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Coloration Process &Parameters for Knit Fabric Dyeing along with Different forms of Dyeing Faults & Correlated Remedies in Textile Dyeing Industries

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Abstract:*Dyeing is one the most important part in the textiles manufacturing house. Various types of fabric coloration are performed in dyeing section based on the requirements & demand of the buyer. Lots of traditional dyeing processes are running industrially in different manufacturing unit to dye the fabric. Different dyeing factories perform different dyeing process. But all of the dyeing processes are not practically suitable for the coloration of the fabric to maintain the exactly required shade & quality of colored fabric. There's some criticism to perform the dyeing processes practically for getting the best output. For this purposes some of the industrially applicable & suitable dyeing processes are analyzed & discussed in this research paper. During & after coloration different types of dyeing faults arise. These types of problem arise due to the implementation of wrong dyeing procedure & also for lack of concentration by the responsible authority in the dyeing floor. To overcome such kind of problem root causes along with the remedies are also discussed in this research paper. The machine parameters setting like as proper process curve, Reel speed, Cycle time, temperature grading etc. are also extremely important to dye the fabric.Different types of knitted fabric like Single jersey, Rib, Lacoste, Interlock, Fleece requires different reel speed & cycle time to dye the fabric. Accordingly different types of color like turquoise, Anthracite, Khaki, Black, Navy, White, Jester red, Lemmon Yellow, Brown, Pale Blue, Ecru of different fabric like natural & synthetic also need different dyeing processes to get the required dyeing shade. Reactive dyes for cotton & synthetic dyes for polyester are widely used in coloration textile industry.*

Keywords: *Dyeingknit fabric, Machine, Shade, Dyes and Chemicals, Flow process,fastness*

I. Introduction

Dyeing is a process of coloration of textile fabric by using some required dyes & chemical according to the specified shade, color & order. Dyeing is the aqueous application of dyes on textile substrate[1]. Dyes can be absorbed or adhere on to the substrate in solution form through covalent bond or complexes with salts or metals by chemical retention or physical adsorption. Dyes are of different types & applied to different fabrics like natural or synthetic in different methods[2]. Reactive dyes are most common for cotton fabric dyeing, disperse dyes are widely used for polyester fabric dyeing in the industry & pigments are also used for cotton & CVC fabric dyeing[3, 4].

Dyes are classified based on their physical & chemical structure. These types of structures are important for reaction or other dyeing mechanism with the fabric. Dyes exists chromophore group which are responsible for the coloration of the fabric[5, 6]. This chromophore contains different functional group like nitro, anthraquinone, azo, carbonyl, methane, aryl methane etc. Electron donating substituents intensify the color of chromophore is termed as auxochrome. Carboxyl, amine, sulphonate are some examples of the auxochrome[7].

More than 10,000 dyes & pigments have application for coloration in the manufacturing house. The production of synthetic dyes is more than 7×10^5 tons annually all over the world per year[4, 8]. The processes used for the coloration of textiles depend on the types of fiber, yarn, Fabric structure & also on the quality requirements of dyed fabric. During dyeing the coloration process is most important for getting the proper shade & quality of the dyed fabric[9, 10].

Shade matching is the main task of dyeing section. Shade is the depth of color percentage. Shade is expressed in percentage of dye amount in unit weight of fabric[11]. Shade matching depends on the accuracy of the man's eye which is matched industrially in the light box. It is a visual process for this reason same shade may have difference comments from different person. So, dyeing expert or color expert is needed for this purpose[12]. Besides the manual shade matching system computer color matching system (CCMS) can help man to take decision about the shade of a specific sample[13, 14].

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II. Experimental section

2.1.Materials

Knit Fabric (Various construction), Different Chemicals & dyes used by traditional dyeing industries.

2.2.Instruments

Color Matching Cabinet (Model 1: CAC 60, Brand Name: VeriVide, Origin: UK), DATACOLOR 650 (spectrometer and a photometer), Dyeing machines of Sclavos Brand (Microfiber group, Esquire group), Automation or dossing of dyes & chemicals, Light box etc.

2.3. Procedures

2.3.1.Taking orders from marketing division

Firstly marketing division supplies Fabric Orders to the Planning and control division by a special format.

2.3.2 Analyzing the orders

This section analyzes the orders according to buyers, Order Quantity, type of orders (i.e. type of fabric, color to be dyed etc.), delivery date etc. Then it selects which M/C. to use, no of M/C. to use, time required for production etc. This section plans for required quantity of fabric to be knitted (Order quantity + 6% of Order Quantity), knitting balance, fabric need to be dyed. Dyeing balance, RFD (Ready for delivery), RFD balance, delivered fabric and delivery balance.

2.3.3. Planning for knitting

This section plans for knitting production. It selects machine for knit the fabric for specific type of fabric, type of yarn used, required GSM, width etc. It also gives delivery data for knitted fabric. It also places orders for buying of yarn from spinning mills by a specific schedule.

2.3.4. Planning for dyeing the fabric

Production planning for dyeing is called 'Batch Plan'. According to the batch numberand color, width, style and construction the batch plan is made. For easy understand this section gives some 'T.' cards. 'T' cards are serialized according to the priority of delivery. The batches and 'T' cards also serialized as to dye light shade at first and lastly the dark shades, since faulty shades can be converted to dark color later.

