Daffodil International University

Dhaka, Bangladesh

PROJECT REPORT

ON

"POLYESTER/COTTON FABRIC BLENDS DYEING"

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This Report Presented By Partial Fulfillment of the requirements for the Degree of Bachelor of Science in Textile Engineering.

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APPROVAL

This project titled “Polyester/Cotton Blends Dyeing”, submitted by **Md. Mostafa Kamal** & **Md. Tohidur Rahman** of the department of textile engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Textile Engineering and approved as to its style and contents.

ACKNOWLEDGEMENT

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At last, we like to acknowledge our parents for their blessing, support & love and all my friends to their help & support to complete the report.

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DECLARATION

We hereby declare that, this project has been done by us under the supervision of

Dr. S. M. Mahabub-Ul-Haque Majumder, Professor, Department of Textile Engineering, Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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ABSTRACT

This project is on “Blend Dyeing on Cotton/Polyester fabric with disperse & reactive dye”.

This is a dyeing process where polyester part with disperse dye and cotton part with reactive dye.

The experiment was conducted in the laboratory of DIU, Department of TE & lab of NTL. The aim of this project is to dye the fabric with disperse, carrier method & reactive at60 degree centigrade in textile processing.

‘The use of salt & soda makes the effluent toxic for the environment. In conventional method of dyeing on cotton fabric with reactive dyes, alkali pH should be maintained in bath. This method requires more electrolytes for exhaustion and fixation.

In this project, fiber modification technique based on polyacryl amide has discussed. Color fastness test is done after dyeing the cotton & polyester fabric. It is to be hoped that by the end of this thesis paper the reader will have a better idea about “Blends dyeing 0n cotton/polyester fabric with disperse & reactive dyes”.

INTRODUCTION

In current practice, cellulosic fibers are predominantly dyed with reactive dyes in the presence of a considerable amount of salt and fixed under alkali conditions. However, dye fixation efficiency on cellulosic fibers is generally low (varying from 50-90%). This results in a highly colored effluent, which is unfavorable on environmental grounds. Furthermore, the high concentrations (40-100 g/l) of electrolyte & alkali (5-20 g/l) required in cellulose fiber dyeing may pose additional effluent problems.

In this work, a new fiber – modification technique based on cationic acrylic copolymer is used. Pretreatment of cellulosic fiber with polymer is believed to offer an opportunity for increasing both the substantively and reactivity of fibers towards reactive dyes under neutral conditions. The nature of a reactive polymer resin is such that it may react with nucleo-philic sites in cellulosic fibers or in the polymer itself, thus fixing the polymer to the substrate. During subsequent dyeing, further reactions between the polymer and the dye stuff, and the fiber and the polymer and can be expected to take place, forming crosslink within the fibers.

CHAPTER 1

LITERATURE REVIEW

1.0 Cotton:

Cotton is a cellulosic fiber. Cotton is used as a fiber because it has a large amorphous portion which makes the fabric comfortable. It is also soft when properly ginned and has a high absorbency power hence making it easy to use for dyeing. It is also said to have good strength and good drape ability.

1.2 Characteristics of Cotton:

- Comfortable Soft hand
- Good absorbency
- Color retention
- Prints well
- Dry-cleanable
- Good strength
- Drapes well
- Easy to handle and sew

Fig: Cotton Fiber

1.3 Cotton Fabric:

Cotton is a natural fiber that comes from the seedpod of the cotton plant & is used to make many fabric types at every price point. The fiber is hollow in the center and under the microscope, resembles at twisted ribbon.

Fig: Cotton Fabric

1.4 Physical Properties of Cotton:

Color: The color of cotton fiber could be white, creamy white, bluish white, yellowish white or grey.

Tensile Strength: Cotton is moderately strong fiber; tenacity is 26.5-44.1 cN/tex and tensile strength 2800-8400 Kg/cm^2. The strength is greatly affected by moisture; the wet strength of cotton is 20%, which is higher than dry strength.

Elongation at break: Cotton does not stress easily. It has an elongation break of 5-1%.

Elastic Recovery: Cotton is inelastic and rigid fiber. at 2% extension it has an elastic recovery of 74% and at 5% extension the elastic recovery is 45%.

Specific Gravity: Specific gravity is 1.54

Moisture Regain: Standard moisture regain is 8.5%.

Effect of heat: Cotton has an excellent resistant to degradation by heat. It begins to turn yellow after several hours at 120°C and decomposes marked by at 150°C. As a result of oxidation, cotton is severally damaged after few minutes at 240°C. Cotton burns in air.

Effects of Age: Cotton shows a small loss of strength when stored carefully. After 50 years of storage cotton may differ only slightly from the new fibers.

Effect of Sun Light: There is gradual loss of strength when cotton is exposed to sun light and the fiber turn yellow. The degradation of cotton by oxidation is done when heat is promoted and encouraged. By sun light much of the damage is caused by UV-light and by the shorten weaves of visible light.

1.5 Chemical Properties of Cotton:

Effects of Acids: Cotton is attacked by hot dilute acids or cold concentrated acids which it disintegrates. It is not affected by cold weak acids.

Effects of Alkalis: Cotton has an excellent resistance to alkali. It swells in caustic alkalis but does not damage. It can be washed in soap solution without any problem.

Effects of Organic Solvents: Cotton has high resistance to normal cleaning solvents. Cotton is dissolved by the copper complexes, such as cupper ammonium hydroxide, cupperiethylenediamine and concentrated 70% $H2SO_4$.

Effects of Insects: Cotton is attacked by moth-grubs or beetles.

Effects of micro Organism: Cotton is attacked by fungi and bacteria. Mildew will feed on cotton fabric, rotting and weakling the materials. Mildews and bacteria will flourish on cotton under hot and humid condition. They can be protected by impregnation with certain types of chemicals. Copper Nepthenate is one of the chemicals.

1.6 Polyester Fabric:

Polyester is a strong and durable synthetic fabric. Polyester dries quickly and can be washable or dry clean only, so check your tags. Polyester is often used as a blend with other fabrics to lend wrinkle resistance. It is not the easiest fabric to remove stains from, and doesn't breathe as well as other fabrics may.

