source: HVS, 2012 Current Trends and Opportunities in Hotel Sustainability)

MAKING HOUSEKEEPING ENVIRONMENT FRIENDLY

The housekeeping department can contribute in a big way to make a hotel an ecotel. This can be done through the following ways:

- Bed linen which is washed on a daily basis is almost very lightly soiled. The department & the management may decide to draw up a policy for laundering bed linen only once in 2-3 days unless noticeably soiled. This practice will save large amounts of water. Guests could also be involved by letting them decide whether they require the bed room sheets to be changed daily.
- Educating employees to switch off lights and electrical equipment when not in use.
- Employees should immediately report any leaky faucets or pipes.
- Employees need to use only the correct wattage of bulbs & make sure light shades are clean.
- To maximize the effect of air conditioning, the employees should ensure the drapes are closed entirely.
- Usage of cold-water detergents will reduce the need for hot water.
- Bio-degradable detergents should be used.
- In laundry wash cycle, the final rinse water should be used for the first wash of the next batch of soiled linen.
- Consider using fabric blends with synthetic fibres, as they require lower temperatures for washing, drying and ironing.
- Ensure preventive maintenance of all equipment.





- Use bio-degradable and eco-friendly chemicals in all cleaning and laundry operations.
- No aerosol dispensers should be used in dispensing or applying cleaning materials and air fresheners.
- Guest supplies and amenities, provided by the housekeeping department for guests should be biodegradable and eco-friendly.
- Minimize the amount of paper used for each guest. In room writing material can be reduced or made of smaller size.
- Linen made from organically grown produce could be sourced and purchased.
- Water from laundry can be treated and used for watering plants.
- The executive housekeeper should create an incentive program to encourage staff to participate in and improve upon environment-friendly practices.

A CASE STUDY ON THE ORCHID MUMBAI: INDIA'S ECO-PIONEER

To demonstrate the study of ecotel concept, we have taken a case study which will show how the ecotel concept not only benefits the owner and guest but also provides a friendly environment for coming generations. A Mumbai based hotel called The Orchid.

Launched in 1997, The Orchid, Asia's First Ecotel Hotel, a prestigious hotel or leading landmark in the city center of Mumbai, has gained international importance due to its pioneering efforts in the eco-friendly sphere. The Mission Statement of The Orchid clearly states its core values in accepting responsibility for living in close harmony with the society & environment. In addition to this Orchid ecotel hotel received ISO-14001 Environment Management Systems certification for the implementation of eco-friendly practices.

The Orchid is a recipient of numerous international and national awards. Let us take an insight on the various practices undertaken by India's first Ecotel.

Waste Management

- Construction materials used at The Orchid have a high proportion of recycled content. To elaborate, cement has 15 % fly ash, concrete has approximately 60% fly ash, internal panels are made from fertilizer waste, MDF (Medium-Density-Fibres) wood comes from cotton stalks.

- Waste is segregated in all the kitchens. Four separate colour coded bins are used for separating the waste into dry, wet, recyclable and other. A two bin segregation system is used not only in the hotel's common areas but also in guestrooms
- The food waste or wet waste is decomposed in the hotel premises through vermiculture (cultivation of earthworms in order to use them to convert organic waste into fertilizer). The rich and fertile vermi-compost has been serving as an excellent fertilizer for our gardens. Through the vermiculture system they have generated more than 3,60,000 Kilograms of vermi-compost from approx 40,00,000 kilograms of food waste. (Report 2013)
- Dry waste is given out to a recycler for recycling
- All paper used has a minimum of 25% recycled content
- Guest Room amenities include biodegradable herbal products and stationery made from environment friendly material. To elaborate; hangers are made from sawdust, slippers from reed/cloth, folders from jute, wood saver pencils, laundry baskets from cane, laundry and shopping bags from cloth . Only potted plants are used in the hotel instead of cut flowers. No carbon paper is used in the hotel as it is toxic to microbes that breakdown organic waste

Energy & Carbon

Energy efficient designs and systems have been integrated into the hotel from its very foundation.

- The Skylight: Double layered domes admit maximum natural light in the atrium of the hotel thereby reducing the extent of artificial lighting required in the lobby, corridors, rooms and restaurants
- The Façade: Depressions and protrusions in the façade play an important role in reducing energy consumption since majority of the walls remain under shade thereby preventing surface radiation from entering the structure
- Triple Glazed windows incorporated in the rooms consist of three panes separated by two hermetically sealed spaces. These windows have the best thermal

insulating properties and also assist in curtailing noise from India's busiest domestic airport

- Energy efficient lighting: The hotel uses energy efficient lighting such as CFL (Compact Fluorescent Lighting) and LEDs
- Solar energy: The hotel has solar panels on its roof and the electricity generated through these panels is used for the rooftop lighting, reducing the extent of conventional coal based electricity used by the hotel
- Intelligent control systems: Each room in the hotel has a master control panel to control the lighting and temperature of the room. This master control panel has an eco-button, which when pressed increases the temperature of the room by two degrees without affecting guest comfort
- Air conditioning and refrigeration systems use CFC free refrigerants with low ozone depleting potential

By saving an average 99,344 units of electricity per month The Orchid Hotel prevents 212,596 pounds of CO₂ equivalent emissions going into the atmosphere each month.