2.3.4.5. Planning for finishing the fabric

Finishing schedule is same us the dyeing. After dyeing the material goes to the finishing section with the batch plan. Finished data is written to the batch card and is informed to the planning section.

2.3.6. Preparation of dyed Sample

The sample preparation starts through receiving the fabric from knitting department. Then as per following sequence the sample proceeds[15, 16].

2.4. Sequence of operation for a textile manufacturing house

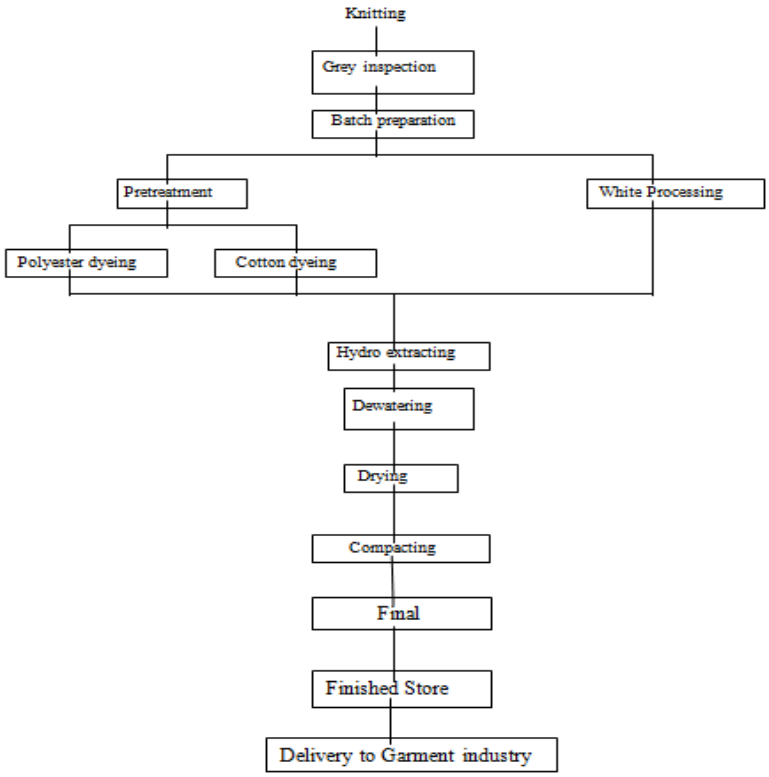


Figure 1. Sequence of operation for a textile manufacturing house

After taking the fabric from knitting department the dyeing section prepares the batch as per order given by buyer. Then dyeing of the fabric is performed in the designed machine according to the shades & fabric.

2.8 For starting dyeing, batch preparation is most important.

2.8.1. Batch preparation

Production planning for dyeing is called Batch Plan. According to the batch number, color, width, style and construction the batch plan is made. For easy understand, this section gives some 'T' cards. 'T' cards are serialized according to the priority of delivery. The batches and 'T' cards are also serialized as to dye light shade at first and lastly the dark shades, since faulty shade and can be converted to dark color later.

Calculation of Winch Speed

Let,
Fabric weight = 1000kg
Per nozzle fabric weight =250kg
Fabric Diameter (open) = 56 inch
Cycle time or Dwell time = 2.5-3.0 m per minute
G.S.M =180
We know, GSM = gram / meter^2
= gram / (Length × Diameter)
Or, Length = gram / (GSM × Diameter)
= (250×1000×100) / (56×2.54×180)
= 976 meters

$$\frac{\text{Fabric Length}}{\text{nozzle}} = \frac{\text{Fabric weight(kg)} \times 1000 \times 100}{\text{Fabric GSM} \times \text{Fabric diameter}(″) \times 2.54(\text{cm}) \times \text{numberof nozzle}}$$

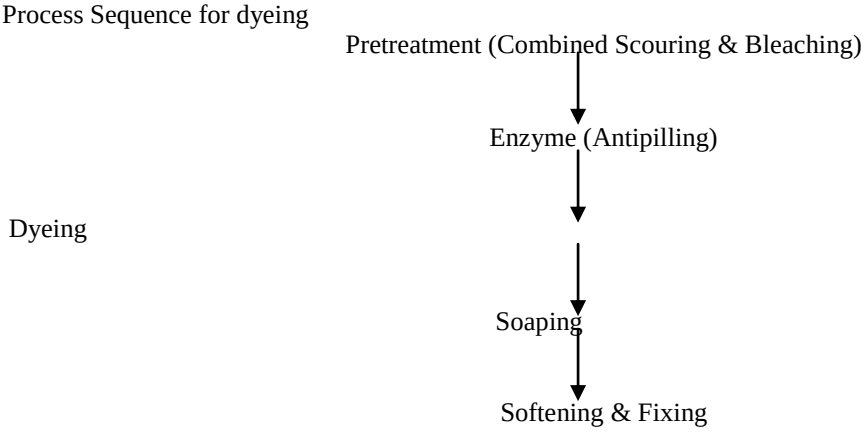
So, Winch or Reel Speed = per nozzle Fabric length / Cycle time
= 976 / 3 meter/minute = 325 meter/minute [12].