Fig: Polyester Fabric

1.7 Characteristics of polyester:

- Polyester fabrics and fibers are extremely strong.
- Polyester is very durable: resistant to most chemicals, stretching and shrinking, wrinkle resistant, mildew and abrasion resistant.
- Polyester is hydrophobic in nature and quick drying. It can be used for insulation by manufacturing hollow fibers.
- Polyester retains its shape and hence is good for making outdoor clothing for harsh climates.
- It is easily washed and dried.

1.8 Physical and Chemical Properties of polyester:

Physical Properties:

- The weight of polyester is 1.22-1.38 g/cm3
- It is able to hold forms very well, allowing more things to be made from polyester.
- It can be wet or dry and still remain strong and it dries very quickly.
- Very resistant to stretching and wrinkling. That is why it is widely used in manufacturing clothing.
- Polyester is very resistant to shrinking
- Resistant to abrasion (which means to wear something out by rubbing away or by friction, and by mildew which is a form of fungi) Colorless.
- Transparent (reason for most water bottles are colorless and transparent being made form polyester.)

Chemical Properties:

- When burned, polyester gives off a strong odour.
- The molten residue can cause many harmful burns when it comes in contact with human skin.
- Polyester melts at a temperature of 249-288° C

1.9 Uses of Polyester:

1. Woven and Knitted Fabrics especially blends.
2. Conveyor belts, type cords, tarpaulines etc.
3. For filling pillows
4.For paper making machine
5.Insulating tapes
6. Hose pipe with rubber or PVC
7. Ropes, fish netting and sail cloth.

1.10 Reactive Dye:

A dye, which is capable of reacting chemically with a substrate to form a covalent dye substrate linkage, is known as reactive dye.
Here the dye contains a reactive group and this reactive group makes covalent bond with the fiber polymer and act as an integral part of fiber. This covalent bond is formed between the dye molecules and the terminal –OH (hydroxyl) group of cellulosic fibers on between the dye molecules and the terminal –NH2 (amino) group of polyamide or wool fibers.

History:

Reactive dyes first appeared commercially in 1956, after their invention in1954 by Rattee & Step heness at the Imperial chemical Industry (ICI). Dyestuffs Division site in Bleckley, Manchetor. UK.

Usages:

- By reactive dyes the following fibers can be dyed successfully:
- Cotton, rayon, flax and other cellulosic fibers.
- Polyamide and wool fibers.
- Silk and acetate fibers.

Trade names:

Trade name	Manufacturer	Country
Procion	I.C.I	U.K
Cibacron	Ciba	Switzerland
Remazol	Hoechst	Germany
Levafix	Bayer	Germany
Reactone	Geigy	Switzerland
Primazin	BASF	Germany
Drimarine	Sandoz	Switzerland

1.11 Properties of reactive dye:

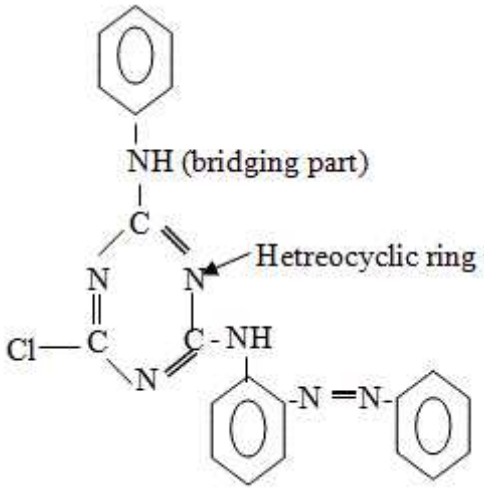
- Reactive dyes are anionic dyes, which are used for dyeing cellulose, protein and polyamide fibers.
- Reactive dyes are found in power, liquid and print paste form.
- During dyeing the reactive group of this dye forms covalent bond with fiber polymer and becomes an integral part of the fiber.
- Reactive dyes are soluble in water.
- They have very good light fastness with rating about 6. The dyes have very stable electron arrangement and can protect the degrading effect of ultra-violet ray.
- Textile materials dyed with reactive dyes have very good wash fastness with rating Reactive dye gives brighter shades and have moderate rubbing fastness.
- Dyeing method of reactive dyes is easy. It requires less time and low temperature for dyeing.
- Reactive dyes are comparatively cheap

- Reactive dyes have good perspiration fastness with rating 4-5.
- Reactive dyes have good perspiration fastness.

1.12 Structure of reactive dyes:

The general structure of reactive dye is: D-B-G-X.

Chemical structure of reactive dyes:



Chemical structure of reactive dyes

Here,

D= dye part or chromogen (color producing part)
Dyes may be direct, acid, disperse, premetallized dye etc.

B = bridging part.
Bridging part may be –NH- group or –NR- group.
G = reactive group bearing part.
X= reactive group.

1.13 Classification of reactive dyes:

Reactive dyes may be classified in various ways as below:
1. On the basis of reactive group:
(a) Halogen (commonly chlorine) derivatives of nitrogen containing hetero-cycle, like 3 types-

I. Triazine group

II. Pyridimine group

III. Quinoxaline dyes

Example:
Triazine derivatives: procion, cibacron.
Pyridimine derivatives: reactone
Quinoxaline derivatives: levafix.

(b) Activated vinyl compound:

I. Vinyl sulphone

II. Vinyl acrylamide

III. Vinyl sulphonamide.

Example:

Vinyl sulphone: remazol

Vinyl acrylamide: primazine

Vinyl sulphonamide: levafix.

2. On the basis of reactivity:
(a) Lower reactive dye:

(b) Medium reactive dye: here pH is maintained 11-12 by using Na_2CO3 in dye bath.
(c) Higher reactive dye: here pH is maintained 10-11 by using $NaHCO_3$ in dye bath.

3. On the basis of dyeing temperature:

(a) Cold brand:
These types of dyes contain reactive group of high reactivity. So dyeing can be done in lower temperature i.e. 32^0-60^0 C.
For example: PROCION M, LIVAFIX E.

(b) Medium brand:
This type of dyes contains reactive groups of moderate reactivity. So dyeing is done in higher temperature than that of cold brand dyes i.e. in between 60^0-71^0 C temperatures.
For example, Remazol, Livafix are medium brand dyes.

(c) Hot brand:
This type of dye contains reactive groups of least reactivity. So high temperature is required for dyeing i.e. 72^0-93^0 C temperature is required for dyeing.
For example PRICION H, CIBACRON are hot brand dyes.

