

Script

Lesson 44 - Types of dyeing- fiber, yarn and fabric

Dyeing is a method of applying colour and their shades to textiles to beautify them. Dyeing gives a creative look to textiles. Colour may be added to fabric at any one of four steps in its processing. Dyeing can happen when the textile material is in the fiber state, or after it is made into a yarn or even after it is either woven, knitted or braided, finally it can be dyed after the fabric is made into a garment. There are different fabrics and also different dyes available with each dye specific to one or two types of fibers. Selection of proper dye to the fiber type and method of dyeing if chosen correctly, textiles would be dyed perfectly without any defects. In the beginning, dyeing was carried out manually but now different types machines are developed which can do an excellent job. Dyeing machine types include those in which the material to be dyed is moved through the dye solution and those in which the dye solution is circulated through the material. However, in some of the newer machines, there is movement of both the material and the dye solution.

Classification of dyeing methods:

Textiles may be dyed at any stage of their development from fibre to fabric or certain garments by the following methods.

- 1) **Stock dyeing**, which is done at the fibre stage. Top dyeing, is also done in the fiber stage but it is done for combed wool when it is in the sliver stage. Filament yarn in the form of tow is also dyed called as tow dyeing.
- 2) **Mass pigmentation** / dope dyeing and **gel dyeing** are the methods employed for synthetics before fiber is extruded.
- 3) **Yarn dyeing** is dyeing of yarn after the fibre has been spun in to yarn. Further, this can be skein dyeing, package dyeing or beam dyeing based on the yarn in these forms
- 4) **Piece dyeing**, after the yarn has been constructed in to fabric.
- 5) **Garment dyeing**, after the fabric has been constructed into a garment.

Dyeing at fiber stage:

In the fiber dyeing process, colour is added to fibers before yarn spinning.

Producer Dyeing:

Producer dyeing is also called as solution dyeing, dope dyeing, mass pigmentation and spun dyeing. Synthetics, due to their crystalline nature they cannot be dyed in pure, deep shades after the fiber is extruded from the spinneret. Colourant is added to the spinning solution before the polymer mix is extruded and formed into a manufactured fiber which helps to disperse the colour evenly throughout the fiber and constitutes as an

integral part of the fiber. Fibers dyed in this manner are called producer-dyed fibers, and fabric are called producer –dyed fabrics.

Gel Dyeing:

Gel dyeing involves the addition of dye or pigment to the liquid coagulating bath during the formation of wet spun manufactured fibers. The dye or pigment is absorbed by fibers while they are still in the soft, gel stage. Upon complete coagulation, the colourant is trapped within the fibers.

Stock dyeing refers to the dyeing of fibres, or stock, before it is spun in to yarn. It is a batch process. It is done on loose, unspun fibres. There are two methods of dyeing the fiber.

- **Vat dyeing.** This is an older method where fiber is opened from bales and put into large containers called as vats. Then the dye solution is circulated through the fiber. In this from 500-3000 pounds of fibre is dyed at one time, the average being about 1000 pounds.
- **Bale dyeing:** The second and newer method is bale dyeing, that is generally done to and all types of manmade fibres. In this method, bales covering with tapes are split on all sides and the complete bale is placed in a specially designed machine for dyeing. Dye liquor is forced through the bale of fibre. This method saves time and labour costs.

In both the methods though the dye liquor is pumped through the fiber in large quantities, there may be some areas where the dye does not penetrate completely. This can be overcome when fiber is blended before the spinning operations. But stock dyeing, is the most effective and expensive method of dyeing. It is effective because the colour is well penetrated in the fibres and does not crock readily and it is expensive because during subsequent blending and other operations for spinning a lot of fiber may get wasted. A problem encountered with stock dyed fibres is that they lose some of its flexibility and so spinning may be a problem. Lubricants added in the final rinsing overcomes most of this difficulty and woollens are often stock dyed.

Top dyeing and tow dyeing: In the worsted industry, dyeing of fiber is done one step nearer to finished yarn, in the top stage. It is so called because worsted fibers are long and are called as tops. It is not exactly in the fiber stage but it is in a loose ropelike form of about about $\frac{1}{4}$ th inch thick This is wound on perforated spools and dye liquor is circulated through them. The resultant tops have a very even dyeing.

Tow dyeing is similar to top dyeing except that it involves the immersion to tow - ropes of filament fibers destined to be cut into short lengths into a dye bath. Stock, yarn or beam dyeing equipment may be used.

Yarn dyeing:

When dyeing is done after the fiber has been spun into yarn, it is described as yarn dyeing. The main reason for the dyeing of yarn is for the production of multi coloured designs such as plaids, stripes, and checks. Some typical yarn-dyed fabrics are multi coloured gingham and madras shirting. There are several methods of yarn dyeing. The purpose is to have the dyestuff penetrate to the fibers in the core of the yarn; this is similar to the penetration of the fibers in stock dyeing. Cloths made of dyed yarns are called yarn-dyed. There are several methods of yarn dyeing in vogue. There are three major approaches to yarn dyeing: skein, package and beam dyeing.