2.8.2.Process sequence of batch preparation

- Receive batch card from Grey-In-Charge.
- Make the priority as per dyeing.
- Take one specific batch card.
- Check the availability of the fabric.
- Take required quantity of body fabric from ware-house.
- Make required no-rope maintaining equal length.
- Take collar/cuff as per size, keep the total weight.
- Distribute collar/cuff/rib in each rope equally ensure equal length.
- Stitch the fabric.
- Write down the weight against roll number in the back side of batch card.
- Write the total weight in batch card.
- Put signature and date.
- Fill up the production report form.

2.9. Coloration Process

Process Sequence for dyeing



2.10. Isothermal dyeing Process

It's one of the most common & widely used dyeing processes at 60˚C temperature.

2.10.1. Isothermaldyeing Process flow chart

Pretreatment

Machine filling with water at normal Temperature

↓

Fabric loaded at normal temperature (36-40^{0}C)

↓

Chemicals (Chintex NF -150, Jinsofter BSK/CBF =Anticreasingagent, Ablutex-AP-750 (42% Sol^n)= Wetting Agent+ Detergent,Reduzin AC-BL-100)= Multifunctional chemical) Dozing at 50 ^{0}C & Run for 4 min

↓

Bleaching Agent, H_2O_2 (50% Sol^n) is added at 60^{0}C within 3-4 minute

↓

Scouring Agent, NaOH= Scouring Agent is added for 7 min at 70^{0}C

↓

Run time 110^{0}C×20 min.

↓

Cooling at 95-80 ^{0}C & then aquachroan washing is done

↓

Water is leveled

↓

Absorbency test is done.

↓

Per oxide Killer (Raduzin-THN (50% Sol^n)) is added at 80C for 10 min,

↓

Per oxide is checked (if H_2O_2 = O)

↓

Aquachron washing is done at 55^{0}C

↓

Water is leveled

↓

Acetic Acid is added at 55^{0}C for 5 min

↓

P^{H}is Checked (P^H=4.8)

↓

Antipilling

Washing Agent (Flock-BM /SQ-117) is added at 55^0C & run for 10 min

↓

P^H is Checked (P^H=4.8)

↓

Enzyme (Retrocell PLX-TRA) at 55^0C runs for 45 min

↓

Drain out

↓

Soda ash + Flock-BM is added at 80^0C & run for 10 min to deactivate the action of enzyme

↓

Aquachron washing is done

↓

Acetic Acid is added at 60^0C and run for 3-5 min

↓

Isothermal Dyeing

Leveling agent (Jinlev-CL/RL) is added at 60^0C and run for 10 min

↓

P^H is Checked (P^H= 6-6.5)

↓

Dyes are mixed up by 20min added at 60^0 run for 10 min.

↓

Salt is added at 60^0C through transfer dosing for 24min and run for 20 min

↓

Specific gravity of salt is checked

↓

Soda is added at 60^0C for 24 min and run for 5 min

↓

P^H is Checked (P^H= 10-11.5)

↓

After 5 min shade is checked

↓

If shade is not “OK” then it’s checked after every 15 min until matching

↓

If shade is “OK”

↓

Wash is done at 60^0C for 25 min

↓

Acid wash is done at 60^0C and run for 6 min for neutralization

↓

P^H is checked (acidic condition)

Soaping

↓

Soaping agent (QSE) is added at 90^0C & run for 12 min

↓

Aquachron washing is done

↓

Hot wash at 90^0C run for 9 min

↓

Aquachron is done

↓

Drain out

Fixing

↓

Fixing agent (WER)is added for 10 min at 40^0C and run for 10 min

↓

Softening

Acidic acid &DossingBevsoft-CF= Softener +Jinsofter –WCS= Fixing agent is added for 10 min at 40^0C & runfor 20 min

↓

Unload

2.11. Bio scouring dyeing process

2.11.1. Bioscouring dyeing process flow chart

Machine filling with water at normal Temperature

↓

Fabric loaded at normal temperature (36-40^0C)

↓

Chemicals ((ContiponS (10% Sol^n) =Antifoaming Agent,Jinsofter BSK= Anti creasing Agent, Ablutex-AP-750 (42% Sol^n) = Wetting Agent, Reduzin AC-BL-100= multifunctional agent) Dozing at 50 ^{0}C & then Run for 4 min

↓

H_2O_2 (50% Sol ^{n}) is added at 60^0C within 3-4 minute

↓

NaOH=Scouring agent is added for 7 min at 70^0C

↓

Run time 110^0C×20 min.

↓

Cooling at 95-80-95 ^{0}C & then aquachroan washing is done

↓

Water is leveled

↓

Per oxide Killer (Raduzin-THN (50% Sol^n)) is added at 80^0C & run for 10 min,

↓

Per oxide is checked (if H_2O_2= O)

↓

Aquachron washing is done at 55^0C

↓

Water is leveling is ensured

↓

Acetic Acid is added at 55^0C for 5 min
P^H is Checked (P^H=4.8)

↓

Bio scouring Dyeing

MA Scour AIN (Prep-IN) is added at 50^0C and run for 3-5 min

↓

Temperature is raised to 60^0C & run for 5 min

↓

Salt is added at 60^0C for 10 min

↓

P^H + $S_G$of salt is Checked (P^H= 6.6 & S_G = 1.008)

↓

If ok,Dyes (Remazol Red-3BS-A-150G, Remazol Yellow- 3RS, Remazol B Blue) is mixed up by 20 min added at 60^0C & then run for 10 min.