1.14 Dyeing mechanism of reactive dye:

The dyeing mechanism of material with reactive dye takes place in 3 stages:-

a. Exhaustion of dye in presence of electrolyte or dye absorption.
b. Fixation under the influence of alkali.
c. Wash-off the unfixed dye from material surface.

Now they are mentioned below:

Dye absorption:

When fiber is immersed in dye liquor, an electrolyte is added to assist the exhaustion of dye. Here Nacl is used as the electrolyte. This electrolyte neutralizes absorption. So when the textile material is introduces to dye liquor the dye is exhausted on to the fiber.

Fixation:
Fixation of dye means the reaction of reactive group of dye with terminal –OH or-NH2 group of fiber and thus forming strong covalent bond with the fiber and thus forming strong covalent bond with the fiber. This is an important phase, which is controlled by maintaining proper pH by adding alkali. The alkali used for this creates proper pH in dye bath and do as the dye-fixing agent. The reaction takes place in this stage is shown below: -

$D\text{-}SO_2 –CH_2 –CH_2\text{-}OSO_3Na + OH\text{-}Cell = D\text{-}SO_2\text{-}CH_2\text{-}CH_2\text{-}O\text{-}Cell + NaHSO_3$

$D\text{-}SO_2\text{-}CH_2\text{-}CH_2\text{-}OSO_3Na + OH\text{-}Wool = D\text{-}SO_2\text{-}CH_2\text{-}CH_2\text{-}O\text{-}Wool + NaHSO_3$

Wash-off:
As the dyeing is completed, a good wash must be applied to the material to remove extra and unfixed dyes from material surface. This is necessary for level dyeing and good wash-fastness. It is done by a series of hot wash, cold wash and soap solution wash.

1.15 Application method:

These are 3 application procedures available:
1. Discontinuous method-

- Conventional method
- Exhaust or constant temperature method
- High temperature method
- Hot critical method.

2. Continuous method-

- Pad-steam method
- Pad dry method
- Pad thermofix method

3. Semi continuous method-

- Pad roll method
- Pad jig method
- Pad batch method.

1.16 Stripping of reactive dye:

The reactive dye cannot be satisfactory stripped from fiber due to covalent bond between dye molecule and fiber. Stripping becomes necessary when uneven dyeing occurs.
Partial stripping:
Partial stripping is obtained by treating the dyed fabric with dilute acetic acid or formic acid. Here temperature is raised to 70^0-100°C and treatment is continued until shade is product of hydrolysis. The amount of acid used is as below: -
Glacial acetic acid: 5-10 parts
with water: 1000 parts
Or
Formic acid: 2.5 to 10 parts
with water: 1000 parts
Temperature: 70 - 100°C
Time: until desired shade is obtained.

1.17 Different methods of reactive dye application:

1) Pad-batch method.
Pad batch processes are of two types-

a) Pad (alkali)-batch (cold) process.
b) Pad (alkali)-batch (warm or hot) process.

2) Pad dry method
3) Pad steam method.

1.18 Disperse Dye:

Introduction:

Dyeing of natural fibers such as cotton, wool, silk etc, which are hydrophilic in nature, are done by direct, acid, vat, sulphur etc.Dyes which are water soluble or made soluble by reduction. When hydrophobic fibers made their appearance, soon after First World War, faced a problem in dyeing as the — OH group has been blocked by — $COOCH_3$ group. Therefore affinity for dyes has been checked. Scientists took attemps of creating new dyes and developed acetate dyes or disperse dye. The term disperse dyes means free from ionizing groups, low water solubility and are suitable for dyeing hydrophobic fibers from colloidal dispersion.

Disperse Dye:

A dye that is almost totally insoluble in water. Disperse dye exist in the dye bath as a suspension or dispersion of microscopic particles, with only a tiny amount in true solution at any time. They are the only dyes that are effective for "Normal" polyester. Some types are used for Nylon and Acetate. Polyester is dyed with disperse dyes by boiling with carrier chemicals or by heating the liquor to about 130°C which requires elevated pressure (Like a pressure cooker), Thermsol dyeing,
Where the fabric is padded with dye liquor then dried and heated to about 200°C for about 90 seconds, is also used for polyester and for coloring the polyester component of poly-cotton blends. Disperse dyes are also used for sublimation printing of synthetic fibers and are the colorant used in crayons and inks sold for making "Iron-ON" transfers.
The first dyes for cellulose acetate fibers were water soluble. The dye molecules contained a methyl amino sulphonate group (-$NHCH_2SO_2Na$) introduced by reaction of a primary amino group with formaldehyde and sodium bisulphate (Ionamine dyes, 1922). During dyeing, this group hydrolyzed to the less soluble parent amine (on figure-01).

$$Dye\text{-}NH\text{-}CH_2\ SO_3Na\ (aq) + H_2O \rightarrow DyeNH_2(s) + CH_2O(aq) + NaHSO_3(aq)$$

It was soon recognized that it was this compound that the cellulose acetate absorbed. The first true disperse dyes were simple, relatively insoluble azo and anthraquinone compounds dispersed in water using the sodium salt of sulphatedricinoleic acid (on figure-02).

Dye(s) ↔ Dye (aq) ↔ Dye (fiber)

Many of these dyes are obsolete but their development provided the technology for preparing fine aqueous dispersions by grinding the dye with dispersing agents. A fine dispersion is essential for rapid dyeing and avoids deposition of larger dye particles on the material.

1.19 Classification of Disperse dye for Polyester:

01. Low energy.

02. Medium energy.

03. High energy.

1. Low Energy Disperse Dye:
Most dyeing and fastness properties change gradually with increase in molecular size. Small dye molecules with low polarity are leveling, rapid dyeing dyes with poor heat resistance. These are called low energy disperse dye.

2. Medium Energy Disperse Dye:
Most of the dyeing and fastness properties change gradually with increase in molecular size. Moderate dye molecules with moderate polarity are leveling, rapid dyeing dyes with moderate heat resistance. These are called medium energy disperse dye.

3. High Energy Disperse Dye:
More polar, higher molecular weight dye has low dyeing rates, poor migration during dyeing but good heat and sublimation fastness. These constitute the high energy disperse dye.

