UNIT III

Dyeing – Classification of colorants – fastness properties of dyes. Dyeing – classification of colorants – fastness properties of dyes. Dyeing machines – fiber, yarn and fabric dyeing machines – loose stock fiber bale – hank package – jigger – winch – HT Beam jet – padding mangles. Garment dyeing machines.

AIMS AND OBJECTIVES

We here discuss about in general on dyeing, its strategies and methods. After going through the unit, it will be easy to

- Know about the Dyeing
- Understand Classification of colorants and fastness properties of dyes.
- Understand fastness properties of dyes.
- Know about different Dyeing machines

Dyeing is the process of coloring textile materials by immersing them in an aqueous solution of dye, called dye liquor. Normally the dye liquor consists of dye, water and an auxiliary. To improve the effectiveness of dyeing, heat is usually applied to the dye liquor.

The general theory of dyeing explains the interaction between dye, fiber, water and dye auxiliary. More specifically, it explains:

1. Force of repulsion which are developed between the dye molecules and water and
2. Force of attraction which are developed between the dye molecules and fibres.

These forces are responsible for the dye molecules leaving the aqueous dye liquor entering and attaching themselves to the polymers of the fibres.

THE DYE MOLECULE

Dye molecules are organic molecules, which can be classified as:

1. Anionic – in which the color is caused by the anionic part of the dye molecule;
2. Cationic – in which the color is caused by the cationic part of the dye molecule;
3. Disperse – in which the color is caused by the whole molecule. The first two dye molecule types are applied from an aqueous solution. The third is applied from an aqueous dispersion.

A dye stuff is a substance which is capable of coloring a textile material in such a manner that it associate closely with the fiber, that it is not removable by simple physical means (e.g.: rubbing or mild deterging). It must be soluble in water, are capable of going into solution by chemical means, whereby a highly dispersed condition may be regarded as a form of solution.

An essential feature of the dyeing process is that the dye molecule must be capable of entering the fiber structure, the path for the dye molecules is provided by the intermolecular spaces in the fiber and once the dye has entered the fiber structure it becomes firmly attached to the surface of the molecules either by purely physical forces (Secondary Valences) or by chemical combination. The former mode of attachment is believed to be prevalent in the dyeing of cellulosic fibres, the latter mode in the dyeing of protein fibres.

Acetate rayon and synthetic fibres resist penetration by the dye molecules, but certain dyes are capable of forming a solid solution with the fibrous molecule; for dyeing with other dyes, the synthetic fibres may be swollen with suitable agents.

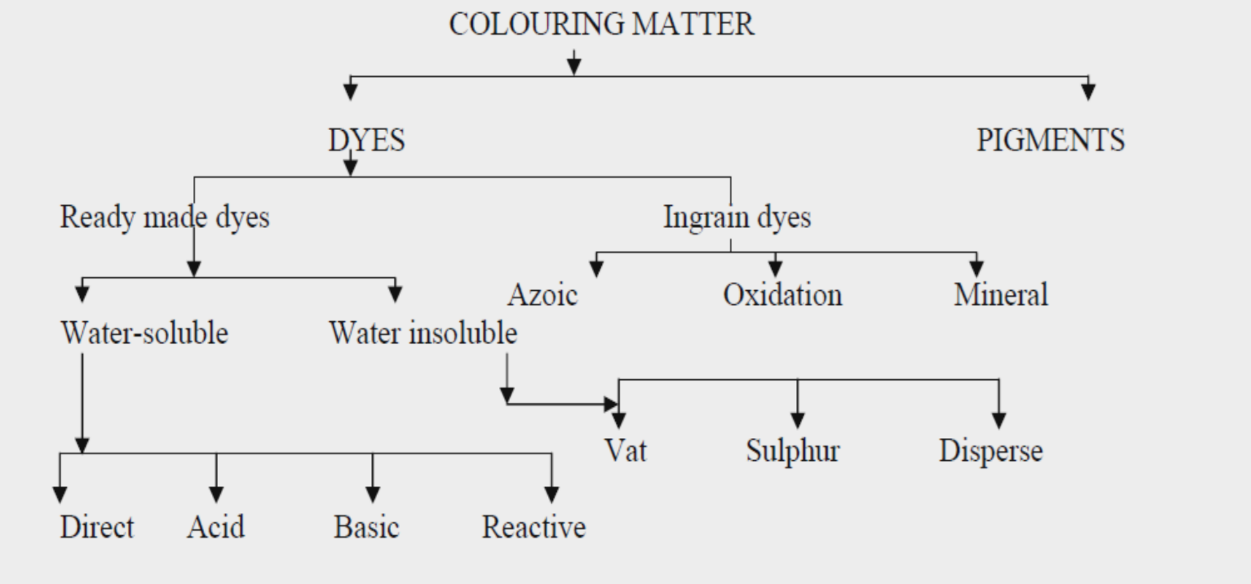
Swelling of the fibers appears to play a large part in dyeing of all fibres, and is principally affected by water (or solvents in the case of synthetics) and by raising the temperature of the dye bath.

The dyeing process can thus be considered as taking place in three phases (i) Attachment of the dye molecule to the surface of the fiber (ii) Penetration into the intermolecular spaces as well as diffusion through the fiber, and (iii) Orientation (and fixation) along the long chain molecules.

Dyeing is governed by three factors, the dye, the fiber and the dye liquor. All the three lead an independent assistance which influences the technique of dyeing. A dye must be water soluble in order to dye textile materials. It may be soluble by nature of its chemical interference. The solution of the dye from which it is applied is called the ‘dye bath’. A dye may have direct ‘affinity’ for a fiber (or vice versa) i.e., it is held by the fibre either physically (absorption) or chemically (combination) as soon as the fiber is immersed in the dye bath.

Accumulation of the dye in the fiber is a gradual process, the rate of suchbuilding up being referred to as the ‘rate of dyeing’. This rate of dyeing is governed by the condition of the dye bath, namely concentration of dye, temperature, and presence ofelectrolytes; It is proportional to all three factors. The rate of dyeing is also influenced bythe ‘Material to liquor’ which is expressed by a fraction, e.g. 1:20, which means one part(by weight) of the textile material dyed in twenty times its weight of dye bath. The rate offdyeing decreases with increasing ratio of goods to liquor.

Dyeing is carried out to produce a certain ‘Shade’ by which is meant a certain color,difference in shade being due to different ’Hue’. A blue shade may, for instance, have agreenish or a reddish hue. The amount of dye needed for the production of a certain depthof shade is expressed as a percentage of the weight of the material. A 1% dyeingrepresents a shade produced by the coloring of 100 lbs. of material with one lb. of(commercial) dye under well defined dyeing conditions. It is necessary to define theseconditions because of their influence on the ‘exhaustion’ of the dye bath. Exhaustiondetermines that amount of dye which is taken up the fiber or in directly, that amountwhich remains in the dye bath after ‘equilibrium’ between dye and fiber is reached, i.e., atthat point where no further dyeing takes place



WATER SOLUBLE DYES

DIRECT DYES

These colors are known as substantive dyes or Salt dyestuffs or even simply cotton colors. The colors are well known for its use in dyeing cellulose fibres like cotton, viscose rayon, animal fibres such as wool and silk. Selected substantive dyes can be used to give solid shades on wool and cotton mixtures. Direct dyes are also called Substantive dyes because of their excellent substantively for cellulose textile materials like cotton and viscose rayon.

This class of dyes derives its name from its property of having direct affinity for cellulosic fibres when applied from an aqueous solution

PROPERTIES OF DIRECT DYES

1. Direct dyes are readily soluble in water.
2. Some of the dyes need a little amount of soda ash (Sodium Carbonate) for complete dissolve them in water.
3. Direct dyes are used for dyeing cotton, viscose rayon, wool and silk fibres.
4. If common salt or Glauber's salt (Sodium sulphate) is added to the dye during dyeing, more dye is taken up by the fiber i.e. the dye bath gets exhausted to a greater extent. Hence these salts are exhausting agents for direct while dyeing or cotton.
5. Direct dyes have poor washing fastness and poor light fastness. These fastness properties can be improved by certain after-treatments. If a piece of cotton dyed with a direct dye is boiled with soap and water which contains also a small piece of undyed cotton, the latter generally becomes stained with the dye from former. This is known as bleeding.
6. All direct dyestuffs combine with basic dyes to give compounds which are less soluble that the original direct dyes. The process of dyeing the direct dye on cotton with basic color is known as topping.

APPLICATION OF DIRECT DYES TO COTTON/VISCOSE

The dye bath is usually made up with twenty items as much water as the material. For example for 100 kgs. Of cotton 2,000 liters of water can be taken. For dyeing only soft water should be used. From 0.5 to 5% of the dyestuff according to the shade required to be taken.

The dyestuff is pasted with cold water and sufficient boiling water is then added, with constant stirring to bring it into solution. It is then added to the dye liquor through a strainer.

Some direct dyestuffs give better results in a slightly alkaline bath. In fact it is advantageous in most cases, since it renders the dyestuff more completely soluble in the dye bath. From 0.5 to 2% of Sodium carbonate may be used.

The cotton material is wetted out in water and entered into the dye bath at 41ºC to 50 ºC and the liquid is raised to the boil over a period of 30 to 40 minutes and then common salt or Glauber's salt is added to the dye bath for the complete exhaustion of the dye bath. These salts are exhausting agents for direct dyes while dyeing on cotton. The dyeing is continued at the boil for ¾ to 1 hour. At the end of the dyeing the material is rinsed in cold water and dried without soaping. Direct dyes have poor washing fastness and poor light fastness. However, these fastness properties can be improved by certain after treatments.

AFTER TREATMENT

A dye fixing treatment may give in a fresh bath containing a cationic dye-fixing agent before drying; this process improves the wet fastness of the dyed goods.

Fastness properties of Direct dyed goods

Both washing and light fastness of most of the direct dyed goods are generally poor; to improve the fastness properties after – treatments may be given.

ACID DYES

The Acid dye stuff is so called mainly due to two reasons. In the first place these classes of dyestuff were applied in a bath containing mineral or organic acids like sulphuric,acetic or formic acid and secondly most of them are sodium salts of organics acids.

Properties of Acid Dyes:

1. Acid dyestuff is soluble in water.
2. These dyes are easily applied on wool, silk and nylon fibres,
3. These dyes are generally applied in the presence of acids like sulphuric, acetic or formic acid.
4. They are in much case soluble in alcohol.
5. When acid dyestuffs are treated with a reducing agent they are generally decolorized.
6. They are usually combined with basic dyes.
7. The dyed acid colors have good light fastness and moderate washing fastness and leveling characteristics:

Acid dyes are divided into three Groups according to the leveling characteristics

(1) Acid dyes with Good leveling characteristics.

The relatively poor sustained of this type of acid dye is responsible for their good leveling characteristics. As the dye molecules have less attraction for the fibre they will migrate only slowly into the polymer systems of wool or nylon fibres. However to obtain sufficient substantively and ensure adequate exhausting agent (sulphuric acid) is added to the dye liquor, their lack of substantively is evidence by their poor wash fastness.

However the light fastness is very good to excellent.

(ii)Acid dyes with average leveling characteristics:

The moderate substantively of this type of acid dye is responsible for average leveling characteristics to obtain sufficient substantively and ensure adequate exhaustion a week acid (Acetic acid or Formic acid) is added to the dye both. The washing fastness of these dyes is fair, whilst their light – fastness is good to very good.

(iii) Acid dyes with poor leveling characteristics:

These dyes are also known as fast acid dyes, and milling dyes or Natural dyeing acid dyeing acid dyes. They have the best substantively of all the acid dyes, but have relatively poor leveling characteristics. Unless care is taken during, their relatively good substantively for the fibre may result in too rapid uptake and consequently unleveled dyeing

The excellent substantively of these dyes require neutral bath in order to obtain slower exhaustion and more level dyeing. The wash fastnesses of these dyes are good to very good. While their light fastness is fair to good. The better wash-fastness, compared with the other two type of acid dyes, is due to the greater number of sodium sulphate groups.

Application of acid dyes on wool:

The application of acid dyes to protein fibers results in an ionic or salt link between the dye molecule and the fibre polymer. The point of the fibre polymer at which the dye is attached is termed the dye site. In wool, the dye sites are of many amino group of the fibre. Under dyeing conditions, the amino group becomes positively charged and attracts the negatively charged dye anion. This can be represented as follows:

Wool - NH2 + H+ Wool – NH3 +

Wool polymer with Hydrogen Wool polymer with positively

Amine group or acid ion charged amino group

Then

Wool - NH3 + DSO3 Wool - NH3 + SO3D

Wool polymer with Dye anion lonic link formed between

Positively charged

positively charged amino groupAmino group on wool polymer and dye anion.

These are a large number of amino in the wool fibre. As a guide, there are approximately twenty times as many amino groups on wool as on nylon and five times as many amino groups on wool as on silk. Dark shades can be readily be obtained on wool because of the highly amorphous nature of the fibre, which results in relatively easy penetration of the fibre polymer by the dye molecule and because of the presence of minor groups.