↓

Soda is added at 60^0C & run for 45 min

↓

After that Sample is checked

↓

If shade is not "OK" then it's checked after every 15 min until matching

If shade is "OK"

Drain

Soaping Bio scouring
Water filling & Wash is done at 60^0C

Green Acid is added at 60^0C & run for 43 min

MA Disp-ARE (Soap - Rea) is added at 90^0C & run for 7 min

Aquachron washing is done

Hot wash at 90^0C & run for 9 min

Aquachron is done

Drain out

Softening
Acidic acid + Bevsoft-CF=Softener is added for 10 min at 40^0C & run for 20 min

Unload

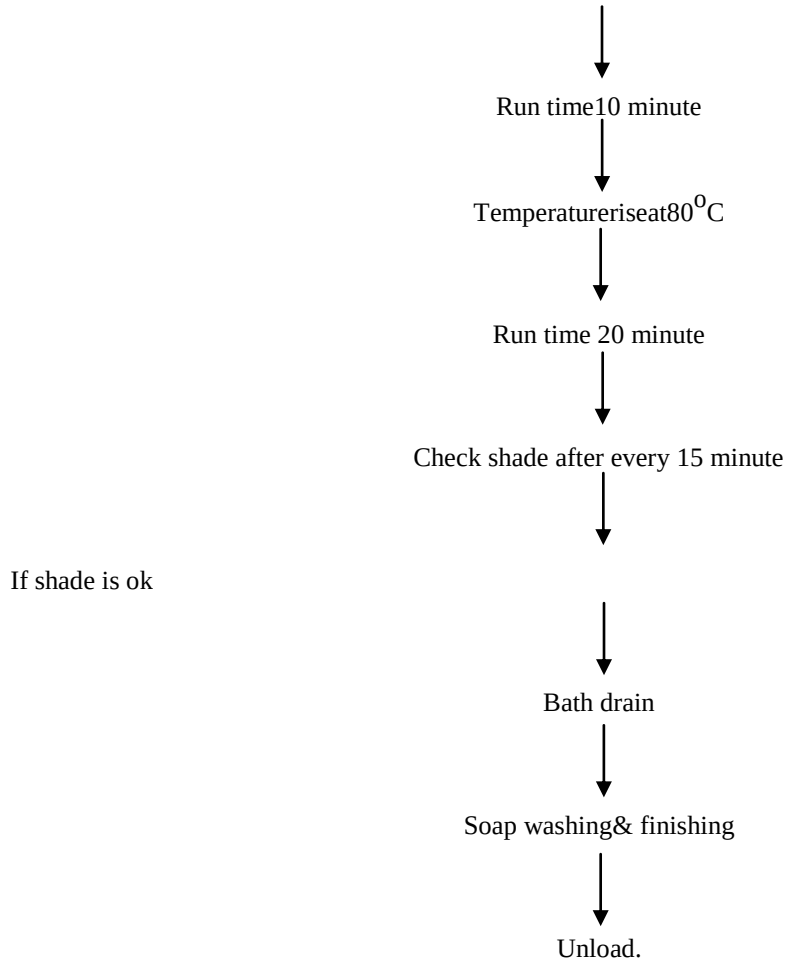
2.12. Migrationdyeing process flow chart