1.20 Selection Properties:

Disperse dyes have some general properties which are given bellow –

- Solubility: Disperse dyes are insoluble in water or slightly soluble in water. It makes fine dispersion with water with water with dispersing agent. Dissolves in organic solvents like benzene, toluene etc.
- Fastness to washing: The fabric dyes with disperse dyes shows moderate to good washing fastness.
- Light Fastness: Most of the disperse are very fast to washing. The minimum light fastness rating is 4-5.
- Sublime ability: Due to stable electronic arrangement heating arrangement

1.21 Commercial (Trade name) name of Disperse dyes:

- Terasil
- Foron
- Palanin
- Resolin
- Samaron
- Dispersol

1.22 Dispersing Agent:

The actual disperse dye is formed as relatively large particles and in this form it is unsuitable for application on hydrophobic fibers. If these big particles are used in dyeing as such, they produce uneven and specky dyeing and their full color value is not realized. In order to ensure uniform dyeing, the dye should be present in the dye bath in a uniform and very fine form, which should be stable under dyeing condition. This requires a large amount of suitable dispersing agents followed by grinding. The dispersing agent should be effective under the dyeing conditions and should be stable to hard water, high temperature and other dyeing assistants.
Soap powder, Turkey Red Oil, Alkylsulphates, Alkylarylsulphonates, Fatty Alcholethylene Oxide condensates, Naphthalene-β-sulphonate and formaldehyde etc are the recommended dispersing agent performs many functions. It assists the process of particle size reduction of the dye. It also enables the dye to be formed in the powder form. When the powder is added to the dye bath, it facilitates the recon version of the powder in to dispersion; it is required for carrying out the dyeing. Finally, it maintains the dispersion in a fine form in the dye bath throughout the dyeing process. Dispersing agents increase the solubility of the disperse dye in water. It is seen that solubility of the dye in water is considerably increased by the dispersing agent and that different dispersing agents affect the solubility to different extents. It can be noted that the dyeing rate increase with increasing solubility the dyeing rate actually decreases. Where the solubility is very high as in the case of direct dyes, practically no dyeing takes place.

1.23 Commercial (Trade name) Name of Dispersing agent:

1. Setamol -BASF.
2. Edalon -Sandoz.
3. Calsolene Oil HS –A.C.I.
4. Hipogal –Hoechst.

1.24 Commercial (Trade name) Name of Carrier:

Tumescal –A.C.I.
Matexil –A.C.I.
Levagol –Bayer.
Dilatin –Sandoz.
Nvalon –Ciba.
Hisogal –Hoechst.

CHAPTER 2

RAW MATERIALS

2.0 Raw Materials:

- Grey fabric
- Chemicals
- Dyes

2.1 Fabric Specification:

100% cotton knitted fabric (single jersey)

Yarn count : 32 Ne

Wales per inch (WPI) : 42

Course per inch (CPI) : 54

Twist per inch (TPI) : 14

Gram per square meter (GSM): 171

2.2 Used chemicals:

For scouring & bleaching: (Anti creasing agent, Detergent, Sequestering agent, caustic soda, Soda ash, Hydrogen peroxide)

For Neutralization and peroxide killer: (Acetic acid, Hydrogen peroxide killer)

The scoured and bleached fabric is treated with ploy acrylamide.

For Dyeing: (Dispersing agent, carrier, wetting agent, Sequestering agent, Disperse dye and Reactive dye)

2.3 Name of Dyes:

- Disperse dye
- Reactive dye

2.4 Apparatus:

- Beaker
- Spirit lamp
- Stand
- Pipette
- PH scale
- Stop watch
- Glass rod
- Thermometer
- Padding Machine
- Curing machine
- Fire box
- Etc

CHAPTER 3

PRETREATMENT

3.1 Pretreatment:

Wet processing engineering (WPE) is the most significant division in the textile preparation and processing. It is a major stream in textile engineering which is under the section of textile chemical processing engineering and applied science. Textile manufacturing is covers everything from fiber to apparel; covering with yarn, fabric, fabric dyeing, printing, finishing, garments or apparel manufacturing. There are many variable processes available at the spinning and fabric-forming stages coupled with the complexities of the finishing and coloration processes to the production of wide ranges of products.

In Bangladesh, textile manufacturing is a major industry. In this industry, wet processing plays a vital role in the area of pre-treatment, dyeing, printing and finishing of both fabrics and apparels. But coloration in fiber stage or yarn stage is also included in the wet processing division.

All the processes of this stream are carried out in an aqueous state or aqueous medium. The main processes of this section include;

- Singeing
- Desizing
- Scouring
- Bleaching
- Mercerizing
- Dyeing
- Printing
- Finishing

Singeing:

The process of singeing is carried out for the purpose of removing the loose hairy fibers protruding from the surface of the cloth, thereby giving it a smooth, even and clean looking face. Singeing is an essential process for the goods or textile material which will be subjected to mercerizing, dyeing and printing to obtain best results from these processes.

Singeing is performed only in the woven fabric. But in case of knit fabric, similar process of singeing is known as bio-polishing where enzyme is used to remove the protruding fibers.

Singeing is a mechanical process by which hairy, loose fibers are removed from the surface of the textile material either by heating or burning to make the material smoother and lustrous.

Desizing:

Desizing is the process of removing sizing materials from the fabric, which is applied in order to increase the strength of the yarn which can withstand with the friction of loom. Fabric which has not been desized is very stiff and causes difficulty in its treatment with different solution in subsequent processes

After singeing operation the sizing material is removed by making it water soluble and washing it with warm water. Desizing can be done by either the hydrolytic method (rot steep, acid steep, enzymatic steep) or the oxidative method (chlorine, chloride, bromide, hydrogen peroxide)

Scouring:

Scouring is a chemical washing process carried out on cotton fabric to remove natural wax and non-fibrous impurities (e.g. the remains of seed fragments) from the fibers and any added soiling or dirt. Scouring is usually carried in iron vessels called kiers. The fabric is boiled in an alkali, which forms a soap with free fatty acids (saponification). A kier is usually enclosed, so the solution of sodium hydroxide can be boiled under pressure, excluding oxygen which would degrade the cellulose in the fiber. If the appropriate reagents are used, scouring will also remove size from the fabric although desizing often precedes scouring and is considered to be a separate process known as fabric preparation. Preparation and scouring are prerequisites to most of the other finishing processes. At this stage even the most naturally white cotton fibers are yellowish, and bleaching, the next process, is required.