Preparation of dye solution

The acid dyes are easy to dissolve, but care is necessary to avoid the possibility of a dissolved particular becoming deposited on the goods. The requisite amount of dyestuff is made into a smooth paste, preferably with a small amount of an anionic or non ionic wetting agent, and sufficient boiling water is added to dissolve it completely. It is advisable to strain the dye solution before adding it to the dye bath.

Method of dyeing with acid dyes on NYLON

The dyeing properties of acid dyes with regard to nylon and wool are similar. The shades are very similar to the corresponding colors on wool, but the saturation point is lower with nylon. When the pH of the dye solution 2 or lower, nylon has greatly increased affinity for acid dyes. In practice, dyeing cannot be carried out in the pH region of 2 to 2.5 because the degradation of the nylon would be excessive. Acid dyes requiring strong acid are applied from a dye liquor containing 3 to 5% of formic acid. Sulphuric acid should not be used because it can cause degradation of the nylon, and the addition of Glauber's salt is omitted because it has no beneficial effect. Non-ionic leveling agent, either alone or mixed with cationic products, are used. The goods are entered cold and the dye bath is brought to the boil and dyeing continued at this temperature for ¾ to 1 hour. With these acid dyes exhausting well with weaker acid, 1 to 3% acetic acid (80%), may be substituted for the formic acid or, alternatively, 1 to 3% of ammonium acetate may be used.

The application of acid dyes to nylon also results in ionic bonds or salt links between the dye molecules and the polymer. The point at which the ionic is formed is the terminal amino groups of nylon. The greater crystalline fibre structure of nylon compared with wool as well as the relatively lower number of amino groups means that dark shades on nylon cannot be obtained with acid dyes.

Stripping / leveling uneven Dyeing of Acid Dyes

i With the molecularly – dispersed acid dyes, on account of their good migrating properties, continued boiling in the same liquor is often effective. It must, how ever be borne in mind that wool felts if it so boiled form too long.

ii Boiling in fresh liquor with 20% of Glauber's salt will strip some of the color, and this can be exhausted again by cautious addition of acid or, preferably, ammonium salt.

iii If treatment with Glauber's salt is not successful, more of the color can be stripped by boiling with 0.5% ammonia, or in liquor containing 2% pyridine.

iv Another method is to boil the unevenly-dyed material with 3 to 5% of a cationic, non-ionic mixture such as Tine gal W or Lyogen SMK. When sufficient color has been removed by any of these compounds the wool is rinsed and redeye.

Dyeing

The wool must be scoured before dyeing. For pale shades it is after necessary to bleach with hydrogen peroxide to dye wool goods with acid dyes. A dye bath is first made up containing the acid dye, 3% to 5% sulphuric acid and 10% - 15% of glaubar's salt (Sodium sulphate). The Glauber's salt which enhances the solubility of the dye and prevents it rushing too quickly on to the wool fibre and causing uneven dyeing. In fact Glauber's salt acts as a retarding agent in the dyeing of acid dyes on wool. The sulphuric acid acts exhausting agents while dyeing acid dyes on wool. The goods should be kept turned from time to time to ensure equal distribution of the dye liquor throughout the material. When necessary, more complete exhaustion of the dye liquor is promoted by the addition of some more sulphuric acid. At the end of the dyeing, if the color does not appear even the goods should be put back into the dye bath and boiling is continued for further 15 minutes. This boiling rectifies the unevenness to certain level. If the material is very uneven, the dyed material is treated in a solution containing 10% - 20% Glauber's salt for ½ hour to remove the dye sufficiently and then the material is re-dyed. After the dyeing is completed the goods are rinsed, hydro-extracted and dried.

Application of Acid dyes on silk:
Although silk has an affinity for acid dyes the colors tend to be less fast than on wool. Silk will exert its affinity for acid dyes at lower temperature than is the case with wool, and dyeing is usually commenced at 40ºC and the temperature is not allowed to rise above 85ºC Glauber's salt is not suitable for use with silk as it diminishes its luster. Sulfuric acid damages the silk. If acid is used it should be acetic acid. While using boiled off liquor the bath must be neutral or only faintly acidic From 10 to 15 gallons of boiled off liquor per 100 gallons of water is taken. The acid dye is taken according to the shade percentage required and it is dissolved as usual. If the dyes require acid the boiled off liquor is broken with sulphuric acid and in the case of neutral dyeing acetic acid is substituted. When the acetic acid is added to boiled off liquor the liquor should be stirred well. The acetic acid neutralizes alkali and also liberates fatty acids to form the soap which rise to the surface and must be skimmed off before the dyeing commences. The material is entered at 50ºC and run for a short time before adding the previously dissolved dyestuff.

The dye solution is added in portions and the temperature of the bath is raised gradually to 85ºC and the bath maintained at this temperature for ½ to 1 hour until the dyeing is complete. If at the end of this period the dye bath is not completely exhausted 1-2 % glacial acetic acid (on the weight of the material) is added dyeing continued for a further period of 10 to 15 minutes. Prolonged heating beyond 85ºC or boiling is avoided as it injures the silk and affects its luster further; many acid dyes have a tendency to strip off the fibre at boil. Certain acid dyestuffs have so great an affinity for silk that they can be dyed at a temperature lower than 85ºC after dyeing the silk is rinsed and brightened by working in a dilute solution of acetic acid, squeezed well and dried without rinsing.

BASIC DYES

Basic dyes are called so since they are salts of organic bases.
Basic dyes are also called cationic dyes because in solution the basic dye molecule ionizes, causing its colored component to become an action of positively charged radical. Basic dyes are used for dyeing wool, silk, and acrylic and modacrylicfibres.

Properties of Basic Dyes:

1. The outstanding characteristics of the basic are brilliance and intensity of their colors.
2. The bright colors achieved from basic dyes do not usually occur with other dye classes.
3. Many of the basic dyes are sparingly soluble in water.
4. The addition of glacial acetic acid helps to dissolve the basic dye quickly in water.
5. Basic dyes are readily soluble in alcohol or mentholated spirit.

6. The basic dyes are poor fastness to light and vary with regard to washing fastness from poor to moderate.
7. An important property of basic dyes is that they will combine with tannic acid to form an insoluble compound provided mineral acid is absent.
8. The wet fastness of the basic dyes on protein fibres can also be improved by back tanning. This consists of after treating the dyed material with tannic acid in order to form the insoluble complex thereby reducing the tendency to migrate.
9. The basic dyestuff will combine with direct or sulphur or some acid dyestuffs. So they cannot be used together in the same bath. But basic dyestuffs are used in after treating cotton or other materials dyed with direct colors. Here the direct dyestuff acts as mordant.
10. When treated with a reducing agent most of the basic dyes get converted into their colors less leuco compounds, return to their original color by oxidizing agents or even by exposure to air.
11. Basic dyes can be removed from the material by boiling it with dilute acetic acid or hydrochloric acid.
12. Basic dyes are used for woolen goods when particularly bright shades are required which cannot be obtained with an acid dyes.
13. Basic dyes do not have affinity for cellulosic fibres like cotton. The use of basic dyes on cotton involves the troublesome process of mandating with tannic acid. But, sometimes, bright shades are demanded on cotton which can only be obtained with them.
14. Special cationic dyes are available for dyeing acrylic fibres.
15. Basic dyes are also used for making inks, typewriter ribbons and dyeing leather.

APPLICATION OF BASIC DYES TO SILK:

Silk - COOH	H^+	Silk - COO^-
Silk polymer with Carboxylic group	Hydrogen ion	Silk polymer with negatively charged carboxylic group
	Then	
Silk- COO	+ (Dye cat ion)$^+$	Silk – Coo^- (Dye cat ion)
Silk polymer with Negatively charged Carboxylic group	Dye cat ion	Oink link formed between negatively charged carboxylic group of silk polymer and dye

Preparation of dye solution:

Owing to the relative insolubility and tendency special precautions are necessary whendissolving basic dyes. The dyestuff is first made into a paste with about its own weight about its 30% acetic acid; sufficient boiling water is then added with constant stirring to dissolve the dye. It is sometimes advantageous to use methylated spirit instead of acetic acid to assist in preparing a satisfactory solution. The dye solution should always be filtered before adding into the dye bath, due to its high tinctorial power, it is very difficult to see undisclosed particles.

The basic dyes have such a great affinity for the protein fibres like wool, silk that the presence of a retarding agent is often desirable. From 1 or 2% of acetic acid on the weight of the goods is generally used for this purpose. The excess of hydrogen ions in the liquor counteracts the attraction of the electron sites in the fibre and slow down the rate of absorption of the dye ions. When acid has to be used the addition of a small amount of alkali may be necessary towards the end of the dyeing to complete exhaustion. Since basic dyes are absorbed in a neutral or alkaline bath, soap may be used as on assistant instead of acetic acid; from 10 to 5% on the weight of the goods is required. When dyeing with soap, soft water is essential. Boiled-off liquor is also used as an assistant while dyeing silk with basic dyes.

Dyeing is broken degumming liquor:

Silk is often dyed with basic dyes in “broken” degumming liquor prepared in the following manner; A dye bath is made up containing 25 gallons of boiled-off liquor diluted to 100 gallons with soft water. Acetic acid is added with stirring. This neutralizes alkali and also liberates fatty acid from the scrap which rise to the surface and must be skimmed off before the dyeing commences.

The bath is raise without any additions to 40ºC and silk is entered and wetted out. It is then lifted and the strained dye solution is added and well mixed by stirring. The silk is returned to the bath and kept in motion for the next 20 minutes. The temperature is then raised slowly to 82ºC (1/80ºf) of which it is kept for half an hour. The material is then taken out and rinsed and dried. Owing to the great affinity which silk, this method may sometimes give uneven results, for this reason a slower process of dyeing may be preferred. The dyestuff solution is divided into three equal portions. One part is added to the dye bath and the silk is worked in the cold bath for 20 minutes, after which it is lifted out and the second portion of raised to 40ºC at which temperature dyeing is continued for a further 20 minutes. Finally the silk is again taken out the remainder of the dye is added the goods are reentered and temperature is raised slowly at 82ºC and dyeing continued at this temperature for 30 minutes. After dyeing the goods are rinsed, hydroextracted and dried; Scooping with acetic acid is then applied, if desired.

Preparation of Dye Solution:

Owing to the relative insolubility special precautions are necessary when dissolving basic dyes. The dyestuff is first made into a paste with about its own weight of 30% acetic acid. Sufficient boiling water is then added with constant stirring to dissolve the dye. The basic dyes have such a great affinity for wool fibres the presence of a retarding agent is often desirable. The Acetic acid acts as a retarding agent.

The excess of hydrogen ions in the liquor counter acts the attracting of the electro negative sites in the fibre and slows down the rate of absorption. When acid has been used, the addition of a small amount alkali may be necessary towards the end of the dyeing to complete exhaustion.

Dyeing:

The dye bath is made up containing 1 to 3 % of 40% acetic on the weight of the wool, the dye solution, after being strained through a filter is added, and the goods, which have previously been scoured, are entered. The dye bath temperature is slowly raised to the boil and dyeing is continued for ½ to ¾ hour. After dyeing the goods are rinsed, hydroextracted and dried.

REACTIVE DYES

Reactive dyes are so called because their molecules react chemically with the fire polymers of some fibres to form a covalent bond between the dye molecule and fibre polymer. The fibres most readily colored with reactive dyes are cellulose fibres, wool, silk and nylon. Reactive dyes are also called as Procion dyes When direct dyestuff is applied to cotton and to viscose rayon the process is one of Physical absorption there is no covalent union between dye and fibres.

DH + H O – cell DH……..HO –Cell

Direct dye cellulose dyed (not reactively) Cellulose

Direct dye, DH, applied to cellulose, there is no chemical reaction and no covalent union, there is, as indicated by the dotted bond, hydrogen bonding and attachment thorough Vander walls forces. The nature of the union between bye and fibre, commonly referred to absorption, may be difficult to analyze precisely; it may have been mechanical, physical or chemical sorption, hydrogen bonding and so no, but it was certainly not covalent bond.

Drcl + HO - cell DH O cell + HCl

Reactive Dye Cellulose reactively (covalently) Dyed cellulose

With the old direct dye DH we obtained dyed rayon DH …..HO-cell. With the reactive dye DRcl we have obtained reactively dyed rayon Dr – O cell. All that we have gained is covalent union (i.e. Chemical combination) between dye and fibre. As a result of this, fastness to washing and wet processing generally should be much better and so in reactively dyed cellulose DR-O Cell, the dye is part of the fibre; it is impossible to wash it out or to extract it even with such powerful agents as aqueous pyridine.

The porcine dyes, on account of the sulphonic acid groups in their molecules, are readily soluble in water. In neutral solution, they have substantively towards cellulose similar to that of very low affinity direct dyes, a wet-fastness of a low order, and they exhaust better in the presence of an electrolyte (salt). In the neutral solution physical adsorption and possibly some hydrogen bonding take place, but there is no formation of covalent bonds until alkali has been added.