Level in at60C

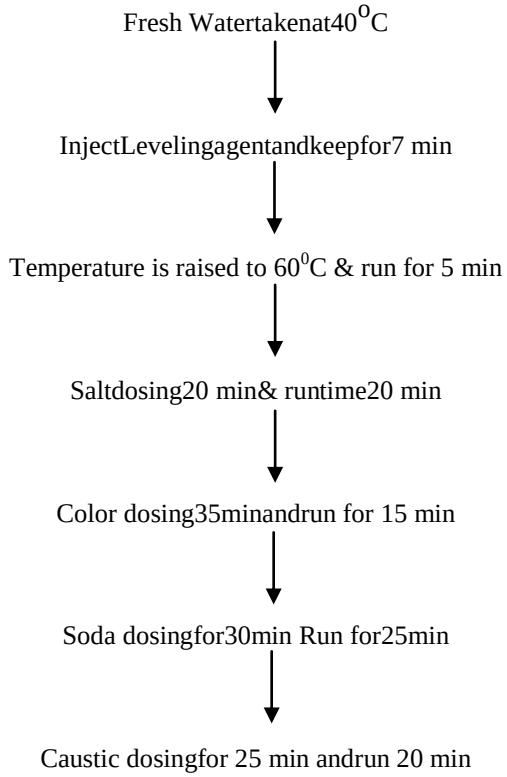
Color dosingfor35´

Run time10´

Saltdissolving 15min



2.13. DyeingProcessFlowChart forDark or Black Shade



Sample checkafter 10 min

If shade is ok

Bath drain

Soap washing & finishing

Unload

2.14. Dyeingprocedure forLight/MediumShade

Fabricload andthen Water taken

Risetemperatureto60^{O}C

P^{H}controlto 6.5

Injectlevelingagentandrunfor 10 min

Color dosingfor45min+ add½SV Run thebath 10min

Other ½SVinjectandrun 20 min

½ Saltaddandrun10min

Extra ½ Saltaddition andrun for 20 min

Soda dosingfor60min

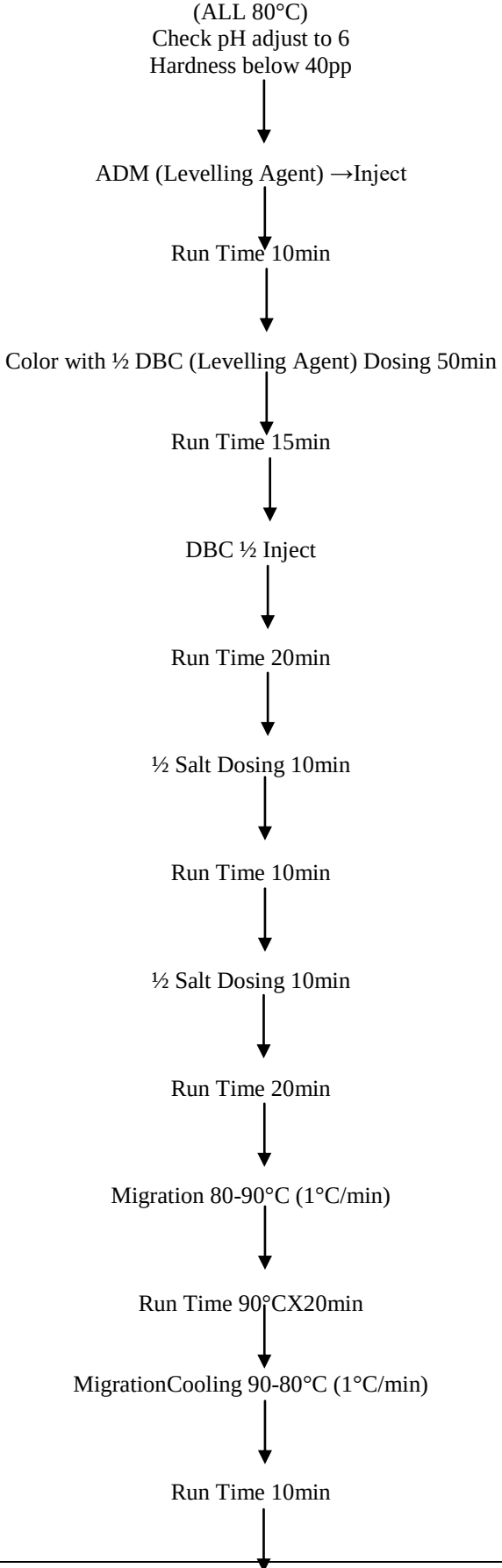
After 10min Sample check

If shade is ok, Bath drain

Soap washing & finishing

Unload.

2.15. Process flowchart for Turquoise color



Soda Dosing 60min at 80°C

↓

BD Washfor 30min

↓

Normal Hot washes 70°CX10minutes

2.16. DyeingProcessflowchartforwhite shade

Detergent, Peroxide stabilizer addedat60˚C

↓

Fabricload andrunfor 5min

↓

Caustic dosingfor 5 minat60˚C

↓

Temperatureraisedto70˚C

↓

Peroxide added andraisestemperatureto80˚C

↓

Optical brighteningagentdosingfor 10 minandtemperatureraiseto 105˚C

↓

Run for 50 min andlower temperatureto80˚C

↓

Bath drain andwater taken at80˚C

↓

Rinsingfor10 minthenbath drain

↓

Fresh water takenandAcetic acid is added at60˚C

↓

Run for 10 min then drain thebathagain

↓

Acetic acid at55˚CandP^{H}controlto4.5

↓

Enzymeisaddedandrun for 50 min at55˚C

↓

Bath drainandfresh water at 60˚C

↓

InjectSequesteringagentandtemperatureraise to 90˚C

↓

Run 10 min andaddSoftener, againrun for 20 min

↓

Fabricunload

2.17. Washing of grey mélange fabric

Leveling with water

↓

Wetting agent at 60ºC

↓

Bath Drain

↓

Leveling

↓

P^H=5.5 and temperature at 55˚C

↓

Enzyme

↓

Run time 60min

↓

Rise temperature to 80ºC

↓

MIR rinse for 15 minute

↓

WaterLevelling

↓

Softener 45ºCx10'

↓

Bath Drain

↓

Cold rinse

↓

After treatment

2.18. Polyester dyeing process for CVC fleece, Single Jersey, Rib&Pk fabric

Scouring & Bleaching

↓

Dispersing agent =1.0g/l
Acetic acid=1.5g/l
Buffering Agent (AB-45) =1g/l
Leveling Agent =1g/l
CHECK pH=4

↓

Color Inject (5min)

↓

Run Time 10min

↓

Raise Temp. =90˚C (Direct)

↓

90˚C-130˚C (Gradient 1.5C/min)

↓

Run Time=45Min

↓

130˚C-90˚C (Gradient 1.5˚C/min)

↓

90˚C-80˚C (Direct)