Since damage can be caused to the cotton substrate by sodium hydroxide. Due to this, and in order to reduce alkali content in the effluent, Bio-scouring is introduced in the scouring process in which biological agent is used, such as an enzyme.

Bleaching:

Bleaching improves whiteness by removing natural coloration and remaining trace impurities from the cotton; the degree of bleaching necessary is determined by the required whiteness and absorbency. Cotton being a vegetable fiber will be bleached using an oxidizing agent, such as dilute sodium hypochlorite or dilute hydrogen peroxide. If the fabric is to be dyed a deep shade, then lower levels of bleaching are acceptable. However, for white bed sheets and medical applications, the highest levels of whiteness and absorbency are essential.

Reductive bleaching is also carried out, using sodium hydrosulphite. Fibers like polyamide, polyacrylics and polyacetates can be bleached using reductive bleaching technology.

After scouring and bleaching, optical brightening agents (OBA), are applied to make the textile material appear more white. These OBAs are available in different tints such as blue, violet and red.

Mercerization:

Mercerization is a treatment for cotton fabric and thread that gives fabric or yarns a lustrous appearance and strengthens them. The process is applied to cellulosic materials like cotton or hemp. A further possibility is mercerizing during which the fabric is treated with sodium hydroxide solution to cause swelling of the fibers. This results in improved luster, strength and dye affinity. Cotton is mercerized under tension, and all alkali must be washed out before the tension is released or shrinkage will take place. Mercerizing can take place directly on grey cloth, or after bleaching.

Dyeing:

Dyeing is the process of adding color to textile products like fibers, yarns, and fabrics. Dyeing is normally done in a special solution containing dyes and particular chemical material. After dyeing, dye molecules have uncut chemical bond with fiber molecules. The temperature and time controlling are two key factors in dyeing. There are mainly two classes of dye, natural and man-made.

3.2 Types of dyeing:

- Cross dyeing
- Fiber dyeing
- Yarn dyeing
- Fabric dyeing
- Union dyeing
- Solution Dyeing
- Product dyeing

Printing:

Textile printing is referred as localized dyeing. It is the application of color in the form of a paste or ink to the surface of a fabric, in a predetermined pattern. Printing designs onto already dyed fabric is also possible. In properly printed fabrics the color is bonded with the fiber, so as to resist washing and friction. Textile printing is related to dyeing but, whereas in dyeing proper the whole fabric is uniformly covered with one color, in printing one or more colors are applied to certain parts only, and in sharply defined patterns. In printing, wooden blocks, stencils, engraved plates, rollers, or silks can be used to place colors on the fabric. Colorants used in printing contain dyes thickened to prevent the color from spreading by capillary attraction beyond the limits of the pattern or design.

Finishing:

Textile finishing is the term used for a series of processes to which all bleached, dyed, printed and certain grey fabrics are subjected before they put on the market. The object of textile finishing is to render textile goods fit for their purpose or end-use and/or improve serviceability of the fabric.

CHAPTER 4

METHODOLOGY

4.1 The Flowchart of Wet Processing of Blended Fabric(For Dyeing):

Grey Cloth
↓
Stitching and Sewing
↓
Shearing and Cropping
↓
Brushing
↓
Singeing
↓
Desizing
↓
Scouring
↓
Bleaching
↓
Washing
↓
Drying
↓
Mercerizing
↓
Washing/Scouring
↓
Drying
↓
Jet Dyeing (for polyester part)
↓
Drying
↓
Jigger/Pad Roll Dyeing (for cotton part)
↓
Drying
↓
Stentering
↓
Sunforizing/Calendaring
↓
Folding/Rolling

↓

Packing

↓

Baling

4.2 DYEING PROCESS (POLYESTER PART DYEING)

Polyester fabric requires a Heat Setting operation before dying. Heat settings eliminate the internal tensions within the fiber generated during manufacture and the new state can be fixed by rapid cooling. This heat setting fixed the fabrics in the relaxed state and thus avoids subsequent shrinkage or creasing of fabric. Dye bath settings & Dyeing:

Recipe (Shade 1%):

Disperse Dye : 1 % owf

Dispersing Agent : 1 gm/lit

Acetic Acid : 1 gm/lit

P^H: 5.5-6.0

Temperature : 130°C

Time: 1 hr

Recipe (Shade 2%):

Disperse Dye: 2 % owf

Dispersing Agent: 2 gm/lit

Acetic Acid: 1 gm/lit

P^H: 5.5-6.0

Temperature: 130°C

Time: 1 hr

Recipe (Shade 3%):