The application of reactive dyes to cotton materials involves two distinct steps

1) Dyeing with the dye in the presence of common salt to effect as much exhaustion as possible and

2) Chemically reaching the dye with the fibre (fixation) in the presence of an alkali like soda ash.

In the first stage of dyeing, the reactive dye resembles like direct dyes in that its exhaustion can be brought about by adding common salt or Glauber's salt. However, it has much lower affinity to cotton than direct dyes.

During the second stage of application (fixation) the alkali is added to the dye bath, when the dye reacts with the fibres, however the dye also reacts with water (only after the addition of alkali) and when this rakes place, the dye gets deactivated (hydrolyzed) and then it cannot react with the cotton fibre. In the dyeing and fixing of reactive dyes, 5 to 30% of the dye used for dyeing and the remaining is deactivated and hence this is a waste. The deactivated dye has some affinity for cotton and hence is absorbed and retained by cotton. Because of the lower affinity of the deactivated dye (compared to direct dyes on cotton) the washing fastness of this form of the dye present, on cotton is very poor and hence it gets washed out progressively during the washing of the garments made from such fabrics. Therefore, as part of the dyeing process the fabrics are boiled with a soap solution after the fixation step, when most of the deactivated dye is removed from the dyed fabric. The other form of the dye present in the fibre in a chemically reacted form is not removed during the soaping step, since it is firmly bound to the fibre by a covalent bond.

COLD BRAND AND HOT BRAND REACTIVE DYES

The reactivity of these dyes is due to the chlorine atoms attached to the triazine ring. When two chlorine atoms are present in the dye molecule are called Dichloride Procions. Dichloride procions are referred to as M-type procions and their characteristic is that they will combine with alkaline cellulose at room temperature (20ºC to 30ºC) and hence they are called cold brand reactive dyes when only one chlorine atom is present in the dyestuff molecule, the reactivity of the dye decreases considerably and the dyeing has to be carried out at a higher temperature (65ºC to 80ºC). Hence these dyes are called hot brand reactive dyes. Mono chloride procions are referred to as 'H' type procions. Normally 'M' Brands are suitable for dyeing and H brands are suitable for printing.

The instability of the solutions of the cold-dyeing procion colors was a serious disadvantage in their application to textile printing. The stock solution for printing must be kept and used for several hours. The reactive dyes having only one chlorine atom in their molecule are less reactive. Their aqueous, therefore, are more stable and very suitable for printing.

TYPES OF REACTIVE DYES:

1. Cold brand reactive dye - 'M' brand
2. Hot brand reactive dye - 'H' brand (or 'X' brand)
3. High exhaust reactive dye - 'HE' brand
4. High exhaust reactive dye - 'ME' brand
5. Vinyl Sulphone reactive dye - for dyeing and printing
6. Low salt reactive dye - LS dyes

PROPERTIES OF REACTIVE DYES:

1. The Procion dyes, on account of the sulphuric acid groups in their molecule, are readily soluble in water.
2. These dyes, unlike any other class of dye stuffs, react and combine chemically (covalently) with cellulose and this leading to excellent wash-fastness.
3. These dyes give very bright shades such as orange, pink, magenta etc, which were not possible with other class of dyes.
4. They do not react with water nearly as readily as with cellulosic hydroxyl in alkaline conditions, so that they can be applied from an aqueous solution.
5. Reactivity of the dyestuffs can be reduced when desirable by blocking one of the reactive chlorine atoms giving H-type Procions.
6. Procions are dyes with small molecules; their molecules do not have to be very long as those of direct dyes to match the distance between absorption sites on the fibre.
Short molecules bring two advantages (a) Clarity and brightness of hue and (b) easy penetration and therefore good leveling.
7. Because there is some, even although not very much reaction between procion dyestuffs and water it is very important to wash the dyes fibre thoroughly clean and free from the reaction product with water.
8. Textile materials colored with reactive dyes have very good light fastness.
9. Textile materials colored with reactive dyed has very good wash-fastness.
10. Textile materials which are colored with reactive dyes have to be thoroughly rinsed and scoured. Reactive dyes can react with the hydroxyl groups of the water molecule to produce dye molecules to produce dye molecules with poor substantively for the fiber. In fact it is these molecules which have to be removed by a washing-off process, involving soaping and rinsing. If these molecules of dye are not removed, poor rub-fastness may result.
11. The formation of the covalent bond between dye and fiber occurs under alkaline conditions. The presence of acids may reverse this process. Perspiration and atmospheric pollution which are both slightly acid may affect textile materials colored with reactive dyes and result in some fading.

APPLICATION OF COLD BRAND REACTIVE DYES ON COTTON

(Dichlorotriazinyt Reactive dyes (or) Procion – M brand)

PREPARATION OF DYE SOLUTION

The dyestuff is dissolved by making them into paste with cold water, followed by dilution with more water, the temperature of which must not exceed 50ºC, A stock solution will not remain stable for more then about 4 hours, after which it will begin to lose strength due to hydrolysis.

DYEING

The goods are loaded into the machine and 30 and 60 parts per 1000 of common salt are added, the quantity varying according to the depth of the shade. The liquor is then raised to the required temperature either 40ºC or 60ºC and the pre dissolved dye is added in the machine is then allowed to run for 20 to 30 minutes and the necessary amount of Soda ash is added over a period of 10 to 30 minutes.

Dyeing is continued for further 20 to 40 minutes after which the goods are rinsed to remove the salt and the alkali, and they are then washed off at the boil for 15 to 30 minutes to extract any of the products of hydrolyzed dye. Considerable importance must be attached to the final washing of goods dyed with procion colors. The exhaustion is often not good and much dyestuff will be in retained in the liquor, but of greater significance is the fact that cellulose has some affinity for the hydrolyzed dye which is having lost its chlorine atoms, has not entered into chemical combination. The load is first rinsed thoroughly in as great a volume of cold water as the machine permits. The goods should then be rinsed in hot water nearly at the boil, after which they are soured at the boil, for 15 to 30 minutes with a synthetic detergent or soap and finally rinsed, first in hot and then in cold water.

APPLICATION OF HOT BRAND DYES ON COTTON

MONOCHLOROTRIAZINYL, REACTIVE DYES (OR) PROCION + H brand

The mono chlorotriazinyl dyes or hot brand reactive dyes are less reactive. Their aqueous solutions are more stable but they do not react with cellulose so readily and the temperature of dyeing must be increased to 60ºC to 70ºC and in some cases, as high as 90ºC to 95ºC.

The dyestuffs are dissolved by making them into a paste with cold water, followed by dilution with more water. The dye bath is made by dissolving sufficient common salt to give a concentration of 40 to 80 parts per 1000 according to the depth of the shade, the goods already having been entered. The temperature is brought up to 40ºC and the machine is run for five to ten minutes in order that the fabric can be uniformly impregnated.

The pre dissolved dye is then added in two portions at five minute intervals followed by the alkali which should be 20 parts per 1000 of soda ash. The alkali should be added in two portions at five minute intervals and the temperature then raised to between 60 to 90ºC according to that which is recommended for the dye selected. Dyeing is continued for a period of 20 to 40 minutes and then continued for 30 to 60 minutes when soda ash (alkali) is used. After dyeing, the materials must be rinsed and soap boiled to remove hydrolyzed and unfixed dye.

After treatment:

1. Treat the dyed material with 1 to 2 g/l of neutral soap at boil for 15 minutes and wash it.
2. Treat the soaped material with 2 to 3 g/l of cationic dye fixing agent at 40ºC for 20 to 30 minutes and dry it

WATER INSOLUBLE DYES

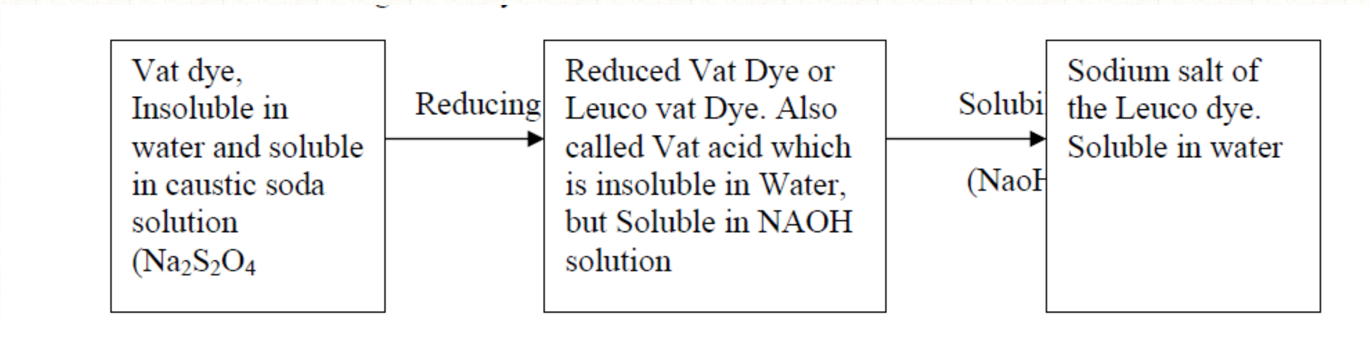
VAT DYE

The name Vat was derived from the large wooden vessel from which the Vat dyes were first applied. Vat dyes provide textile materials with the best color fastness of all the dyes in common use. The fiber most readily colored with Vat dyes are the natural and man made cellulose fibres of cotton, viscose rayon.

Properties of Vat Dyes:
1. Vat dyes are insoluble in water and hence cannot be used directly for dyeing but when treated with the reducing agent, they leuco compounds are soluble in alkaline solutions in which cotton and other textile fibres have a considerable affinity on them. When cotton containing these, is exposed to air, the leuco compounds are oxidized and the insoluble coloring matters are produced on the fibres.
2. Vat dyes fabrics have excellent light fastness.
3. Vat dyes fabrics have excellent washing fastness. This is attributed to the large vat dye molecule as well as its aqueous insolubility. The large vat dye molecules is trapped with the polymer system of the fibre, because of its size and aqueous insolubility and is absorbed within the fibre polymer system by Vander wail's forces.
4. Vat dyes have always been very expensive compares with other dye classes.
5. Vat dyes are mainly used for coloring of cellulose fibres, but these dyes dyed at low temperature and with small amount of alkali for dyeing wool and silk. Vat dyes being insoluble in water cannot be directly applied to textile materials. They have to be converted into water soluble form having affinity for textile fibres such as cellulose fibres.

This conversion is usually brought about in two steps:
1. Reduction of the dye into the weakly acidic leuco vat from and
2. Salt formation by neutralizing these acidic leuco vat dyes by sodium hydroxide to give a water-soluble product.

Since the second the step results in the formation of water-soluble sodium salt of leuco vat dye, it may be called as the solubilising step. Reduction followed by solubiling is called the vatting of the dye. For this purpose sodium hydrosulphite, (Na2S2O4) (Usually called "hydrous") is used as the reducing agent and sodium hydroxide (NaOH) as the solubilising (Neutralizing) agent. The different steps involve in the vatting of the dye



Classification of Vat dyes
Vat dyes are classified based on chemical constitution of the dyes or based on the method of application.
In the first method, vat dyes are divided into two main classes
1) Indigoid vat dye.

2) Anthraquinone vat dye.

Indigoid vat dye:

The indigoids usually derivatives of indigo tin. The indigoids include natural and synthetic Indigo and substituted Indigoes. These are call characterized by forming pale yellow leuco compounds which dissolve in week solutions of sodium hydroxide (NaoH). The leuco compounds are oxidized readily when exposed to air. They are used in neural or slightly alkaline bath and are suitable both for animal and vegetables fibres. These Indigoid colors sublime when heated and are soluble in boiling pyridine.

Anthraquinone Vat Dye:

The Anthraquinone vat dyes derived basically from Anthraquinone. The Anthraquinone vat dyes give colored leuco compounds which are soluble only in Strong alkaline solution and therefore not suitable for animal fibres or protein fibres. The dyestuffs do not (with few exceptions) sublime when heated and are often insoluble in boiling pyridine.

The Vat dyes are classified based on the method of application into four groups.

1. lN dyes (Normal dyeing)
2. lw dyes (warm dyeing)
3. lc dyes (Cold dyeing)
4. lN Special dyes (Special dyeing)

The function of Nacl is an exhaustion agent.

IN class of vat dyes requiring relatively high alkali concentration and high vatting and dyeing g temperature. They exhaust well and require no electrolyte (Nacl – common salt or Glauber's salts).

IW Class of vat dyes requiring only a moderate amount of alkali lowers temperatures for reducing and dyeing. But require the addition of some salt (Common salt or Glauber's salt to complete exhaustion).

IK class of vat dyes requiring low alkali concentration lows vatting and dyeing temperature but considerable quantities of electrolyte.