↓

Bath Drain

↓

Reduction Cleaning
Caustic=2.5g/l
Hydrose=3g/l
Detergent (NOF) =0.5g/l

↓

Neutralization (60˚Cx15min)

↓

Unload fabric/ Start cotton part dyeing

2.19.Process flow chart for viscose dyeing

Pretreatment

Fabric Load at normal temperature
↓
NOF(Detergent) + SOF (Wetting Agent) + ALBA C(Anti creasing agent): inject
↓
Run time- 5min
↓
Soda Dosing- 5min
↓
Run time- 5min
↓
H_2O_2: Dosing- 10min
↓
Run time 5min
↓
Temp- 98°C (1°C/MIN)
↓
Scouring: 105°C × 60’
↓
Wash : 60°C × 20’
↓
Normal hot : 90°C × 10’ (2-times)
↓
Normal Hot Wash: 10’
↓
Acid
↓

→ Check Absorbency

Dyeing
(Temp 80°C)
(Migration 90°C)

Water filling
↓
Sequestering Agent (Securon)+ Anticreasing Agent(Albafluid C) + Levelling Agent (ADM) : inject
↓
Run time : 10'
↓
Check P^H& Water Hardness
↓
1/2 Leveling Agent(RDLB) + Color Dosing : 45'
↓
Run time : 30'
↓
1/2 Leveling Agent (RDLB) : inject
↓
Run time : 20'
↓
1/2 Salt Dosing- 10'
↓
Run time- 10'
↓
1/2 Salt Dosing- 10'
↓
Run time- 15'

↓
Migration- 80°C-90°C (1°C/Min)
↓
Run time- 20'
↓
Migration Cooling- 90°C-80°C (1°C/Min)
↓
RUN- 10'
↓
Soda Dosing- 60' (70% Progressive)
↓
Run time- 10'
↓
Sample Check
↓
Bath Drain (BD) Wash- 25'
↓
Bath Drain(BD) Normal Hot- 70°C × 10'
↓
BD Normal Hot Wash- 10"
↓
BD Acid- 25'

2.20. OrderofColorandSalt dissolving/dosing

- Incase of0-1.0 %(light)shadecolorisdosedfirst thensaltdissolvingis performed.
- Incase of1-2.5%(medium)shadesaltisdissolvedatfirstthencolorisdosed.
- Incase of3&above %(dark) shadesaltis dissolvedatfirst thencolorisdosed.

2.21. Process parameters

2.21.1.P^H

- ScouringP^H: 11-12
- During H_2O_2bleaching P^H : 10.5-11
- EnzymeP^H:4.5-4.8
- During reactive dyeing P^H : 10.5-11.5
- During polyester dyeing P^H:4.5-5.5
- Beforedyeing(Leveling) P^H:– 6.5
- During disperse dyeing P^H: 4.5-5.5
- Salt P^H : 7-8
- Softener P^H: 6.5

2.21.2Temperature

- For cotton scouring:90-120 $^\circ$C
- DuringNaOHaddition 65 $^\circ$C
- During H_2O_2 addition70 $^\circ$C
- Peroxidekillingat80 $^\circ$C
- Polyester dyeing: 100^0 – 135 $^\circ$C
- Bio Polishing= 55 – 63 $^\circ$C
- For Cotton Dyeing :
    - Cold Brand=45 $^\circ$C
    - Medium Brand=60 $^\circ$C
    - Hot Brand=80 $^\circ$C

- Migration for turquoisecolor at– 80/90 °C
- Optical brighteningagent(OBA) at–80 °C
- Polyesterdying: Around135 °C
- Polyester Stripping: Around 130 °C
- Reduction Cleaning: Around 80/90 °C
- Softener at: Around55 °C

2.21.3. Approximaterequiredtime for dyeing
- For white fabric: 3-5hrs
- For 100%cotton: 8-10hrs
- For 100%polyester: 3.5- 5hrs
- CVC 2 parts: 1314hrs.

2.21.4. M: L Ratio
- For reactive dyeingM: Lratiomaintainedbetween=1:6
- For Turquoise dyeingM: Lratiomaintainedbetween= 1:8
- For Viscose dyeingM: Lratiomaintainedbetween= 1:10
- For Fluorescent dyeingM: Lratiomaintainedbetween 1:20
- For critical shade dyeingM: Lratiomaintainedbetween 1:6/1:8

2.21.5. Typesof dosing
- Linear Dosing - Progressive Dosing - Decreasive Dosing

2.22. Common Dyeing faults with their Causes & Remedies

■ **Uneven dyeing in a rope**

➢ **Causes**
- Very rapid addition of dyes and chemicals
- Improper pre-treatments (Scouring & bleaching)
- Lack of control of dyeing machine like-
    - m/c speed
    - Temperature
    - Dosing time
    - Circulation pump and reel speed
    - Plaiting device
    - M:L ratio

➢ **Remedies**
- ✓ Addition of dyes & chemicals in dosing
- ✓ Proper pre-treatments
- ✓ Proper control of dyeing machine

■ **Rope to rope uneven shade**

➢ **Causes**
- Due to not equal rope length in each nozzle
- Due to not equal fabric flow speed in each nozzle