Disperse Dye: 3 % owf

Dispersing Agent: 2 gm/lit

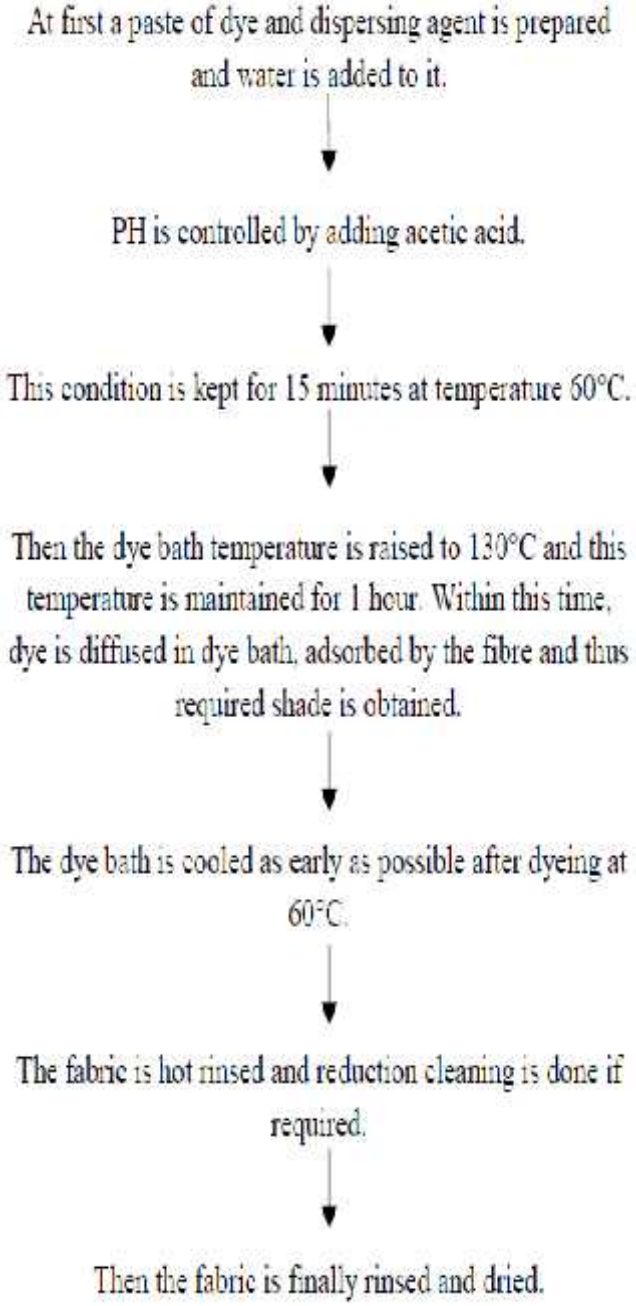
Acetic Acid: 1 gm/lit

P^H: 5.5-6.0

Temperature: 130°C

Time: 1 hr

Procedure:



Dyeing curve:

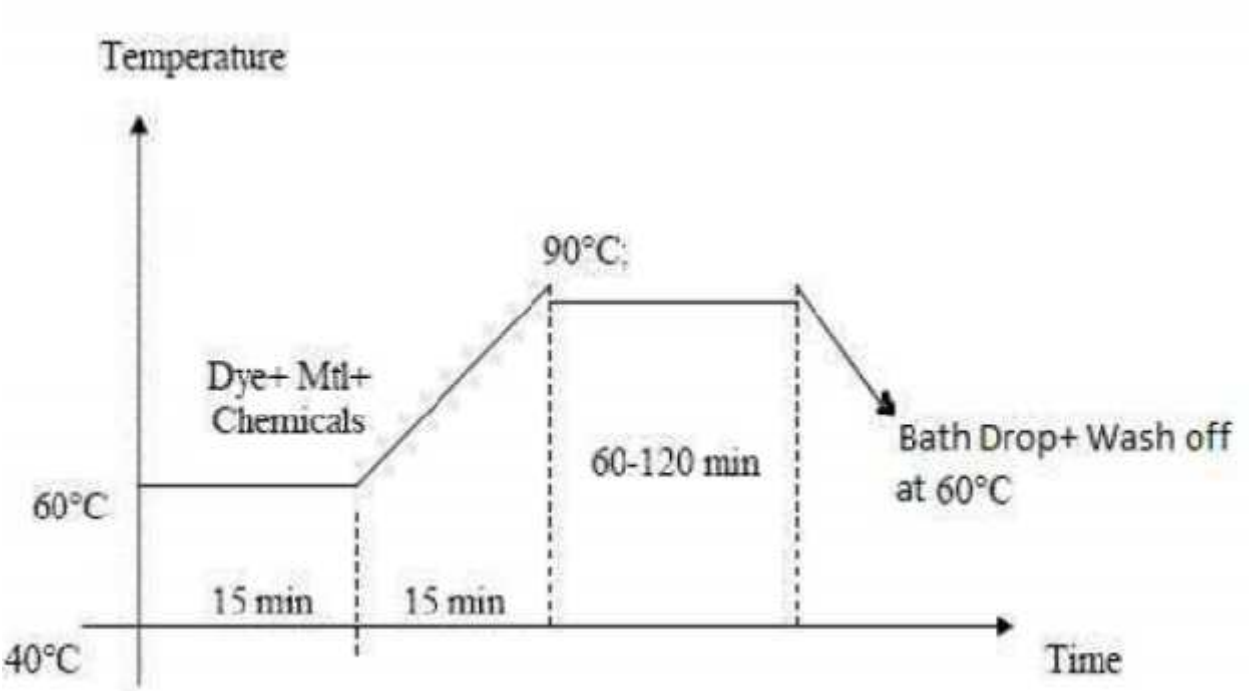


Fig: Dyeing curve of polyester part

4.3 DYEING PROCESS (COTTON PART DYEING):

Recipe (Shade 1%):

Reactive dye: 1% owf

Salt: 20 gm/L

Soda: 7 gm/L

Sequestering Agent: 1 cc/L

Wetting Agent: 1 cc/L

Leveling Agent: 1cc/L

P^H: 10

Temperature: 40°C

Time: 60 min

M: L: 1: 20

Recipe (Shade 2%):

Reactive dye: 2% owf

Salt: 35 gm/L

Soda: 10 gm/L

Sequestering Agent: 1 cc/L

Wetting Agent: 1 cc/L

Leveling Agent: 1cc/L

P^H: 10

Temperature: 40°C

Time: 60 min

M: L: 1: 20

Recipe (Shade 3%):