1. Skein dyeing:

In skein dyeing wrapped skeins of yarn are looped over rods and immersed in a dye bath. The rods move in closer and move out and so they loosen and tightens the skeins during dyeing. This results in good penetration of dye into the yarn. This method is most suitable for soft, lofty yarns such as hand knitting yarns. Yarns remain softer even after dyeing. But this is an expensive process as skeins need to be rewound before weaving or other fabric construction methods. Skein dyed yarns are used for handlooms.

2. Package dyeing:

Yarns are wound on spools, cones or similar units as packages and then dyed. So the name as package dyed yarn. About a pound of the yarn is wound on a small perforated spool or tubes called as packages. These packages are fitted into the dyeing machine, in which the flow of the dye is made to flow from the center to the outside and then from the outside to the center of the package under pressure. This helps in good penetration of dye on the entire yarn as thoroughly as possible but may not be as soft as that of skein dyed yarn. This method is very widely used for most types of yarn used in knitted and woven fabrics

3. Warp beam dyeing:

Beam dyeing is simply a much larger version of package dyeing. This method is similar to package dyeing but is more economical. If the fabric has one colour in warp then the yarn is wound on to a perforated warp beam or cylinder, which is then placed in the beam dyeing machine where the flow of the dye takes place as in package dyeing. This is the most economical method than skein or package dyeing.

4. Space dyeing:

A variation in plain-yarn dyeing is space dyeing, in which the yarns, either warp or filling are dyed by dipping or spotting various parts along the yarn. This effect can be accomplished by (a) Dyeing a knit fabric and then raveling it in a knit-de-knit process,

(b) Yarn package impregnation - Squirting dye from a needle into a yarn package

(c) Spraying colourant into yarn skeins.

Space dyed yarns create mottled and variegated colourations. Space-dyed yarns are used in carpeting to help disguise soil.

Piece dyeing

“Dyed in piece” is the term that describes about textiles that are dyed at fabric stage. This is the method generally followed by manufacturers to meet the demand on time. There are some specific names given to when and how fabrics are dyed such as union, cross, tone-on-tone, and reserve dyeing depending on the different dyeing characteristics of the fibers.

Union dyeing:

When a fabric is woven with two types of fibers of different classes either as blends or mixtures and are to be dyed in one single colour this method is followed. It is accomplished either in one bath or two bath method. The dyer accomplishes this by using two or more classes of dye, each of the same colour.

Cross dyeing:

Unlike union dyeing, the purpose is to obtain multicolour effects on the fabric. Fabric containing two or more fibers types are purposely dyed in such a way that each type of fiber takes up different colour. The end result varies depending on the arrangement of two different fibers in the fabric. A combination of fibers from different generic groups, natural and manmade fibers or fibers from same generic group which are modified to accept dyes of different classes are generally dyed in this method. This method is flexible, economic and speed method.

Tone on Tone dyeing:

In this the fabrics have lighter and darker shades of the same hue. This is also called differential dyeing. Two different types of the same generic fiber might be used in which both the types respond to the same type of dye but one may be less reactive than the other resulting in lighter and darker colours of the same hue.

Reserve Dyeing:

This is way of dyeing fabric in which one type of fiber will remain undyed when the fabric is a blend or mixture. Such reserve dyed fabrics will contain white fibers or white yarns. Either the face of the fabric or back of the fabric can be reserved by coating the back and then dyeing. Various other methods can be employed to obtain varied effects.

Production methods:

In piece dyeing, the finished fabric is passed through a dye bath for absorption of dye. A number of different methods are employed for piece dyeing, each differing based on the suitability of the fabric. Generally fabrics can be dyed in continuous method for longer lengths of fabrics or batch process for shorter lengths of fabric. Batch processes include *Beck* and *Jet* methods for fabric in rope form and *Jig* and *Beam* methods are employed for fabrics in open form.

Beck dyeing is known as **box** or **winch** dyeing used for dyeing wool fabrics, open weave fabrics and knits which have to be dyed without tension. Fabric ends are stitched to make a rope and 1000 meters can be dyed at a time. The fabric remains in the dyebath for some time before being taken out.

Jet dyeing is ideal for fabrics prone to felting when subjected to lengthy dye cycles and for fabrics that do not tolerate added dye for shade adjustment. Dyeing is accomplished in a closed, tubelike system in which fabrics in rope form passes through a fast moving stream of pressurized dye liquor. The dye is recirculated as the fabric moves or floats in a tension-free condition along the tube container at rapid speed.

Jig dyeing :

In this the fabric is rolled on a beams of the jig in open width form running from one beam to the other through sets of rollers that guide the fabric through the dye bath. The fabric passes continuously through the bath from one side to the other, and then back again many times. This is suitable for fabrics of fairly close weave and some heat-sensitive thermoplastic fibers that might form permanent creases or streaks if handled in rope form.

Beam dyeing of fabrics is practically the same as beam dyeing of yarns. No tension or pressure is exerted on the fabric. Lightweight, fairly open weave fabrics and tricot knits can be beam dyed.

Garment dyeing:

This method is also called product dyeing which is done after the garment is made. The machines used are called paddle machines. Equipment consists of a large tub into which the fabricated product and dye solution are placed. A motor driven paddle wheel placed over the tub has wide, short blades that move the product the dye solution continuously. This process however tends to misshape the garment / product. Product dyeing is important in the apparel and furnishing industries, with an emphasis on quick response to retail and consumer demands