➢ **Remedies**
- ✓ Rope length in each nozzle should be same or as near as possible
- ✓ Check and make sure that fabric flow speed in each nozzle should be same

■ **Dye spot or Color spot**

➢ **Causes**
- Not correctly mixing & thoroughly dissolving the dye stuff in right amount of water
- Dye bath hardness
- No agitation of dye stuff

➢ **Remedies**

- ✓ Proper mixing & thoroughly dissolving of dye stuff in the right amount of water
- ✓ Use adequate amount of sequestering agent to lower bath hardness
- ✓ Proper agitation

■ **Batch to batch shade variation**

➢ **Causes**

- The fabric has the dye affinity and if pre-treatment e.g. Scouring, Bleaching has taken place in different machine
- Liquor ratio changed
- Yarn lot variation
- Process variation
- Parameters variation
- Temperature and added bulk chemicals changed
- Low quality water specially Hardness, P^H etc.

➢ **Remedies**

- ✓ Try to follow identical pre-treatment operation
- ✓ Maintain the same M:L ratio
- ✓ Adjusting the bath volume according to the material weight
- ✓ Control temperature and addition of bulk chemicals
- ✓ Check water supply daily specially the P^H and Hardness

■ **Running shade or Meter to meter**

➢ **Causes**

- Uneven scouring and bleaching
- Improper scouring wash and acid
- Low liquor ratio
- Bad dyes combination
- Rapid dosing of dyes and chemicals
- Improper dyeing method
- Improper cycle time

➢ **Remedies**

- ✓ Proper scouring and bleaching
- ✓ Proper scouring wash and acid
- ✓ Correct liquor ratio
- ✓ Good dye combination
- ✓ Dosing should be proper
- ✓ Proper cycle time
- ✓ Proper dyeing method

■ **Crease mark**

➢ **Causes**

- Faulty plaiting device
- Variation of heating and cooling rate
- Rapid steam up without gradient
- Improper fabric movement

➢ **Remedies**

- ✓ Anti-creasing agents should be used to avoid crease mark
- ✓ Heating and cooling should be done slowly with grade

■ **Soda spot**

➢ **Causes**

- Improper acid after bath drain
- Short time acid treatment
- Improper agitation of soda ash

➢ **Remedies**

- ✓ Proper acid after bath drain
- ✓ Proper time acid treatment
- ✓ Proper agitation of soda ash

■ **Chemical spot**

➢ **Causes**

- Improper amount of chemical is used
- Low quality chemical is used
- Improper wash

➢ **Remedies**

- ✓ Proper amount of chemical should be used
- ✓ Good quality chemical should be used
- ✓ Proper wash

■ **Line mark**

➢ **Causes**

- Improper wash after dye bath drain
- High bath draining temperature
- Incorrect process procedures

➢ **Remedies**

- ✓ Proper wash after dye bath drain
- ✓ Bath drain in cooling temperature
- ✓ Correct process procedure

■ **Pin hole**

➢ **Causes**

- Caustic soda dossing at high temperature
- More caustic soda is used
- Plaiting device not worked
- Injection of caustic soda

➢ **Remedies**

- ✓ Caustic soda dosing at $60^{O}C$ temperature
- ✓ Right amount of caustic soda should be used
- ✓ Plaiting device should be checked

■ **Strength loss**

➢ **Causes**

- Caustic soda dosing at high temperature
- Enzyme treatment for long time
- Excess H_2O_2 is used
- Excess NaOH is used
- More topping and stripping

➢ **Remedies**

- ✓ Caustic soda dosing at $60^{O}C$ temperature
- ✓ Right time enzyme treatment
- ✓ Right amount of H_2O_2 and NaOH

■ **Softener spot**

➢ **Causes**

- Low quality softener
- Softener P^{H}
- Improper mixing of softener

➢ **Remedies**

- ✓ Good quality softener
- ✓ Softener P^H should be 6
- ✓ Proper mixing of softener

■ **Specky dyeing**

➢ **Causes**

- Excess foam formation
- Insufficient after-treatment

➢ **Remedies**

- ✓ Anti-foaming agent should be used
- ✓ Sufficient after-treatment

■ **Fly color**

➢ **Causes**

- Insecure movement of dye stuff
- Flying of one color to another dyed fabric or white fabric

➢ **Remedies**

- ✓ Dye stuff movement should be secured
- ✓ After unloading a batch it should be covered with polyethylene bag

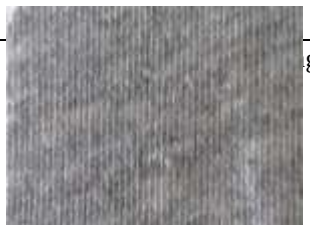
III. Results & discussion

Through using these dyeing processes different types of dyeing shades could be found for both natural & synthetic fabric. By using isothermal dyeing process all types of normal shade could be found, by using migration the critical shades could be dyed, by using turquoise dyeing process turquoise color could be dyed. For Polyester fabric coloration synthetic dyes is used in the above dyeing process. For white & grey mélange fabric the special dyeing processes are used given in the flow process. Some unique shades found through these dyeing processes are as follows:

Pink (Isothermal)

Black (Bio Scouring)

Marl Grey (Migration)



Green (Turquoise) Optic white (White) Grey Mellange (Mellange wash)

B. Blue (Polyester dyeing) Red (Isothermal) Olive (Migration)

Figure 2. Different dyeing Shades obtained from different dyeing processes

The dyeing processes discussed in this article are applied in the dyeing floor of textile composite mills & after several time trials the final procedure is obtained. The fastness obtained after these dyeing processes are also excellent. If the processes could be used effectively in the dyeing floor the fastness & quality both would become very good.

