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# Comparative study on Garments dyeing process and Fabric dyeing process on various parameters (PH, M: L, softener etc)

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***Abstract:*** *Today is the world of most scientific and advanced level of dyeing. There are huge numbers of process to do coloration. Natural and man-made colors are also used. In this research, the difference of garments dyeing and fabric dyeing are analyzed. At first we compare garments dyeing and fabric dyeing process with using respectively direct dye and reactive dye. Compare two processes we find out when we change pH in polyester fabric & get different types of shade. When we take less pH (3) then the shade become lighter, poor fastness to wash. When we take pH (6) the shade become more saturated, excellent fastness to wash. But in the process of garments dyeing shade variation less occur. We get some different types of result such as M: L, time, shade, variation, pH, cost etc.*

***Keywords:*** *Garments dyeing, Fabric dyeing, ph, M: L, Softener*

## I. INTRODUCTION

Textile coloration is combination of same series processes such as scouring, bleaching, dyeing & after treatment which can be carried out at different stages of fiber processing in different forms like staple, yarn, fabric (rope or open-width, piece & garments) Dyeing of staple forms(loose fiber) is better for achieving better colorfastness, maximum penetration and uniform migration of dues over dyeing. Piece (batch) dyeing is carried out open width or rope form in depending on machine type & end-dyes. Usually these materials are dyed in exhaust dyeing method in a single dyeing machine. But lightweight woven fabrics & garments are also possible to dye with same principle in different form of dyeing machine such as jet dyeing machine. During garment dye process, some dyeing parameter should be adjusted according to form of products-righty weaved and heavy garments need the dyes with better migration properties, higher dyeing temperature, lower liquor ration & careful circulation of goods.

Usually, textile coloration is carried out impart attracting of textiles & pretreatment is first stage of textile coloration process, plats very role on coloring on textiles. Generally loose fiber, yarn, knit fabric, garment & very lightweight synthetic woven fabric are dyed batch wise in single machine. So the batch preparation is the early step of pretreatment in coloration process.

## II. GARMENTS DYEING

This method is the best process of the dyeing of goods. However, the penetration of the dye solution may not be completely passed to the fibers such as between the seams, buttons, zippers etc. Normally, it is used for lingerie, socks, sweater dyeing etc.

In woven fabric processing generally various types of dyeing process is used. Those are:

i. Pad Dry Steam (PDS)
ii. Pad Dry Cure (PDC)
iii. Cold Pad Steam (CPS)

Machine required for those process:

i. Cold pad batch
ii. Thermosol
iii. Pad steam

**Cold pad batch:** It is the simple & easiest way of woven fabric dyeing. In this process only dark shade can be produced successfully & economically. But limitation is medium or light shade is difficult to match. It takes a long time because after dyeing it required a rotation of 8 to 12 hours.

**Thermosol:** It is a dyeing machine but it cannot produce the color as finally required or permanent. But in PDS process it can be provide finished product. By this machine only color is migrated from liquor to fabric. The it is dried on pre dryer & followed by hot air flow drying in thermosol unit. After this process color is developed in pad steam by chemical padding.

**Pad stream:** Thermosol run fabric must pass through pad steam for the development of color when CPS process is carried out. Here chemical padding is done through which color is fixed on the fabric. CPB run fabric does not require pad steam process. Here based on requirement additional dye can also added.

***2.1 Garments Dyeing Machine Specification:***

No. of machine: 01: Belly Machine
Brand Name: Nagai Shina
Origin: China
Capacity: 250 kg
Model No: NS-2260
RPM: 28
Total Quantity: 18 pcs
Maximum Temperature- 100° c

No. of machine: 02: Front Loading Machine/Computer Machine.
Brand Name: DANIS
Origin: Turkey
Capacity: 450 kg
Model No: MKM-525
RPM: 30(Fixed)
Total Quantity: 08 pcs

No. of machine: 03: Hydro Machine
Brand Name: DANIS
Origin: Turkey
Capacity: 250 kg
Model No: D-2233
RPM: 800N-1000N
Total Quantity: 08 pcs

No. of machine: 04: Dryer Machine (Steam Dryer)
Brand Name: DANIS
Origin: Turkey
Capacity: 180 kg
Model No: D-2218
RPM: 30
Total Quantity: 06 pcs

No. of machine: 05: Dryer Machine (Gas Dryer)
Brand Name: DANIS
Origin: Turkey
Capacity: 180 kg
Model No: D-2218
RPM: 30
Total Quantity: 08 pcs