Reactive dye: 3% owf

Salt: 45 gm/L

Soda: 15 gm/L

Sequestering Agent: 1 cc/L

Wetting Agent: 1 cc/L

Leveling Agent: 1cc/L

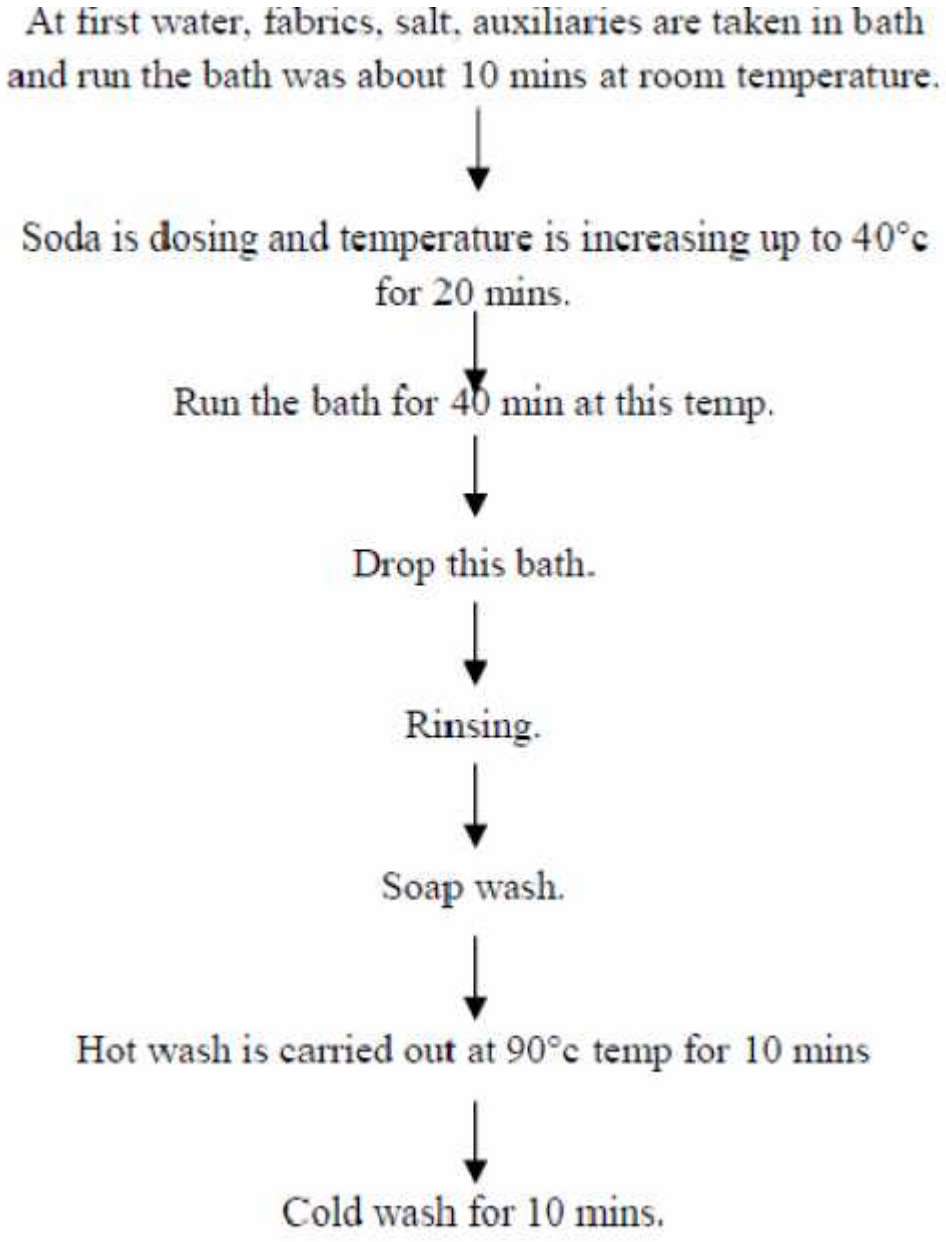
P^H: 10

Temperature: 40°C

Time: 60 min

M: L: 1: 20

Procedure:


At first water, fabrics, salt, auxiliaries are taken in bath and run the bath was about 10 mins at room temperature.
Soda is dosing and temperature is increasing up to 40°c for 20 mins.
Run the bath for 40 min at this temp.
Drop this bath.
Rinsing.
Soap wash.
Hot wash is carried out at 90°c temp for 10 mins
Cold wash for 10 mins.

Dyeing curve:

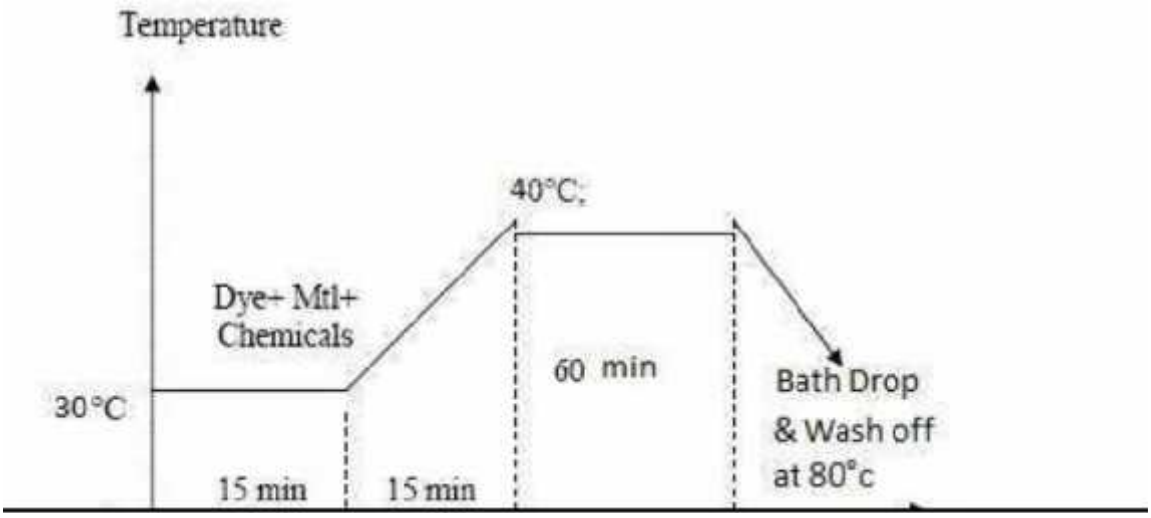


Fig: Dyeing curve of cotton part

4.4 One bath, one-step method:

The one-bath one-step dyeing process of P/C blends with disperse/ reactive (D/R) dyes has the advantages over the conventional dyeing processes on reducing the dyeing cycle as well as energy consumption, and eliminating the use of sodium hydro sulphite, an environmentally questionable chemical in dyeing. The present work involves a method of one-bath one-step dyeing process of P/C blend with a physical mixture of D/R commercially available dyes in powder form for ease of shade matching to the dyers

Typical Recipe for Dying of Polyester/Cotton Blends

Dispersing agent..... = 0.5 – 1.0 g/l
Sequestering agent..... = 1.0 – 2.0 g/l
Leveling agent..... = 1.0-2.0 g/l
Carrier .....= 1.0-3.0
Disperse dyes.....= 1.5%
Reactive dyes..... =1.5%
Acetic acid (50%) .....= 0.5-2 g/l
Glauber salt .....= 5.0 – 20.0 g/l
Temperature..... = 90- 100
Time .....= 60- 120 min
M:L .....= 1:10