IN Special vat dyes are used for dyeing blacks and grays with exceptionally high alkali concentrations and temperatures but no use of electrolyte

Principles of application of Vat Dyes:

Generally, the application of vat dyes to textile materials involves four distinct steps.

(1) **Vatting**in which the insoluble commercial dye is reduced and solidities (vatted) by using Sodium hydrosulphite (hydrous) and sodium hydroxide (NaOH).

(2) **Dyeing**, in which the soluble sodium salt of the leuco vat dye is absorbed by the textile material from an alkaline reducing medium in the presence of either a retarding agent or an exhausting agent depending on the rate of dyeing.

(3) **Oxidation,** in which the soluble form of the dye absorbed by the fibre is reconverted into the original insoluble dye by atmospheric oxygen (Airing) or by "chemical oxidation" (i.e.

involving the use of a chemical like sodium per bonate or potassium dichromate or Hydrogen per oxide).

(4) **After treatment, Soaping – off**, in which the dyed material is subjected to a treatment either boiling soap or other detergent solution in order to get the proper tone by way of aggregation of smaller dye particles into bigger ones and also to get the optimum fastness, especially rubbing fastness by removing the surface deposited dye particles.

APPLICATION OF VAT DYES ON COTTON

Preparation of leuco Vat dye solution

The Vat dyestuff powder is taken in a separate vessel and made into a paste with Turkey red oil (the some weight of dyestuff to be taken) and add some hot water (50º - 60ºC). The caustic soda is first added and then sodium hydro sulphate is added, and allow to stand for 10-20 minutes with occasional stirring, when complete vatting taking place. In above 10- 20 minutes the dyestuff will be reduced completely and going to solution. This can be seen by the clearness of the solution and characteristics of the vat color. The vatting stage temporarily alters the original color of the dye (Reduced color). The color change of some dyes is very market in deed, e.g. from yellow to blue, red to brown, green to blue etc.

Dyeing

The required water for dyeing is taken in the dye bath and it is maintain at proper temperature (50º- 60 ºC) the reducing and dyeing temperatures vary from dyestuffs to dyestuff. The vatted dye solution may then be added to the dye bath containing the required amount of caustic soda sodium hydro sulphate, kept at recommended temperature.

The well scoured wet yarn is entered in the dye bath and turned several times, so that the affinity of the color may be uniform. The yarn is then kept completely immersed under the dye liquor and the dyeing is continued for one hour. The yarn is turned from time to time… Care should be taken to keep the bath at required temperature and also to keep the yarn thoroughly immersed under the liquor. The exhaustion agents or retarding agents are added to the dye bath depending upon the dyestuffs taken, during the entire dyeing period. Excess quantities of both sodium hydroxide (NaoH) and sodium hydro sulphate (Na2s2O4) should be present in the dye bath in order to keep the dye in the soluble form. At the end of the dyeing the partly or completely exhausted dye bath must be kept in a distinctly reduced condition; otherwise oxidation of the residual vatted dye takes place in the dye bath itself leading to the appearance of turbidity.

This is ensured by adding sufficient sodium hydro sulphate. The dyed goods may then be removed from the dye bath and excess liquor which contains the unexhausted vat dye, sodium hydroxide, sodium hydro sulphate is removed as for as possible from the goods.

The dyed goods are rinsed with cold water and then subjected to an oxidation treatment by exposure to atmospheric oxygen. This is called “air oxidation” or “airing” but the oxidation may be accelerated by using stronger oxidizing agent such as sodium per bonate or hydrogen peroxide or sodium dichromate in the presence of acetic acid. This process is usually referred to as chemical oxidation. During the oxidation step the sodium salt of leuco vat dye absorbed by the fibre is oxidized and converted into insoluble dye in the fibre. At the same time the vatted dye contained in the residual liquor in the goods being dyed also gets converted into the insoluble form which is loosely deposited on the fibre surface. This loosely deposited dye on the surface of the fiber has to be removed for achieving optimum fastness properties especially rubbing and washing fastness properties.This is achieved by soaping process. The dyed material is treated in hot soap solution or a synthetic detergent solution for 15 – 30 minutes. After the soaping treatment the dyed goods should be rinsed thoroughly and finally the dyed material is dried. Important manufacturers of vat dyes in India are Indian Dyestuff Industries (I.D.I) and ATIC Industries which market them under the trade names of NAVINON and NOVATIC

SOLUBILISED VAT DYES (INDIGOSOLS)

It will be realized that the vatting troublesome operation requiring great care. To simplify the application, solubilised vat dyes were developed. Solublised forms of Vat dyes are the leuco ester part of the dye molecule that is responsible for the aqueous solubility of vat dyes. This has made vat dyes easier to handle and results in more level dyeing.

Properties of Solubilised Vat Dyes:

1. Soluble in Water,
2. Vatting operation is not necessary and hence can be applied directly in the bath.
3. Solubilised vat dye have less affinity for the fibres and they exhausted by addition of salt.
4. Suitable for light and medium depths.
5. Because of their low affinity, they are usually applied by padding process, followed by a developing bath (an oxidizing treatment).
6. Indigo sols process a good coverage and leveling properties.

Soluble vat dyes are mainly applied to viscose rayon, cotton, wool, and silk fabrics.

The solubilisedleuco compounds are known as the Indigo sols. Another range called the Solidness is prepared mainly from anothroquine vat dyes. Their application is comparatively simple. Cellulosic fibres are dyed in neutral dye liquor and slightly acid baths are used for protein fibres. They exhaust well at 20º to 40ºC although there are some requiring temperatures ranging from 60º to 80ºC. Their affinity for cellulose is not great and high percentages of electoral are often necessary and for this reason they have only found favor in dyeing pale shades where color cost is not so important. The general method of application is to dissolve the dye in hot but not boiling water and added it to the dye liquor through a strainer, together with the required amount of electrolyte. The goods are entered and the temperature is raised to that at which maximum affinity is developed, which varies from one dye to another.

The goods are dyed at the appropriate for a period of 30 minutes.

SULPHUR DYES

These dyes are so called because they contain sulphur atoms in their molecules. The fibres most readily colored with sulphur dyes are the natural and man-made cellulosic fibres. (Cotton, Viscose rayon)

The Characteristics feature of the dyes of this class is that they all contain sulphur linkages within their molecules: They are usually insoluble in water but dissolve in a solution of sodium sulphate to which sodium carbonate may or may not be added. The sodium sulphate acts a reducing agent severing the sulphur linkage and breaking down the molecules into simpler components which are soluble in water and substantive towards cellulose.

General Properties of Sulphur Dyes:

The sulphur dyes are cheap and easy to apply. Their wet fastness is good and the lightfastness- satisfactory. They therefore provide a cheap method of dyeing cellulosic fibres with a wet-fastness better than the direct dyes. The sulphur dyes have poor fastness to chlorine and are no use for effect in merchandise which must be bleached with hypochlorite, but they will withstand the conditions in an acid dye bath and can be incorporated in woolen goods intended for subsequent dyeing, as will be referred to latter, however, the after-treatments which improve the fastness of these dyes.

In their reduced state, their dyeing properties resemble in any respects those of the direct dyes. They exhaust better in the presence of electrolytes and vary considerably with regard to the temperature at which maximum exhaustion takes place. They are decomposed with acids usually with the liberation of hydrogen sulphate and the precipitation of insoluble decomposition products. On exposure to air or when acted upon by mild oxidizing agents, a part of the sulphur is oxidized to sulphuric acid. The sulphur dyes resemble the vat dyes in that they are insoluble in water but reduce to a soluble form, which readily converts to the accompanied by an alteration of color. Sodium sulphate is the reducing agent commonly used but in some cases sodium hydro sulphate may be substituted making it possible to dye selected vat and sulphur dyes together.

Dissolving Sulphur Dyes

The dye bath is made up with dyestuff and from 5 to 25% of the weight of the goods of common salt or 10 to 50% of crystalline Glauber's salt, the actual amount varying according to the depth of shade. The salt may be added at the commencement, but if there is any risk of un-level dyeing it is preferable to add it after the temperature has reaches 100ºC and then in several portion.

The addition of a surface-Active penetrating agent is recommended. With most sulphur dyes, the liquor is brought to the boil and dyeing continued at that temperature for 30 minutes. The steam is then turned off and the application continued in cool liquor for a further ½ an hour. There are some sulphur dyes, however, which exhaust at 70ºC to 75ºC. The sulphur dyes do not give very good exhaustion especially in heavy shades. A machine with a low liquor ratio is therefore preferable. It is common practice to keep a standing bath for black.

On account of the readiness with which the reduced dye oxidizes in the presence of air, it is desirable that the application should be in a machine in which the goods are totally immersed whole of the time.

It is also important that retained liquor should be rinsed out immediately after dyeing to prevent deposition of the insoluble product of oxidation on the surface of the fibres.

Oxidation Step:

Some of the sulphur dyes oxidizes only and it may be inconvenient to have to wait for the true shade to develop. The procedure is to run them after rinsing in a solution of sodium per binate of 0.5 to 1 g per liter concentration at 40ºC to 50ºC for 20 minutes.

After-treatment with metallic salts:

Sulphur dyes are after-treated with copper sulphate or more commonly with copper sulphate together with potassium or sodium dichromate and acetic acid. The treatment improves light-fastness and in some cases was-fastness to a small extent, when copper sulphate alone is used the process consists of running after rinsing at 70ºC for 20 to 30 minutes in a liquor containing.

1-2 per cent (on weight of goods) copper sulphate (Crystals)

1-2 per cent (on weight of goods) acetic acid (60 per cent).

And when dichromate is incorporated the time and temperature are the same, but the liquor contains.

1-1/2 per cent (on weight of goods) of dichromate

½-1 per cent (on weight of goods) of copper sulphate

1-2 per cent (on weight of goods) of acetic acid (60%)

Sulphur blacks may show a tendency to have a ‘bronze’ appearance. Many factors can contribute towards this effect, such as an excessively heavy dyeing exposure of the goods to air while they are being dyed failure to remove excess of dye liquor immediately after dyeing, or insufficient sodium sulphate in the dye both. The breeziness often can be removed by after-treatment in a bath containing a dilute solution of sodium sulphate (0.1%) at 30ºC, which removes some of the excess of dyestuff from the surface of the goods

Sulphur dyes and in particular the black shades are liable to cause tendering of cellulose on storage. This cause is the gradual oxidation of a portion of the sulphur to sulphuric acid.

Tendering can be avoided by dyeing in a little solution of sodium acetate so that the sulphuric acid will be converted into harmless acetic acid as soon as it is formed. Another method is to work the dyed material for 30 minutes in liquor containing 1 to 3% of potassium dichromate and an equal percentage of acetic acid (60%) at 60ºC. This should oxidize any loosely combined sulphur to sulphuric acid, which can then be removed by through rinsing.

DISPERSE DYES

These dyes derive their name from the fact that they are insoluble in water and are, for the purpose of dyeing, dispersed in the dye bath by means of dispersing agents.

The fibres most readily colored by disperse dyes are the acetate fibres, polyester, acrylic and nylon.

DYEING WITH DISPERSE DYES

Disperse dyes are applied from an aqueous dispersion, not form solution, and which, having a greater affinity for the organic fibre than for the water of the dye bath, eventually migrate to the fibre and form a solid solution in it. The application of heat to the dye liquor ncrease the energy of the dye molecules and accelerate the dyeing of the textile fibre. Heating the dye liquor swells the fibre to some extent and assists the dye to penetrate the fibre polymer system resulting in the dye being located in the amorphous regions of the fibre. Once within the fibre polymer system, the dye molecules are held by hydrogen bonds and Vander walls forces.

Polyester fibres are extremely crystalline and hydrophobic, lack of reactive groups and much more closely packed polymer chains and there are no gaps which molecule are very close to change their position to suitably accommodate they dyestuff molecule, and furthermore the chain molecules are very reluctant to change their positions i.e. to close their orientation. This result, the dyestuff particles do not penetrate to the fibre easily and in fact the process is so slow that it takes a matter of days or even weeks to dye a Terelenefibre at a dyeing temperate of 85ºC. It is difficult to obtain medium or dark shades even by dyeing at the boil. In order to obtain medium to dark shades, polyester fibre is dyed using carries or by using high temperature dyeing techniques.

Properties of Disperse Dyes:

1. Generally these dyes are insoluble in water.
2. However they are soluble in hot water to some extent, the solubility increasing with temperature.
3. A feature of disperse dye molecules is their lack of polar groups, evidenced by the insolubility of disperse dyes.
4. Textile materials which have been colored with disperse dyes have a fair to good lightfastness.
5. Textile materials colored with disperse dyes have a moderate to good wash-fastness.
6. Some of the disperse dyes are, however, sensitive to nitrogenous fumes, such as may arise from gas, electric or other fibres, suffering serious discoloration, referred to as gas-fading.

Disperse dyes have the ability to undergo sublimation: i.e. they can be vaporized without a significant change in their color, i.e. light-fastness or wash-fastness.