***2.2 Flow chart for garments dyeing (medium / dark shade):***

M : L – 1 : 8

Garments Load - 2 kg
↓
Level in water 16 liter
↓
Wetting agent 0.5g/l NOF (70° c × 5’)
↓
Normal Wash
↓
Leveling agent LDR (60° c× 5’)
↓
Color dosing (60° c× 10’)
RG Yellow RGB - (0.44%)
RG Red RGB - (0.254%)
RG Blue RR - (0.898%)
Run 10’
↓
Salt dosing {(50g/l) 60° c × (10’ + 10’}
↓

Soda dosing {(16g/l) (60° c × 10')}
↓
Run Time 35' (sample check)
↓
A – Acid (1 g/l × 5')
↓
Fixing agent (E.C) (1g/l) – (40° c × 5 min)
↓
Raise temp. 50° c
↓
Run time 5
↓
Drain
↓
Level in
↓
Cold wash (27° c × 2min)

***2.3 Flow chart for garments dyeing (light shade):***

Level in Raise temp. (70° c × 5min)
□
Wetting + Detergent (NOF)
↓
Leveling agent (LDR) 60° c × 5min)
↓
Color dosing {60° c × (10 +10)}
{CIBA Yellow FNR - 0.048%
CIBA Red FNR – 0.048%
CIBA Blue FNR – 0.048%}
↓
Salt dosing (24g/l){60° c × (10+10)}
↓
Soda dosing {(8g/l) (60° c × 10')}
↓
Run time 35 min (sample check)
↓
Normal Wash
↓
Acetic Acid (1 g/l)
↓
Cold wash
↓
Fixing agent (E.C) (1 g/l) – (40° c × 5 min)
↓
Raise temp. 50° c
↓
Run time 5 min
↓
Drain
↓
Level in
↓
Cold wash (27° c × 2 min)

***2.4 Work procedure***

***2.4.1 Desizing:***

This process to remove the size material and increase the absorbency power of the fabric to make the fabric suitable for the next process is called Desizing.

Chemical Types:

1. Detergent – 200gm
2. Caustic soda – 400gm
3. Water – 400 L

4. Hydrogen Peroxide – 600gm
5. Temperature - 70°c

At first mixed the chemical then run the machine 10 minutes at 70°c. After this process to proper clean the machine with 800 L water.

***2.4.2 Neutral:*** Neutral is done to control the pH of this process pH must be checked. Some chemical are use for the process. At first Acetic Acid (100gm) with water 400 L to run the machine 5 minutes at 45°c. Then after this process to proper clean the machine with 800 L water for the next process.

***2.4.3 Dyeing:*** This process by which is a textile material is to be changed physically or chemically, so that it looks mono uniform colored is called Dyeing.

Dyeing Curve:

Figure 1: Dyeing curve

Alfatex + Anticrease = 45°c – 5min
Dye Chemical = 55°c – 5min + Salt after 20min
Fixing Agent
Softening Agent
Rinsing Wash
Dain

***2.4.4 Objects of dyeing:***

1. The textile goods are dyed uniformly with single color.
2. To increase the attractiveness of the textile goods.
3. To make the fabric suitable for various usage.
4. To make textile goods suitable for decorative purposes.

Some necessary chemicals are needed for this process. Such as

1. Alfatex – 500gm
2. Anticrease – 500gm

Anticrease removes crease mark. The Belly Machine run 5 minute with chemical and water at 80°c temperature then add dyestuff.

- Indosol Scarlet BL – 350GM
- Rose RR – 66.25gm
- Red BA – 153.5gm
- Salt – 15kg

Those chemical are mixed in a bath. Those chemical are taken in a Belly Mache with 800 L water to run the machine 5 minute at 80°c temperature then check garments to match the shade.

***2.4.5 Fixing:*** This is a very important process because it helps to carry dye in garments. It increases durability dye in the garments. For this process fixing agent such as hydrocol sun (300gm) and water is needed to run machine 5 minute at 40°c. Then after this process to proper clean the machine with 800 L water for the next process.

***2.4.6 Enzyme:***

This process is done when the garments carry excess dye than the buyer requirement. But when garments carry light that time enzyme process is not necessary. For enzyme process Jak powder (150gm) and pocket clear (100gm) are needed with water to run the machine 5 minute at 40°c temperature. After this process to proper clean the machine with 800 L water.