Preparation of physical mixture of dyes:

To obtain the same tone of color on fabric, the physical mixture was prepared by calculating the amount of each dye component required which depends on the composition of fibers in fabric as; Blend ratio of P/C = 60/40

Disperse dye required = 1.5 % Stock solution for 100% Polyester fabric

Reactive dye required = 1.5 % Stock solution for 100% Cotton fabric

Dyeing procedure:

P/C blend fabrics were dyed for 1% on weight of fabric (owf) in a Flexi dyer dyeing machine at a material to liquor ratio (M:L) of 1:20. The P/C blend fabric was placed in dye bath with the dye solution at room temperature (RT). Dispersing agent was added to maintain the dispersibility of dye bath during dyeing. Acetic acid was used to maintain pH 4-4.5.Dyeing was commenced at 70 °C and temperature was raised by 1 °C/min to 130 °C, maintained at this temperature for 60 min and then cooled to 60 °C. 30 g/l of Glauber's salt and 15 g/l of sodium carbonate for exhaustion and fixation respectively of the reactive dye were added to dye bath. The bath was maintained at 60 °C for 60 min as shown in Fig. 3. After the completion of dyeing, dye bath was drained. Soaping was carried out at M:L 1:50 of the dyed fabric at 95 °C for 10 min with 2 g/l of non-ionic soap. The fabric was rinsed and then dried.

Dyeing curve:

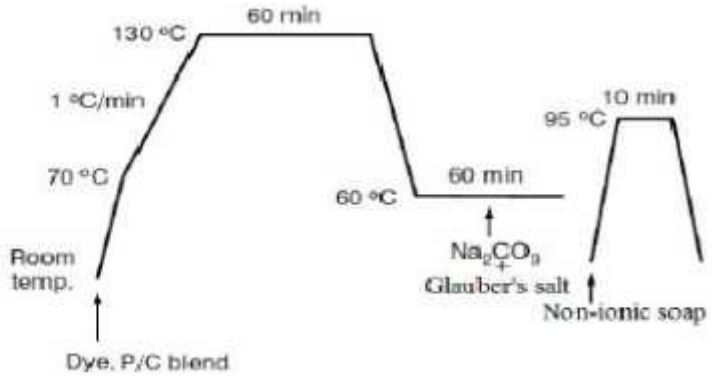


Fig: Dyeing profile for P/C blend fabrics using suitable physical mixture of disperse and reactive dye (1% owf, M: L 1:20)

4.5 Sample presentation:

	Shade 1%	Shade 2%	Shade 3%
1.Solid Effect (Disperse+ Reactive)			
2.Reservation Effect (Disperse Dye)			
3.Reservation Effect (Reactive Dye)			

CHAPTER 5

RESULT & DISCUSSION

5.1 COLOR FASTNESS TO WASH: ISO 105 C06 Test is used here.

5.2 COLOR FASTNESS TO RUBBING:

Required Apparatus:

1. Rubbing tester.
2. Sample holder with pin (a) 22 cm length
   (b) 9 cm width
3. Sample size (a) 22 cm length
   (b) 5 cm width
4. Sample plate.
5. Finger
6. Finger clip
7. Load (9+5, 9-5) N

Working Procedure for Rubbing Test:

- At first we cut the fabric as per requirement size of 22cm x 5cm the fabric was set of the sample holder with pins.
- The crock fabric was taken size of 5cm x 5cm set of on the finger of the crock meter with the help of a clip & the machine b set to zero.
- Then finger was dropped on the sample & 10 turns for 10 sec for rubbing was done by operating handle.
- The crock fabric is collected for assessment.
- Then the finger was converted by a wet crock fabric & rubbing was done 10 times of 10 sec by operating handle.
- After that the wet crock fabric was collected for assessment.

5.3 Results for Color Fastness to Wash:

S.L	Description	Change Value	Remark	Staining Value	Remark
01	1% Solid	4	Fast(Good)	3	Average
02	1% Reserve Reactive	5	Fast(Excellent)	4	Fast(Good)
03	1% Reserve Disperse	4	Fast(Good)	4	Fast(Good)
04	2% Solid	5	Fast(Excellent)	5	Fast(Excellent)
05	2% Reserve Reactive	5	Fast(Excellent)	4	Fast(Good)
06	2% Reserve Disperse	5	Fast(Excellent)	5	Fast(Excellent)
07	3% Solid	4	Fast(Good)	3	Average
08	3% Reserve Reactive	4	Fast(Good)	4	Fast(Good)
09	3% Reserve Disperse	4	Fast(Good)	3	Average

5.4 Results for Color Fastness to Rubbing:

S.L	Description	Staining Value for Dry Sample	Remark	Staining Value for Wet Sample	Remark
01	1% Solid	5	Fast(Excellent)	4	Fast(Good)
02	1% Reserve Reactive	4	Fast(Good)	4	Fast(Good)
03	1% Reserve Disperse	5	Fast(Excellent)	5	Fast(Excellent)
04	2% Solid	5	Fast(Excellent)	5	Fast(Excellent)
05	2% Reserve Reactive	5	Fast(Excellent)	4	Fast(Good)
06	2% Reserve Disperse	5	Fast(Excellent)	5	Fast(Excellent)
07	3% Solid	4	Fast(Good)	4	Fast(Good)
08	3% Reserve Reactive	4	Fast(Good)	4	Fast(Good)
09	3% Reserve Disperse	5	Fast(Excellent)	4	Fast(Good)

Sample Attachment: 01

Sample Attachment: 02

Sample Attachment: 03

CONCLUSION:

P/C fabrics were successfully dyed with the physical mixture of D/R dyes by one- bath one-steps dyeing process. The novelty of undertake study is successful mixing of commercially available dyes as is to give complete shade, in powder form which will open an new avenues to dyestuff suppliers to cater to the blend dyeing need of the textile processing . The work was based on a well established process of dyeing HTHP method which is commercially accepted method in dyeing sector. For the wash and rubbing fastness test ISO testing method was followed. For dyeing of P/C fabric, first polyester fabric was dyed in high temperature then cotton fabric. Performing this project we gathered some knowledge which will be helpful in our future activities during practical life.

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