AZOIC DYES

Azoic dyes are so called because their molecules contain azo group. (N=N) Azoic dyes are also called naphtha dyes or developed colors. The fibres most readily colored with azoic dyes are the man-made and natural cellulose fibres, e.g. Viscose, Cotton etc.

DYEING COTTON WITH AZOIC DYES:

Coloring of textile materials with azoic dyes involved the reaction within the fibre polymer system of the two components, which constitute the azoic dye. These two components are the naphtha or coupling component, and the base or diazo components. The application of azoic colors involved two steps – nautholation (dyeing with naphtha) and development (coupling of diazotized base with naphtha).

The Application of Azoic colors involves the following steps.
1) Preparation of Naphtha solution.
2) Dyeing of cotton yarn with Naphtha solution.
3) Preparation of Diazotized base solution.
4)After treatment of the dyed cotton material.

PREPARATION OF NAPHTHOL SOLUTION:

Naphtha's are insoluble in water. They can be dissolved in water by coveting them into sodium compounds which are soluble in water. For this caustic soda i.e. sodium hydroxide (NaoH) is used.The Naphtha is pasted with its own weight of turkey – red oil and little hot water avoiding any lump formation. The required amount of boiling water is then added to the paste, followed by the required amount sodium hydroxide (NaoH) solution is added. The mixture is boiled till a clear solution is obtained. Cool the solution to 50ºC by adding about some quantity of cold water.

DYEING OF COTTON YARN WITH NAPHTHOL SOLUTION:

The well scoured wet yarn is entered in the cold Naphtha bath are kept turned for severaltimes. In some cases the addition of common salt or Glauber's salt increases theabsorption of the naphtha solution. The impregnated material must not be touched withwet hand or exposed to direct sunlight or brought into contact with metals.In most cases the amount of Naphtha which is absorbed decreases as temperature raisesand the operation is therefore carried out at 25º - 30ºC for 20 – 30 minutes. Afterimpregnation the goods should be hydro extracted or squeezed thoroughly, to avoidcarrying over retained liquor into the coupling bath where it would cause surfacedeposition of the pigment cause the poor rubbing fastness.The sodium salts of the coupling components are usually somewhat unstable towardsexposure to air, especially when in a wet state. If the impregnated goods lie about for anyperiod the decomposition will not occur uniformly and the final result will be patchy.Therefore the naphthalene material should be developed without any delay.

PREPARATION OF DIAZOTIZED BASE SOLUTION.

1) The base is insoluble in water. It should be converted into water soluble salt (hydro chloride of the base) using concentrated hydrochloric acid.
2) The reaction of hydro chloride of the base with Nitrous acid usually at low temperatures (Oº -
5ºc) for 20 – 30 minutes is called the Diazotization of the Base. This is carried out by adding Sodium Nitrite to a solution of hydro chloride of the base in the presence of excess ofHCL.acid. Now the base is converted into diazonium chloride (diazotized Base).The base is pasted with a little amount of con. Hcl. Acid and a few drops of cold water themixture is then added cold water to dissolve the paste. The mixture is stirred till a clearsolution obtained. In some cases the mixture is to be heated or even boiled completeconversion of Base into salt. The solution is cooled to 18º - 20 ºC by adding Crushed icedirectly into the solution when the required temperature is obtained the pre-dissolvedsodium Nitrite is added with constant stirring. Allow the solution for 20 – 30 minutes forthe reaction to go to

completion. Now the diazonium chloride which is generally highlysoluble in water is formed and a very clear solution is obtained. Now the pH of thesolution is too low. The reaction between diazonium chloride and Naphtha (Coupling ordeveloping) takes place quickly over the pH range of 5 to 6. The pH of the solution istherefore raised by adding Sodium acetate. Sodium acetate converts the free Hcl. Acid intoacetic acid, after which the pH of the solution become in the range of 5 – 6. Coupling willalso be retarded if the liquor becomes alkaline, too high a pH and this can occur easily onaccount of sodium hydroxide (NaoH) which may be left in the cotton after it has beenimpregnated with Naphtha solution. Excess of alkali can be neutralized by adding aceticacid or sodium bicarbonate or Aluminum Sulphate. The developing both should bemaintained the pH of 5 – 6 and temperature should be kept below 20ºC in the abovemanner. Now the base solution is ready for dyeing.

Dyeing of Naphthalene material with the Base Solution.

The naphthalene material is entered the diazotized Base solution. It is turned several times and kept for 20 – 30 minutes. This is called coupling (Or) developing process. During coupling the Azoic color is formed on the cotton material. Through the coupling process the pH should maintain 5-6 and temperature should below 20 ºC.

After treatment

After the dyeing the dyed material are rinsed in the cold water bath to which a little Hcl acid is preferably added and are then treated in a soaping bath at boil for 30 minutes to remove the loosely combined dye stuffs.

DYEING OF VISCOSE RAYON WITH DYES:

Azoic colors have a much greater affinity for Viscose rayon than for cotton. The method of application is,

1. Preparation of Naphtha solution
2. Dyeing of Viscose rayon with Naphtha solution.
3. Preparation of diazotized Base solution
4. Dyeing of Naphthalene mat. In the Base solution.
5. after treatment of Azoic Dyed Viscose Rayon mat.

Properties of Azoic Dyes:-

1. It is insoluble in water.
2. It is not a ready made dye but is formed in the fibre substance by the dyer from Components usually referred to as Naphtha and Base.
3. The dyed and printed azoic colors have very good to excellent light fastness.
4. The dyed Azoic colors have good washing fastness.
5. Textile materials dyed with azoic dyes suffer from poor Rubbing – fastness. This occurs because of the formation of the insoluble azoic dye on the surface of the fibre which is not removed during the final stage of dyeing, which is not removed during the final stage of dyeing. This rinsing stage is referred to as Soaping – off and involves a through treatment of the dyed textile material with a detergent. If all stages of azoic dyeing are carefully controlled and followed by thorough soaping – off, poor rub-fastness is unlikely to occur.

<u>DYEING MACHINES</u>

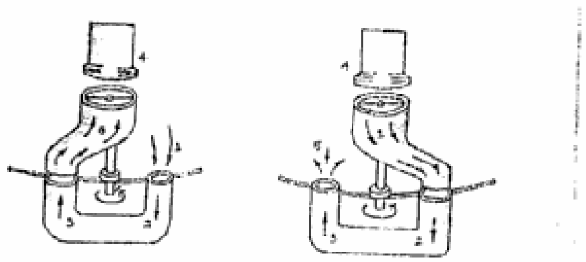
PACKAGE DYEING MACHINE

Yarns are often wound in the form of packages, e.g. cheeses, cones or bobbins. Large amount of yarns of all kinds are usually scoured, if necessary bleached, and dyed in a bath of circulating liquor while in wound package forms. Several circulating machines are available for this, but they are all based on the same principle and type of constructions.

Such machines consist of an outer vessel, mostly capable of being used under pressure for containing the scouring, bleaching or dye liquor. The yarn packages are positioned on a frame or cage provided with a number of perforated tubes in communication with a common central hollow case. The wound packages of yarn are arranged one above the other on these perforated tubes so as to enclose them tightly, leaving no intermediate spaces in between packages. The cover of the outer container is then tightly secured in place.

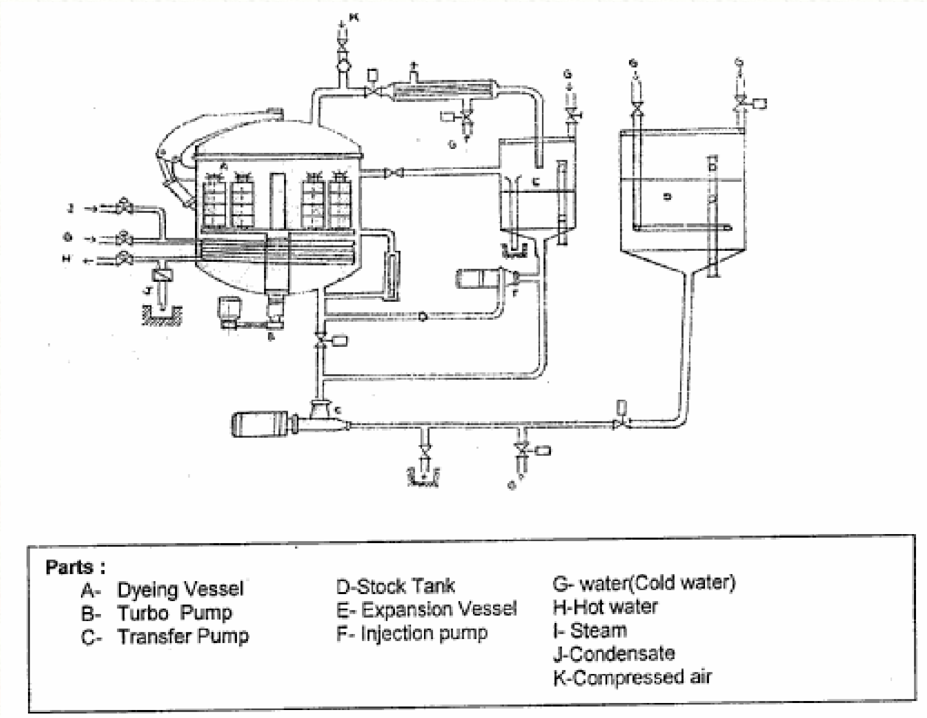
By means of a liquor pump the liquor to be selected (i.e. scouring, bleaching or dye liquor) is withdrawn from the outer container a forced up the tubes, outwardly through their perforations and so through the yarn packages and back into the outer liquor container. This is said to be the “inside out” direction of flow the direction of the flow of the liquor can be reversed automatically from time to time or it may be maintained in the same direction. When it is automatically reversed, it flows “out side – in’ for a preset duration and then reverses in direction to flow “inside – out” for a preset period of time, and then reverses again then the other way and so on.

Inside –Out- Circulation **Outside –In-Circulation**



Parts:
1 - Liquor return flow from material
2 – Suction side off pump
3 – Pressure side of pump
4 - Material corner connecting piece
5 – Liquor flow (outside –in.)
6- liquor flow (Inside –out)

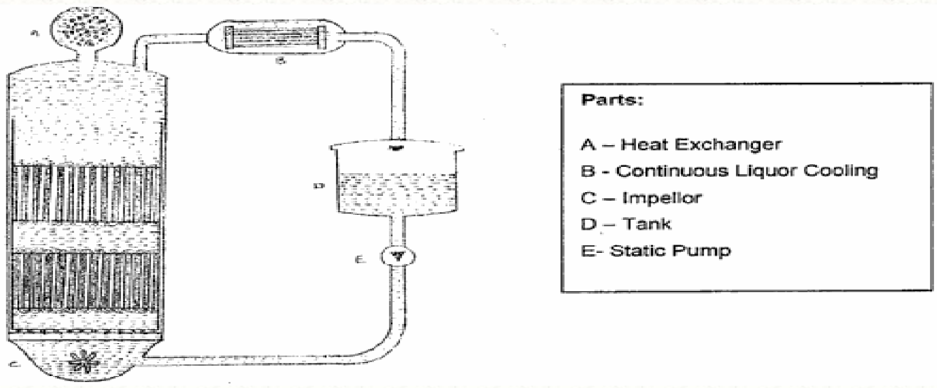
Dyeing machines for any yarn packages are usually vertical machines, which can be loaded or unloaded by means of an overhead hoist. The main parts of a package dyeing machine are



Package dyeing machines are normally capable of working at an M: L ratio of around 1:10.Nowadays, low liquor machines are also available. Other developments include the rapid dyeing machines especially for dyeing polyester yarn packages in a short time, and the programmable machines that allow any pre-determined dyeing cycle to be performed automatically

Cabinet Dyeing Machine/ hank dyeing machine:

Cabinet dyeing machines are used for dyeing yarn in hank form. This machine is also used for all wet treatments such as boiling off, bleaching, acidifying, washing, etc. All kind of dyestuff may be used in this machine. This machine is used for dyeing cotton wool, and high bulk acrylic yarns. In the cabinet, the hanks hang on oval sticks in two or four compartments (the number of compartments depends upon the capacity of the machine) and the liquor is circulated through them by means of a special reversible propeller, which is located at the lower part of the main chamber of the machine. The drive from the electric motor is transmitted by means of V-belt and pulleys, which permit the selection of different speeds in order to suit the circulation of the liquor for the count and quality of the yarn.



Reversal of the flow of liquor can be effected automatically by means of a special cyclic device with pre-selection of times. An automatic temperature controller for use with or without preprogrammed controller or a completely computerized programmed with all pneumatically activated valves for fully automatic operation are available. Devices for heating and distribution of the liquor are also fitted in the liquor part of the cabinet. The sampling device with a stainless steel valve is fitted in a most accessible position and enables sampling to be performed very easily and safely. Provision is available in this machine for different spacing of the hank rods, making them suitable for different reeling lengths and types of yarns. Hydrostatic pressure and static pressure models are available for working temperature up to 100ºC and 180ºC respectively.