Water Conservation

The Orchid is mindful of the fact that merely 3% of the water available on the earth is fresh water. With the current projected water demand in the country it is of utmost importance to conserve, utilise and manage this vital resource in a sustainable manner.

In order to mitigate the negative impact on freshwater depletion due to its operations, The Orchid has adopted a three-fold strategy:

(a) Minimise the consumption of fresh water through installed systems and system aligned practices

- *Aerators*: All the taps in the hotel contain special aerators, which increase the force of the water and reduce outflow, thus reducing water consumption by nearly 50% as compared to conventional ones.

- *Cisterns and Flushes:* Geberit's concealed cisterns have been installed to ensure that water utilised is kept to a minimum. The concealed cistern uses only 6 litres of water per flush as opposed to 15-20 litres used in conventional flushes.



- *Water treatment:* The Orchid also employs environmental treatment methods for water purification. Drinking water and the swimming pool is purified by a combination of Ozone treatment and filtration as opposed to conventional systems that use chlorine. Ozone destroys all micro-organisms and ensures proper disinfection of water i.e. the resultant water is absolutely safe, pure, fresh and healthy. When drinking water is treated with chlorine (chlorine is a highly carcinogenic chemical), the residual chlorine in water is also consumed. On the other hand the use of ozone treatment leaves no trace of toxicity in the water.
- *Linen Reuse Program:* The hotel has a linen reuse program for the guests who stay for more than one night. The standard practice of the hotel is to change the linen everyday. However, a guest can opt to reuse their linen by placing this card on their bed. Guests who reuse their linen are given a certificate along with a gift. The certificate thanks the guest for participating in this program and informs them that their participation helped reduce consumption of fresh water, electricity and detergent
- *Garden plants* are watered before sunrise and after sunset, to avoid water loss due to evaporation.
- *Other practices* include hotel cars being washed using buckets instead of a direct pipe, dishwashers are operated only when fully loaded and leaking taps are immediately attended to

(b) Eliminate discharge of waste water by treating and recycling all waste water

- Treating and recycling all waste water not only reduces fresh water intake but also prevents the pollution of fresh water resources

- The Sewage Treatment Plant at The Orchid (on the roof!) treats all the waste water of the hotel with the technology of Rotating Biological Contractors. This recycled water is reused for irrigating our gardens. Further the quality of waste water is significantly better than those required by statutory norms. Hence if any water is released into the drain, it does not harm the environment since it has been treated completely

(c) Create awareness of water use among the employees and within the community

The Orchid's endeavour towards sustainability include instilling awareness among employees as well as the community at large, on environment issues including water conservation and preservation

Education & training for employees

Environmental awareness amongst the team members is imperative for the hotel to sustain its commitment to the environment. Consequently, training programs and activities for team members are conducted on a regular basis.

The induction program for the new team members includes a session from the Environment Officer who briefs the team of the hotel's environmental systems. Team members are also shown the documentary 'Cutting Carbon Footprints' during this training program. Therefore, the team is well-versed with critical issues that face the environment and are motivated to bring about change not only at the workplace but at home. Refresher Training sessions are also held regularly.

Events

The hotel conducts various events to spread awareness on environment-friendly practices and educating the local community to adapt these sustainable practices.

Some of the events conducted are enlisted below:

- *Nirmalya Composting Initiative:*
- *Beautification of Mumbai with 18 gardens:*
- *School student Visits to the Hotel:*
- *Advanced Locality Management:*

➤ *World Environment Day (5th June) and Earth Day Celebrations (22nd April):*

The Orchid, Mumbai's top 3 tips for adopting eco-friendly practices:

- Understand environmentalism and engrave sustainability in the company culture
- Address the major impacts of the hotel on the environment and opportunities to reduce them
- Set short term, long term targets and review progress

SUMMARY

Nothing is a waste in nature because nature knows how to reuse and recycle. Ecotels follow the same principle – reuse & recycle whatever possible. Popular ecotels in India include The Orchid Mumbai; RODAS, Mumbai; Fern Hotels & Resorts; The Raintree, Chennai. There are other hotels in India which, though not Ecotel-Certified, have been following eco-friendly practices.

There are many international bodies certifying ecotels, and all require few criteria to be met for certification to be granted. The five most important criteria are: energy conservation, water conservation, waste management, environmental commitment and employee education. This chapter discusses the 5 Goble Ecotel Certification.

The chapter also dealt with the consideration of selection of property site and various green practices pertaining to the building of the hotel. Environment-friendly housekeeping practices have been discussed in detail which make any hotel sensitive to its environment.

The Concluding section features a case study on one of India's eco-pioneers: The Orchid Hotel, Mumbai. It comprises of a detailed study on the green practices adopted by the