The L*, a*, b* values of fabric dyed with different dyeing processes are shown in the table. The L* indicates lightness or darkness in CIELAB color space. The L*, a*, b* indicates three different axes in the CIELAB system. The L* represent from 0(Black) to 100(White) [13].The lower the L* value the darker the color. The a* value indicates red if it becomes Positive (+) integer but becomes green if it becomes negative (-) integer. The b* value indicates Yellow if it becomes Positive (+) integer but becomes Blue if it becomes negative (-) integer[17, 18].

3.1. CIELAB Analysis

Table 1.CIE LAB (L*, a*, b*) values of different color obtained from different dyeing processes

Dyeing Process	L*	a*	b*
Dark coloration process	71.02	17.33	16.90
Medium coloration process	67.24	20.55	17.69
Light coloration process	84.12	-2.44	16.98
Turquoise coloration process	84.45	-2.17	17.90
Migration Coloration process	81.07	-0.66	30.32
CVC coloration Process	85.67	-3.43	30.77
Black coloration process	89.56	18.79	17.78

3.2.Light fastness

Light fastness test for different dyeing processes are shown in the table. The minimum range for Light fastness is 5 & maximum range is 6. The light fastness is very good excellent for differently colored fabric. It is observed that the black & turquoise color have lower color fastness to Light than compared to medium , light & turquoise colored fabric.

Table 2. Light fastness of different color obtained from different dyeing processes

Dyeing Process	Light fastness
Dark coloration process	6
Medium coloration process	6
Light coloration process	5-6
Turquoise coloration process	5
Migration Coloration process	5-6
CVC coloration Process	6
Black coloration process	5-6

3.3. Wash fastness

Wash fastness test for different dyeing processes are shown in the table. The minimum range for Wash fastness is 3 & maximum range is 5. It is observed that the black & turquoise color have lower color fastness to wash than compared to medium & light & turquoise colored fabric.

Table 3. Wash fastness of different color obtained from different dyeing processes

Dyeing Process	Change in color(Grey Scale)	Staining(Grey scale)
Dark coloration process	3-4	3
Medium coloration process	4-5	4
Light coloration process	3-4	3
Turquoise coloration process	3-4	3
Migration Coloration process	4-5	4
CVC coloration Process	4-5	3-4
Black coloration process	3-4	3

3.4. Rubbing fastness

Rubbing fastness is performed both in dry & wet conditions. The higher the ratings of crocking color fastness indicate the higher color depth & strength onto the fabric.. Rubbing fastness test for different dyeing processes are shown in the table. The minimum range for rubbing fastness is 3 & maximum range is 5. It is observed that the black & turquoise color have lower color fastness than compared to medium & light & turquoise colored fabric.

Table 4. Rubbing fastness of different color obtained from different dyeing processes

Dyeing Process	Dry Rubbing	Wet Rubbing
Dark coloration process	4-5	4
Medium coloration process	4-5	5
Light coloration process	4-5	5
Turquoise coloration process	4	3-4
Migration Coloration process	4-5	5
CVC coloration Process	4-5	4
Black coloration process	4	3-4

3.5. Perspiration fastness

Perspiration fastness test for different dyeing processes are shown in the table. The Perspiration color fastness indicates the stability of color to perspirations on different conditions of dyed fabric. The minimum range for Perspiration color fastness is 3 & maximum range is 5. It is observed that the black & turquoise color have lower color fastness than compared to medium & light & turquoise colored fabric.

Table 5. Perspiration fastness of different color obtained from different dyeing processes

Dyeing Process	Change in color(Grey Scale)	Staining(Grey scale)
Dark coloration process	3-4	3
Medium coloration process	4	4
Light coloration process	4-5	4
Turquoise coloration process	3-4	3
Migration Coloration process	3-4	4
CVC coloration Process	3-4	4
Black coloration process	4	3-4

IV. Conclusion

Dyeing of textile fabric has significant effect in manufacturing the garments. Among all other sections like spinning, Fabric (weaving or knitting), garments dyeing is most important sector. To dye the fabric properly by ensuring proper shade along with best quality is a most challenging task. Through this research it is tried carefully to find out some traditional effective dyeing processes along with some important dyeing parameters which will be extremely helpful for industrial application. If those dyeing processes are applied to the dyeing industry it would be possible to minimize the dyeing faults to a greater extent. The reprocesses, rectification & re dyeing of the fabric to overcome the dyeing faults would also be minimized so the company will be extremely benefitted economically along with saving time of manufacturing the garments.

The dyeing parameters & processes which are provided in this research work are find out through performing different trial in the dyeing machine owned by different dyeing industries. So it is thought that those processes would be highly effective for quality oriented coloration of fabric. Almost all the colors of cotton & Polyester fabric could be obtained through these dyeing processes.

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