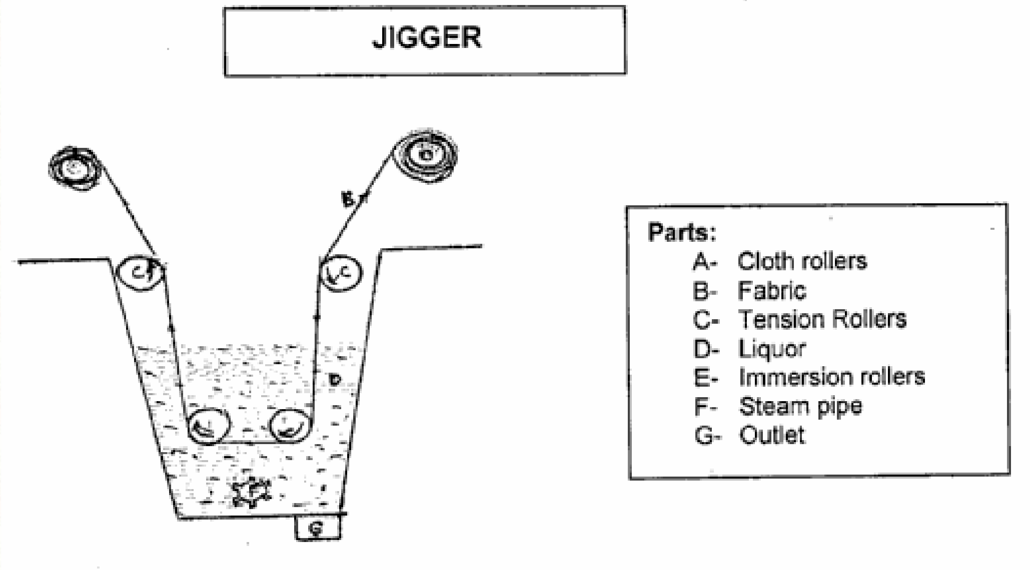
The M: L ratio is normally 1:15 or 1:20depending upon the hank size. Cabinet hank dyeing machines are available for dyeing hanks in three sizes of 54”, 72” and 90”. Cabinet dyeing machines are available as single-tier and double-tier models. Single-tier machines are available for dyeing in capacities of 50kg and 75kg for cotton yarn. Double-tier machines are available for dyeing in capacities of 100kg, 200kg and 500 kg of cotton yarn.

JIGGER

The jigger provides a ‘V’ shape stainless steel vessel for containing the scouring liquor, a pair of upper guide rollers either a single or a pair of similar guide roller, an immersion roller in the bottom of the vessel and two draw roller one on each side of the machine are positioned above the ‘V’ shaped scouring liquor container. About 1000 meters of fabrics which may consist of 5 or 6 separate lengths of fabric temporarily stitched to each end and this cloth is wound on one of the draw roller. The ‘V’ shaped vessel in then filled with suitable scouring liquor which is then heated up to desire temperature (depends upon the type of fabric) by means of an open ended steam pipe placed at the bottom of the jigger.

The free end of the fabric is passed downwards through the scouring liquor and around the guide roller and is then passed to the second draw roller. At this stage the second draw roller is caused to rotate. Thus the fabric is pulled from the first draw roller by the driven second draw roller. This forward and backward travel of the fabric between the draw rollers and through the scouring liquor is continued so as to allow the fabric to pick up more and more scouring liquor. From time to time the cloth is checked to see whether the scouring is over.

After scouring, the scouring liquor is run out from the vessel which is then filled with coldwater. The fabric is rinsed in this and wound in the second draw roller on which it can betaken away for next process. It is usual for each passage of the fabric which is saturated with the scouring liquor which can take up one or other of the draw roller. Each passage of the fabric through the liquor is turned one ‘End’ and since it is usual to run the fabric at least ‘Six ends’. The total time of scouring depending upon the material processed.

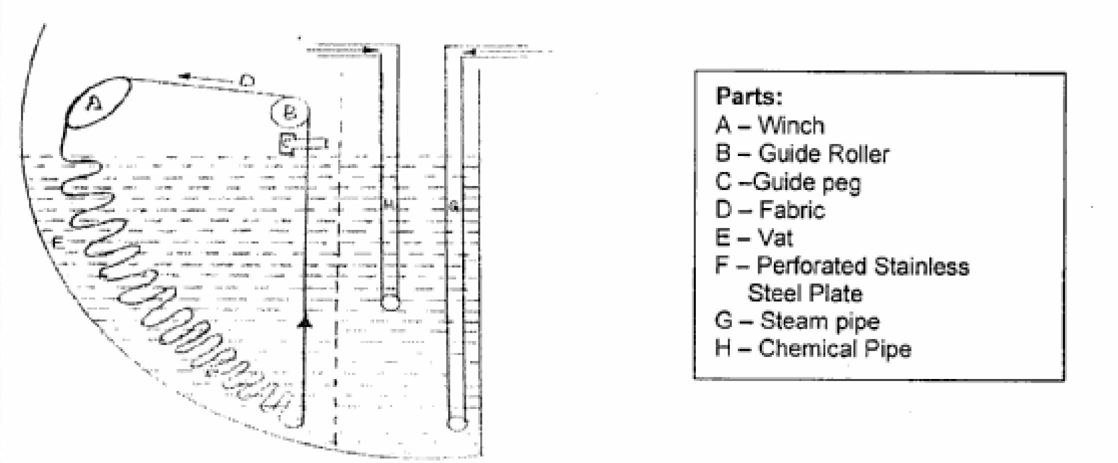


WINCH MACHINE:

The winch scouring machine is quite different in construction from the jigger. More over it is operated in different manner. It consists of a vat (vessel) which is usually longer than in its guide and it is usually has a curved back. Over the top of the vat a winch extending in length is rotated generally by an individual electric motor but some times by means of a belt drive from adjacent shift. At the front of the scouring vat a narrow chamber separate from the vat by a perforated place so that the main bulk of scouring liquor in the scouring vat can pass through the perforation to mix the main bulk of scouring liquor. There is a fabric roller of small diameter extending to the whole width of the vat positioned just above the level of the top of narrow chamber, but well in front of the winch which is higher and parallel to it. The winch is usually positioned nearer to the back of the machine than the front. In this machine the materials are scoured in rope form.

In preparing for scouring operation each length of fabric is run over the rotating winch so that it moves from the front of the machine, then even the winch to fall down at the back of the machine into the scouring vat. When nearly all these lengths of fabric have passed over the winch the first end is brought around the guide roller of the scour vat and stitch to the end which has not passed over the winch. Thus the length of fabric is treated up with the greater part of each length of fabric lying in a folded form on the bottom of the vat. At this stage the scour vat will be full of liquor but yet the chemicals are to be added. It is usual to have in-front of the machine a horizontal bar carrying projecting guide pegs to keep the length of fabric suitably spaced from each other and running side-by-side.When the winch is rotated the fabric at the front of the machine are steadily drawn between the guiding pegs over the guide roller, backward and upward to pass over the winch and then fall back into the vat. The winch is the prime mover of the fabric, but for the greater part of the scouring period of the fabric, is lying wholly immersed in the scouring liquor. It is only periodically that any given portion of the fabric is drawn out of the scouring liquor to pass over the winch and again fall back in the scouring liquor at the back of the machine. The curved back of the vat allows the falling fabric to slide evenly in the scouring liquor.

The liquor is heated by means of an open ended steam pipe which is positioned in the narrow front chamber. To commence scouring a concentrated solution of scouring liquor is added to this chamber. The scouring liquor diffuses or mixes through the perforated plate into the main bulk of the scouring liquor and so scouring of the fabric commences. From time to time addition of scoring liquor and other assistance are made in the front narrow chamber so that they mix evenly into the main scouring liquor. The liquor is heated usually 60ºC to 90ºC and it depends upon the material. Scouring is continued for 20 to 80 minutes and it depends upon the material and then the usual rinsing in cold water. Then the material is removed from the machine.



Chemicals used to scour 100% polyester and 100% Rayon Fabrics:
1. Soda Ash - 1-2gm/litre
2. Detergent - 1 -2gm/litre
3. Temperature - 60 to 70ºC
4. Time - 30 minutes.

Chemicals used to Scour Acetate Rayon:
1. Detergent - 1 gm/liter
2. Temperature - 85ºC
3. Time - 30 minutes.

Chemicals used to Scour polyester cotton Blends:
1. Soda Ash - 0.5 – 1%
2. Detergent - 0.2 – 0.5%
3. Temperature - 100ºC
4. Time - 60 - 90 minutes.

1. Sodium Hydroxide - 0.2 – 0.5%
2. Detergent - 0.2 – 0.5%
3. Temperature - 75ºC
4. Time - 60 – 90 minutes.

If winch machines used for scouring, when the fabric is in rope form, the condition of scouring liquor is milder than those use on the jigger in order to avoid the formation of permanent creases. The temperature is below 75ºC and concentration of soda ash or caustic soda and detergent are half of those used on jigger.

HIGH TEMPERATURE DYEING

The temperature above 100ºC is referred to as High Temperature dyeing method and the dyeing carried out above this temperature is referred as H.T.H.P method. In a closed system containing aqueous bath high temperature is always accompanied by high pressure. The latter can however be attained without the former. In a machine high pressure can be obtained by pumping compressed air without any change in temperature. Hence the tem high pressure dyeing is rather misleading whereas high temperature (HT)dyeing is the correct term to signify dyeing about 100ºC.

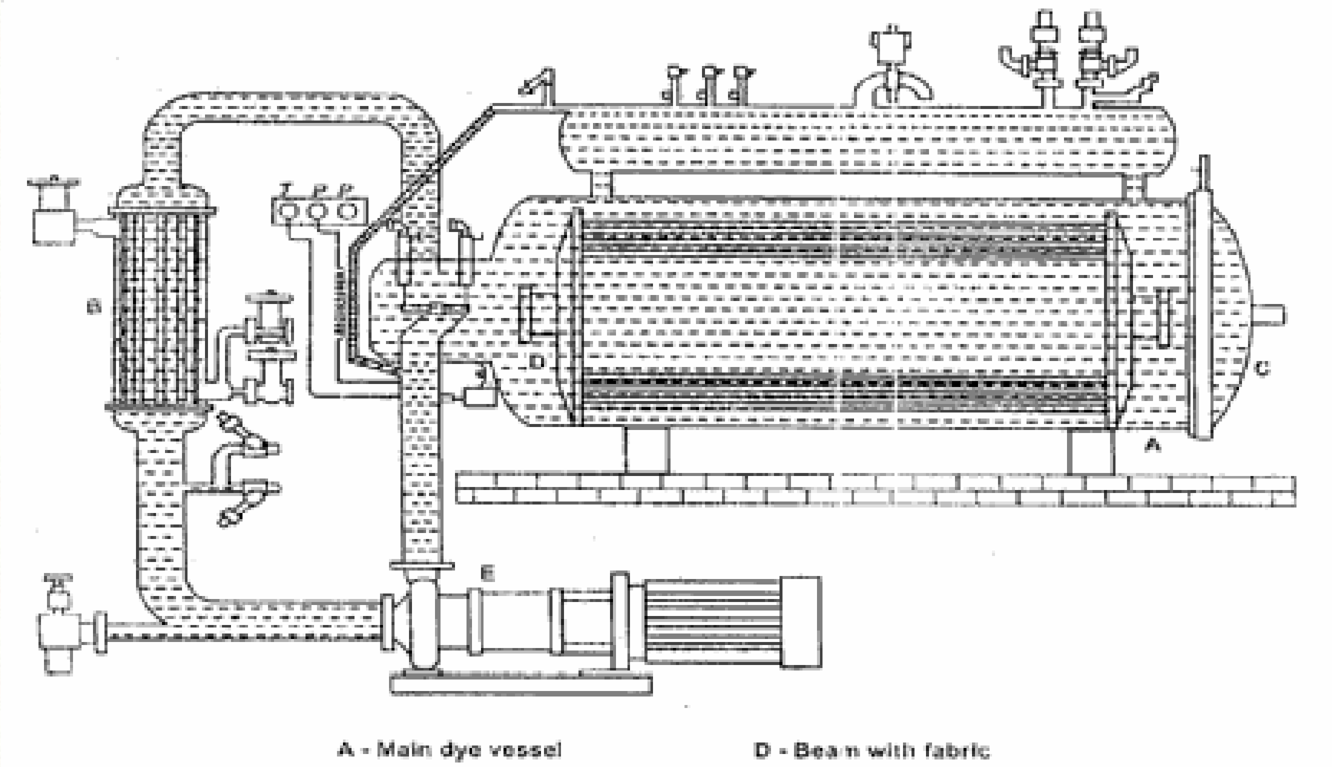
Polyester fibre and their blends with cellulosic fibres may be dyed under high temperature conditions 125ºC to 135ºC but generally at 130ºC above 100ºC the fibres swell to a greater extent. The molecules of the fibre gain energy to move about vigorously so that the spaces between them are enlarged for short interval of times, which are also quite energetic at these temperatures, are able to enter these spaces and penetrate the entry of dye molecules inside the fibre. There is decreased resistance to the diffusion of the dye molecules at 130ºC that at 100ºC. The disperse dye is much more soluble in water soluble in water at a higher temperature than it is below 100ºC and this increased solubility of the dye in water also facilities the dyeing process. While protein and cellulosic fibres contain a greater number of hydrophilic groups (hydroxyl, amino etc.), which cause greater swelling of the fibre when entered into hot water, the polyester fibres (except for a few carboxyl and hydroxyl groups) contain no hydrophilic groups and therefore they swell to a relatively small extent below 100ºC. It is necessary that the sites for reception of the dyestuff molecules be firmly held together so that the thermal action shall produce movement of the macro-molecular chains to provide sufficiently large free space into which the dyestuff molecule can diffuse. A dyestuff molecule, highly charged with energy can force itself into a fibre when its energy content is sufficient to permit it to push and the long chain molecules of the fibre, when they stand in their way. Diffusion of the dye in the fibre can take place when the energy content of the dye molecule is temporarily sufficient to overcome the attraction existing between the dyestuff and the fibres.