***2.4.7 Softener:*** Softener is used to soft the garments. For this process IMA and Acetic Acid are needed with water to run the machine 5 minute at 40°c temperature then garments out. After Finishing those process garments are taken out for finish dry process. Time, Temperature, Liquor Ratio must be controlled.

***2.4.8 Garments dyeing process with vat dyes:***

The following process is suitable specially for garment dyeing.
Typical recipe:
Wetting agent = 0.5 – 1.0 g/l
Sequestering agent = 1.0 - 2.0 g/l
Leveling agent = 1.0 - 2.0 g/l
Retarding agent – 5 - 7 g/l (If necessary use in hot dyes)
Dyes = 7% (owf)
Caustic soda = 5 %(according to vender recommendation)
Hydros (sodium hydrosulfite) = 5%( according to vender recommendation)
Temperature = 70°c - 80°c
Time = 30 – 50 min
M: L = 1:10

***Table 1: Different dye percentage of vat dye***

| Dye%(owf) | Reagents | Warm dyeing | Hot dyeing |
|---|---|---|---|
| 1.0 | Caustic flakes<br>Hydroz<br>Common salt | =3.0 - 4.0 g/l<br>=3.0 - 4.0 g/l<br>=5.0 - 8.0 g/l | =6.0 - 7.0 g/l<br>=6.0 - 7.0 g/l<br>=00 |
| 4.0 | Caustic flakes<br>Hydroz<br>Common salt | =4.0 - 4.5 g/l<br>=3.0 - 4.5 g/l<br>=10.0 - 12.0 g/l | =7.0 - 8.0 g/l<br>=7.0 - 8.0 g/l<br>=00 |
| 8.0 | Caustic flakes<br>Hydroz<br>Common salt | =4.5 - 5.0 g/l<br>=4.5 - 5.0 g/l<br>=12.0 - 15.0 g/l | =8.0 - 9.0 g/l<br>=8.0 - 9.0 g/l<br>=00 |

Note: considering M: L = 1:10

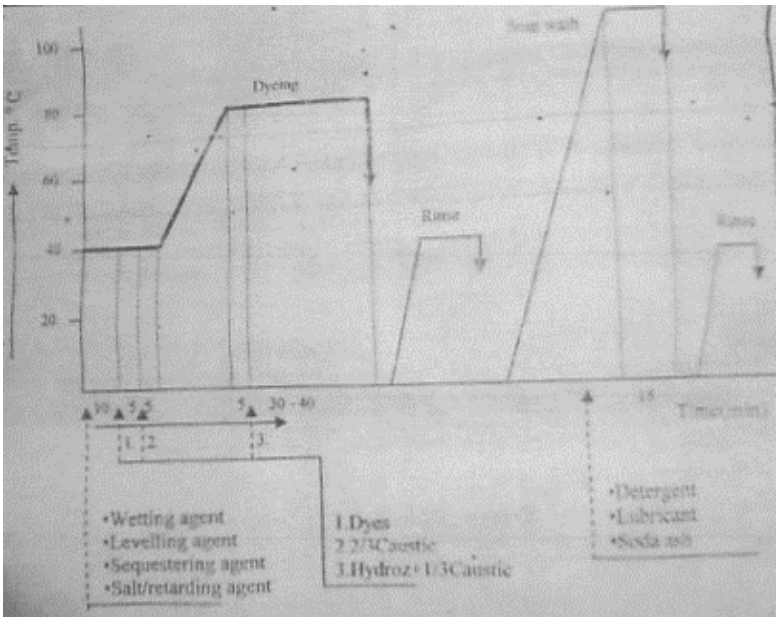


Figure 2: Process curve (dyeing of cotton goods with vat dyes)

Procedure:

1. First, settle dye bath with substrate at 40°c and wetting, sequestering agent, leveling, retarding agent (if necessary) and then run for 5 – 10 min.
2. Add dyes according to substrate weight and run the bath for 5 min.
3. Add 2/3 of caustic soda requirements and run for 5 min.
4. Raise the temperature to 70 – 80 at 2-3c/min and run for 5 min.
5. Add Sodium hydrosulfite (hydroz) to the bath with rest 1/3 amount of caustic requirements.
6. Run the bath for 30 min and maintain reduction by checking with vat reduction paper.
7. Overflow rinse until with cold water.

***2.4.9 Oxidation:*** After dyeing cycle penetrated and distributed dye molecules are oxidized to convert insoluble form into the fiber. The oxidation process can be done in contact of air or other oxidizing agent. For example, the oxidation process can be carried out treating the dyed goods with 0.5 – 1.0 g/l hydrogen 35% at 30 – 35 for 10 min.