Precautions to be taken during thigh temperature dyeing:

Some precautions, however, are necessary in high temperature dyeing. For example the dye bath should not be alkaline as it affects the polyester fibre especially at elevated temperature and loss of strength of the fibre may result. Alkalinity also decreases the percent exhaustion of some disperse dyes and decomposed others. The safe pH- region is 4.5 to 6, which can be maintained by adding acetic acid or sodium or potassium dehydrogenates phosphate.

Dyeing of Polyester fabric using High Temperature Dyeing Method:

The batch of the fabric is entered into the autoclave and the vessel filled with water. Complete removal of air should be ensured before starting the actual dyeing process.



The dye bath is set at 50ºC with 1 g/1 dispersing agent 0.5g/1wetting agent and 0.5-1.0 g/1 leveling agent if required. The PH of the bath is adjusted at 5-6 with acetic acid. The liquor is circulated through the beam for 15 minutes at 50ºC. The dyestuff is pasted and then dispersed in water (10 to 20 times of its weight) at 40 - 50ºC (or as per manufacturer's instructions) and added to the bath through a sieve. After adding the dye to the bath it is circulated at 50ºC for 5 minutes to ensure uniform distribution. The temperature is raised to 90-95ºC within 10 minutes. The increase in temperature from 95ºC to 110ºC should be very slow and uniform as it is the critical zone for the dyeing of polyester fibre. The dye uptake and levelness depends very much on the rate of increase of temperature during this zone.

Mostly the rate of increase is fixed at half a degree per minute and it takes about 30-40 minutes attaining the temperature of 110ºC from 90-95ºC. The dyeing is continued for 30 minutes at this temperature which is then raised at 125-130ºC and dyeing continued for 30-45 minutes. As the temperature rises, pump pressure should be slightly higher than static pressure to prevent cavitations in the pump, and any air entrapped in the dyeing chamber should be removed. The direction of liquor circulation is most of the cases as inside-out during the whole dyeing cycle so that the position of the fabric is not distributed. But with tightly woven fabrics liquor circulation is comes in both the directions as 7 minutes inside-out and 3 minutes outside-in. It is claimed that the latter process gives more uniform results. But at the same time, there are chances of the position of fabric being disturbed. It is due to the dyer to standardize conditions which suit their requirements by trial and error method. After dyeing at 125º - 130ºC for the required time a sample is taken out for shade matching and if necessary, the addition of dyestuff made after the dye bath cooled to 80- 92ºC so that uneven dyeing is avoided. After every addition dyeing should be done at leastfor 15 minutes at dyeing temperature. In completion of dyeing, the bath should be dropped without cooling because below 90-95ºC large crystals of dye are formed resulting in poor rubbing fastness. If necessary, pressure can be raised to allow the dye bath to expel rapidly. Dropping the both in this way gives cleaner dyeing with good rubbing fastness particularly in medium and heavy shades. After dyeing is complete the material is rinsed and subjected to reduction clearing.

Reduction Clearing:

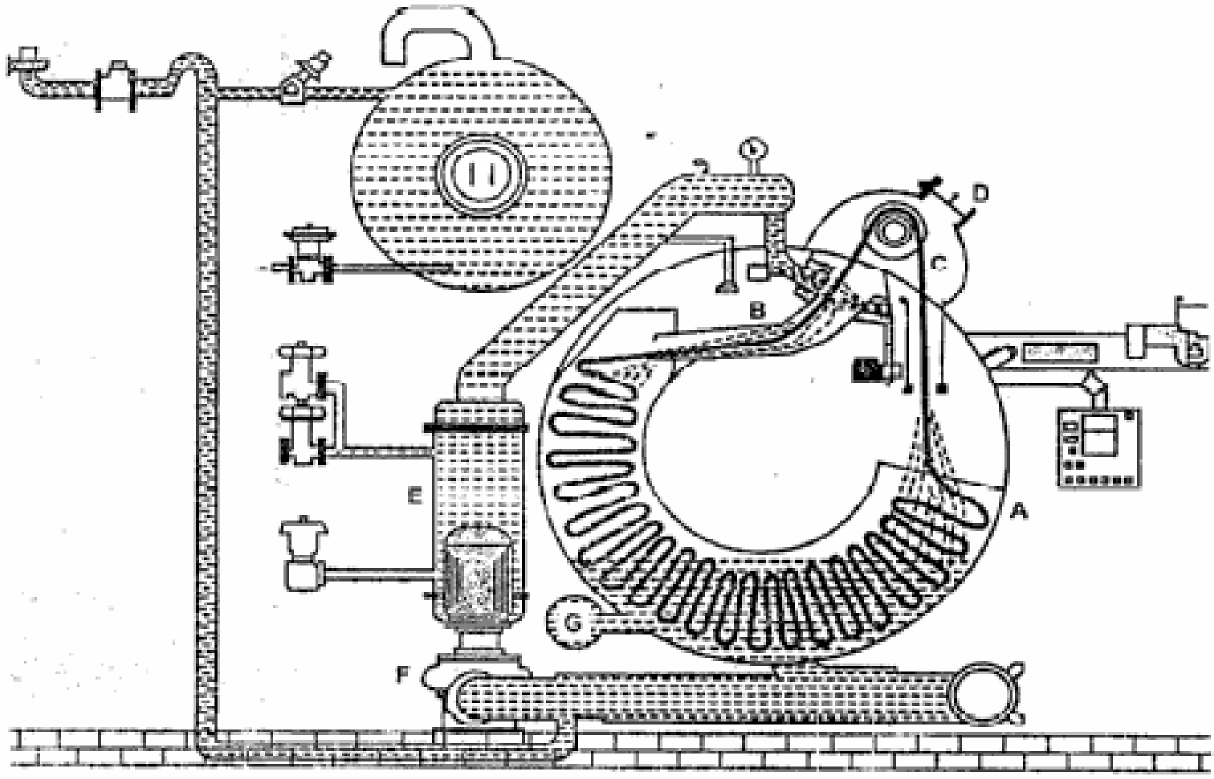
This treatment given after dyeing to remove unfixed dye from the fabric is carried out with caustic soda (1 g/lit) and sodium hydrosulphite (1 g/lit) at 60ºC for 20-30 minutes.

Advantages of high temperature dyeing:

1. Dyeing times are frequently shorter. This is achieved by faster diffusion of the dye in the fibre at elevated temperature.
2. The fastness to light and wet treatment is usually higher in this case, again due to superior penetration of the dye in the fibre.
3. Better exhaustion and deeper dyeing can be produced in the high temperature dyeing method.
4. The possible faults of carrier dyeing (mainly the effort of the residual carrier on the light fastness) are absent.
5. There is a saving on the cost of the carrier and allied chemicals (emulsifiers) as they are not required.
6. Dyeing temperature above 100 ºC causes a great increase in the rate of absorption of dye giving high exhaustion in shorter time. This results in saving of dyestuffs and chemicals to the extent of 50%.
7. Improved leveling is obtained because disperse dyes tend to migrate more readily at these temperatures.
8. High cost of the machine is the major drawback of this method.

JET DYEING MACHINE:

Pre-set cloth is loaded into the machine. The cloth is pulled by the action of jets to the interior of the machine. The material is first scoured at 60ºC with 0.5 g/1 tetra sodium pyrophosphate and 0.5ºC/1 anionic non-forming agent for 10 minutes to remove oily impurities from the goods which are then washed for 10 minutes at 60ºC. The PH is adjusted with other additives, the pressure pump activated and the bath circulated at 80ºC for 10 minutes. Now disperse dye is added followed by the addition of a carrier, ifrequired. The bath is heated at a rate of 2.5ºC /minute to 120ºC. The dyeing is carried out at this temperature for 45 minutes. The bath after cooling at 80º - 85ºC is drained off and the fabric washed.



A - Main dyeing vessel
B - Jet
C - Reel
D - Slight window
E - Heat exchanger
F - Circulation pump
G - Dye liquor

An important aspect of the dyeing is keeping the load reasonably well distributed along the length of the time. If the goods are packed in rear end of the tube, they will crease and trap the loading and resulting in the total stoppage of the fabric movement. On the other hand, if the goods are packed in the front of the tube looping of the fabric on itself may occur thereby jamming the mouth of the tube.

PAD DYEING

In the process of semi-continuous dyeing that consists of pad-batch, pad-jig, pad-roll the fabric is first impregnated with the dye-liquor in, what is called a padding machine. Then it is subjected to batch wise treatment in a jigger. It could also be stored with a slow rotation for many hours. In the pad-batch this treatment is done at room temperature while in pad-roll it is done at increased temperature by employing a heating chamber. This helps in fixation of the dyes on to the fiber. After this fixation process, the material in full width is thoroughly cleansed and rinsed in continuous washing machines. There is only one point of difference between Continuous and semi-continuous dyeing process is that in semi-continuous dyeing, the dye is applied continuously by padding. The fixation and washing remaining discontinuous. Liquor Ratio in semi-continuous dyeing is not of much importance and is not taken as a parameter. One of the widely used techniques for semi-continuous dyeing process is the Pad Batch Dyeing a schematic diagram is given here for the semi-continuous dyeing process.

Pad Batch Dyeing

Pad Batch Dyeing is one of the widely used technique for semi-continuous dyeing process. It is mainly used in the dyeing of cellulosic fibre like cotton or viscose (knit and woven fabric) with reactive dyes. Pad batch dyeing is a textile dyeing process that offers some unique advantages in the form of versatility, simplicity, and flexibility and a substantial reduction in capital investment for equipment. It is primarily a cold method that is the reason why it is sometimes referred to as the cold pad batch dyeing.

Working of a Cold Pad Dyeing Process

The technique or process used in pad-batch dyeing starts with saturating first the prepared fabric with pre-mixed dye liquor. Then it is passed through rollers. The rollers, or padders, effectively forces the dyestuff into the fabric. In the process, excess dye solution is also removed. After removal of excess dye stuff the fabric is subsequently "batched". This batching is done by either storing it in rolls or in boxes. It takes a minimum of 4-12 hours. The batches are generally enclosed by plastic films. This prevents absorption of carbon dioxide and water evaporation. Finally as the reaction is complete the fabrics are washed. This is done by becks, beams, or any other washing devices.

Special Features of Pad Batch Dyeing Process

- Significant cost and waste reduction as compared to other conventional dyeing processes.
- Total elimination of the need for salt and other specialty chemicals. For example there is no need for anti-migrants, leveling agents and fixatives that are necessary in conventional dyebaths.
- Optimum utilisation of dyes that eliminates specialty chemicals, cuts down chemical costs and waste loads in the effluent. All this results in a formidable reduction in wastewater treatment costs.
- Excellent wet fastness properties.
- Pad batch dyeing cuts energy and water consumption owing to low bath ratio (dye:water) required for the process. This is because unlike other dyeing processes it does not function at high temperatures.
- A uniform dye quality is achieved with even color absorbency and colour fastness.
- As compared to rope dyeing, Pad batch dyeing produces much lower defect levels.
- In pad batch dyeing, qualities like high shade reliability and repeatability are common. This is because of high reactivity dyes with rapid fixation rate and stability.
- Lastly Pad batch dyeing can also improve product quality. The fabric undergoing the cold pad batch dyeing process is able to retain an uniformly coloured appearance. It shows added luster and gives a gentle feel. The fabric gives a brighter look in shades.

Pading Mangles

The pad dying machines overcome the deficiency of coinch and jigger dyeing m/c of small batch size and discontinuity in dying. Padding mangle offer continuous process of the fabric in concerned Liquor such as pretreatment dyeing or flushing. Application of dye stuffs is conducted in the pad dyeing machines with single or multiple dipping in solution.

During pad dug the fabric passes into a solution of chemicals, under a submerged roller and out of the batch. It is then squeezed to remove excess solution. The objective of this process is to mechanically impregnate the fabric with solution or dispersion of chemicals pad impregnation is common for the dyeing of fabric and for the application of crushing chemicals machines Description.

Main pair of the padding Mangle

The mainframe: The frames are usually fabricated construction, to withstander vibrations and heavy loads.

Tension elements

While the cloth passes on to the padding machines no slackness should occur in fabric either in warp or welfdirections,and the weft threads of cloth should remain parallel to the nip at the squeezing point.

The padding mangles bowls

The mp rollers often called as pows are the key to successful pad dyeing.Ingeueral too bold nips are preferred for light wight are standard fabrics running at moderate speeds,whereas three bowl arrangements are intendesd for heavier or more obviously woven qualities that may be more difficult wet out and thus requires dup and double nip treatment.

Cloth guiding arrangements

These are provided so that machines should have a universal feeding and delivery system at a uniform tenscon.

Pressure generation and applications

It is either pheumatic or hydraulic that dye trough

The pad trough is usually are deep U shaped vessel with a single roller attached to the base of a displacement block that leaves an narrow passage to accomadate the moving fabric.

Dyeing method

The padding operation itself consists of two essential steps.

Through implementations and immensions of the absorbent fabric in a dye solution containing a wetting agent followed by squeezing of the wet fabric between rollers to expel air end replace it with dye Liquor as well as expressing surplus Liquor back docon the sloping fabric surface to the pad trough.

The cloth to be padded is taken up by either from the folded form or from the batched condition and fed to the padding machines over as set of guide rollers.The fabric as straighter in warp as well as weft direction.It is necessary to attach and end piece on both side of the batch.

The fabric to be padded should be pretreated free from loose,fly,waste,matter,flat crease free and with opened selredges.

To obtain Consistency of shade it is most important that fabric running speed and the length of immersion of fabric in the dye liquor remain constant throughout the padding run 3 main types of automatic level control are

1. float switches-these are reliable and unaffected by foam but they are relatively bulky.

2. Conductivity probes-these are small and neat but foaming of the pad Liquor adversely affects their performance

3. Differntiate pressure Detectors-these are with hollow tube projecting downwards from Liquor surface are difficult to clean preffered type is that with a closed diaphragm set in the base of the vessel.

4. The control of pad Liquor temp is highly desirable to achieve consistent results

PADDING MANGLES:

Padding mangles consists of a small trough containing dye liquor and a set of squeezing bowls.The cloth is passes in full width through the dye liquor and the excess solution is removed. By passing it through the squeezing bowls.

Advantages:-

1. Used for light and medium shades.
2. continuous process
3. high speed
4. dyeing is very cheap
5. low mil ratio
6. low steam consumption
7. low chemical consumption
8.

TYPES OF PADDING MANGLES:-

1. Two bowl padding mangle:-

   It consists of two squeezing bowls. The upper one is made of iron covered with subbed. The lower one is made of brass. The bowls are arranged over a shallow trough containing the dye liquor with 2-3 guide rollers.

2. Three bowl padding mangle:-

   It consists of three bowls. The middle one is rubber covered. And upper and lower bowls are made of brass .The cloth gets two dips and two nips i.e the cloth is immersed twice the dye. Liquor and squeezed twice.

3. Improved mangles:-

   It works on two basic principles.

   1. De aeration of the cloth
   2. Small trough the trough being formed by bowls themselves.

4. Fibe mangle:-

   It is an improved mangle. It consists of four bowls (two soft and two hard) arranged in two pairs. Each makes contact with two anothers. The liquor is enclosed by the four bowls two form trough. The end is close by two rubber cover. When the cloth enter into the machine. It gets squeezed then it's desecrated. Then its immersed in the dye. Liquor and squeezes three times .so the dye penetration more in mangle

FABRIC DYEING MACHINE:

Much the greater portion of textile materials is dyed in the form of fabric, which may be woven or knitted. There is good reason for preferring to dye the fabric rather than loose fibre and yarn the material may be disturbed in some way so as to hinder or make more difficult sub-sequent, manufacturing operation such as spinning, weaving and knitting. But the main reason is that, by delaying the dyeing to the fabric stage, a decision as to the color can be left as late as possible enabling fashion trends to be followed more closely.There is further reason that is generally cheaper to dye textile materials in fabric form.
Fabrics can be dyed in dye liquor circulating machine such as are used for the dyeing of loose fibre and yarn, but it is not easy in this way to ensure the production of level dyeing, so fabric is almost universally dyed in winch or jigger dyeing machines, which have today been brought to a high stage of perfection. The jigger dyeing machine is not suitable for the dyeing of knitted fabrics, but the winch machine can be used for both woven and knitted fabrics. There are certain fundamental differences between these two types of dyeing machines. These machines are also constructed of stainless steel.The speed of the machine should be adjusted according to mature of the material to be dyed. Obviously, the greater the amount of movement, the more uniform will be the dyeing. With wool fabrics hoever excessive movement causes undesirable felting or shrinkage. With wool therefore a slow-running machine is to be recommended, hearing in mind always that excessive speed will load to un leveled dyeing.In the printing operation the following features are to be observed. Finally all the printing rollers are brought into registration with the aid of end box-wheels, so that each will impart its color pattern at the correct position on the fabric being printed and make its own particular contribution to a clear, multi-colored pattern.

Then the machine is set in motion by driving all the printing rollers each of which is turn drives its own color furnishing roller, the central pressure cylinder rotates through the pressure of the printing rollers upon it, whilst both the fabric to be printed and its back-grey move through the machine and are given resilient support by the endless woolen blanket moving in a closed circuit. The fabric becomes printed with a multi-colored pattern and is drawn away from the machine with the back-grey to be separated and dried. Printing in this manner can be continued to produce many thousands of yards of patterned fabric. The printing must be observed constantly so that any faults which develop can be corrected. From time to time the color, boxes must be filled with color paste and the lint scraped off the printing roller by the lint doctors must be removed to prevent undue accumulation. The result of the above printing operation is that a large amount of printed fabric is obtained with a corresponding amount of back-grey.

This back-grey must be separately washed and dried so as to be suitable for re-use. From time to time the woolen blanket must also be washed free from color strains and so that it may retain as its resilience, but by careful use of back-grey it is possible to use a blanket for the printing of 10,000 or more pieces of fabric before it needs to be washed. In recent years increasing use has been made of rubberized these special forms of blanket substitutes have the advantages of being cheaper, more over resistant to attack by any chemicals used in the printing pastes and easier to wash.

The back-grey (consisting of unbleached cloth) are washed after a suitable period of use they can be scoured and then converted into printed cloth.It should be noted that, while the lint doctor remains stationery pressing against the printing roller, the cleaning doctor (color doctor) is given a periodic traverse motion across the surface of the printing roller so as to equalize its action.When multicolored pattern is being printed each roller provides a part of the pattern in each color when one part is printed and the second roller makes an impression on the cloth with its color a part of the paste already printed by the first roller is picked up by the smooth surface. (UN engraved) of the second roller. Since this likely to enter its color box and spoil the printing paste contained in it, the doctor scrapes this color from the smooth surface of the second engraved roller and prevents the contamination of the paste contained in the second color box.

GARMENT DYEING

Garment dyeing is the dyeing of the completed garments. The types of apparel that can be dyed are mostly non-tailored and simpler forms, such as sweaters, sweatshirts, T-shirts, hosiery, and pantyhose. The effect on sizing, thread, zippers, trims and snaps must be considered. Tailored items, such as suits or dresses, cannot be dyed as garments because the difference in shrinkage of the various components and linings disort and misshape the article.

Garment dyeing is done by placing a suitable number of garments (usually about 24 sweaters or the equivalent, depending on the weight) into large nylon net bag. The garments are loosely packed. From 10 to 50 of the bags are placed in large tubs containing the dye bath and kept agitated by a motor – driven paddle in the dye tub. The machine is appropriately called a paddle dryer.

Garment dyeing is the process of dyeing fully fashioned garments (such as pants, pullovers, t-shirts, jeans, sweaters, dresses, bathrobes, casual jackets, shirts, skirts, hosieries) subsequent to manufacturing, as opposed to the conventional method of manufacturing garments from pre-dyed fabrics. Most garments are made of cotton knit goods and/or cotton woven fabrics.

Although several other fabrics can be found in the whole or in part such as wool, nylon, silk, acrylic, polyester and others. Due to cost savings and fashion trends, garment dyeing has been gaining importance and popularity in the past years and will continue to do so in the future.

Objectives of Garment Dyeing

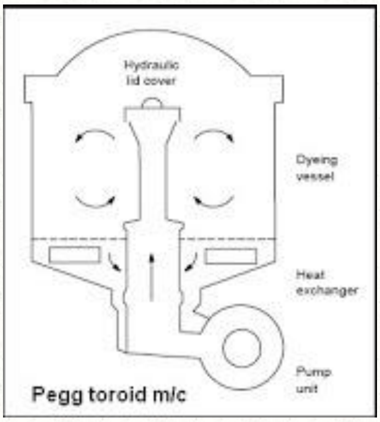
- Traditionally, garments are constructed from fabrics that are pre-dyed (piece dyed) before the actual cutting and sewing.
- The advantage of this process is the cost effectiveness of mass producing identical garments of particular colors.
- A major drawback with this approach is the risk associated with carrying a large inventory of a particular style or color in today's dynamic market.

Garment Dyeing Machines

Paddle machines and rotary drums are the two types of equipment regularly used for garment dyeing. Rotary drum machines are sometimes preferred for garments, which require gentler handling, such as sweaters.

A high liquor ratio is required for paddle machines, which is less economical and may limit shade reproducibility. Many machinery companies have developed sophisticated rotary dyeing machines, which incorporate state-of-the-art technology.

TOROID DYEING MACHINES



Toroid Dyeing Machines

In these machines the garments circulate in the liquor in a toroidal path with the aid of an impeller situated below the perforated false bottom of the vessel. Movement of the goods depends completely on the pumped action of the liquor. High-temperature versions of this machine operating at 120 to 130°C were developed in the 1970s for dyeing fully-fashioned polyester or triacetate garments. The liquor ratio of such machines is about 30:1.

Advantages of Garment Dyeing

1. Handling of smaller lots economically
2. Enables various special effects to achieved
3. Distressed look can be effectively imparted
4. Unsold light shades can be converted into medium and deep shades

By the time the garment has been in a boiling dye bath and then tumble-dried, it will have adopted its lowest energy state and will not suffer further shrinkage under consumer washing conditions Latest fashion trends can be effectively incorporated through garment wet processing by immediate feedback from the customer

Disadvantages of Garment Dyeing

1. High cost of processing
2. A little complicated dyeing

Garment accessories like zips, buttons, etc impose restrictions. The garments produced from woven fabrics create many problems and it has been found that the existing textile treatment styles as developed for piece dyed fabric cannot be just assembled for garment **wet processing** operation such as garment dyeing, unless they have been engineered from the original design stage for garment dyeing.

The factors governing processing of ready-made garments are

- Sewing Thread
- Metal Components.
- Shrink behavior
- Accessories

POINTS TO BE REMEMBER:

- Dyeing is the process of coloring textile materials by immersing them in an aqueous solution of dye, called dye liquor.
- These colors are known as substantive dyes or Salt dyestuffs or even simply cotton colors. The colors are well known for its use in dyeing cellulose fibres like cotton, viscose rayon, animal fibres such as wool and silk
- The Acid dye stuff is so called mainly due to two reasons. In the first place these classes of dyestuff were applied in a bath containing mineral or organic acids like sulphuric,acetic or formic acid and secondly most of them are sodium salts of organics acids
- Basic dyes are called so since they are salts of organic bases.
- Basic dyes are also called cationic dyes because in solution the basic dye molecule ionizes, causing its colored component to become an action of positively charged radical. Basic dyes are used for dyeing wool, silk, and acrylic and modacrylic fibres.
- The name Vat was derived from the large wooden vessel from which the Vat dyes were first applied. Vat dyes provide textile materials with the best color fastness of all the dyes in common use. The fiber most readily colored with Vat dyes are the natural and man made cellulose fibres of cotton, viscose rayon.
- Garment dyeing is the dyeing of the completed garments. The types of apparel that can be dyed are mostly non-tailored and simpler forms, such as sweaters, sweatshirts, T-shirts, hosiery, and pantyhose.

EXPECTED QUESTIONS:

Section A

1. Dyeing is the process of coloring textile materials by immersing them in an aqueous solution of dye, called ___________.
   a. dye liquor   b. printing paste   c. Both a & b   d. none
2. _____________ dyes are the salts of organic bases
   a. basic   b. direct   c. vat   d. none

Section B

1. Define dyeing?
2. What are the different types of dyes?
3. What is the source of dye stuffs?
4. Write about dyeing carried out.

Section C

1. Write about classifications of colourants?
2. Write about the fiber dyeing machines
3. What are the fabric dyeing machines?
4. Discuss about the garment dyeing machines?