***2.4.9.1 Soaping:***

Detergent = 1.0 – 2.0 g/l
Soda ash = 1- 2 g/l
Glucose = 95 – 100c
Time = 15 – 30 min
M: L = 1: 10 – 1: 20
The rinse the goods with cold-hot-cold water successively.

***2.4.9.2 Softening:***

1. That the good with 1.0 – 2.0% softening agent at 10 min.
2. Drop
3. Finally dry the goods uses.

## III. FABRIC DYEING

Fabric dyeing is the method after weaving, knitting or non-woven to make fabrics. This is very popular method of dyeing as the dyed fabrics will be processed further to garment industries very easily. Dyeing forms of the fabric dyeing can be used in 2 ways.

1. Open width form using the fabrics to spread without any creases and dye them.
2. Rope form using the fabrics with the form like a rope.

### *3.1 Dyeing work flow chart:*

Scouring & bleaching
↓
Per oxide hot with a/acid
↓
Enzymes wash with a/acid
↓
Leveling with sequestering
↓
Dyeing dosing
↓
Salt dosing
↓
Soda dosing
↓
Sample
↓
Drain
↓
Washing off
↓
A/acid
↓
Softener
↓
Unload

### *3.2 Dyeing machine:*

Name of the m/c: Dyeing machine
Brand Name: Dilmenlar
Manufacturing Company: Turkey
Year of Manufacturing: 2004
Machine capacity: 150 kg
No. of nozzle: 02
Maximum Temperature: 135°c
Motor: 01
Winch Motor: 01
Pump Motor: 01

### *3.3 The controlled Parameters for dyeing procedure:*

a. pH:
- During $H_2O_2$ bleaching Ph: 10.50 – 12

- During neutralization : 6.50 – 7.0
- During Enzyme : 4.50 – 7.0
- During reactive dyeing pH: 9.5 – 11.50
- During Soda dosing : 10.0 – 11.0
- Soaping : 4.50 – 6.0
- During disperse dyeing pH : 4.50 – 5.0

b. Temperature:
- For cotton scouring : 98°c
- For cotton enzyme : 55°c - 60°c
- For cotton dyeing : 98°c (For hot brand)
- For salt, Soda : 60°c
- Polyester dyeing : 135°c
- For cotton cold wash : 30°c - 40°c
- For cotton hot wash : 80°c - 90°c
- For cotton acid wash : 50°c - 60°c
- OBA application : 98°c

c. Time:
- For scouring & bleaching : 60 minute (when temp. 98°c) If 110°c, time 30min.
- For cotton enzyme : 60 minute
- For reactive dyeing : 30 minute
- For disperse dyeing : 30 minute
- For salt dosing : 30 minute
- For soda dosing : 45 – 60 min

d. M: L ratio:
- For reactive dyeing M: L ratio maintained between 1: 8
- For disperse dyeing M: L ratio maintained between 1: 10

***3.4 The calculated formula followed in production:***

01. Color (%) – Required dye (gm)= Total fabric × Recipe / 100
02. Chemical + Auxilaries (gm/l) - Required chemical (gm)= Total liquor × chemical(gm/l) / 1000

***3.5 Working Procedure:***

Firstly the detergent, Anti-creasing agent, Anti-foaming agent and Stabilizer are mixed in mixing tank, then load to machine at 50°c

↓

The temperature is risen to 60°c. Now the Caustic Soda is given to bath

↓

The Hydrogen Peroxide is given at 70°c

↓

Raise the temperature at 98°c and run for 60 minutes. Here the Ph = 11-12

↓

Rinse the fabric

↓

Hot wash is done at 80°c × 10 → Drain → Normal wash → Drain

↓

Peroxide is applied at 60°c and run for 15 minutes → Hot wash

↓

Add Acetic Acid at same temperature and run 10 minutes

↓

pH checked (pH=6.5) → Normal wash

↓

Now Acetic Acid applied at 55°c for pH control (pH= 4.50) and then Enzyme is given to bath at same temperature with 60 minute

↓

Raise the temperature (Grade rate → 2 C/min) at 80°c and run 6 minute

↓

Cold wash is done 2 times and the drained out.

## IV. DIFFERENCE BETWEEN THE GARMENTS DYEING AND FABRIC DYEING

***Table 2: Difference between the garments dyeing and fabric dyeing***

| Garments Dyeing | Fabric Dyeing |
|---|---|
| 1. When garments are made from grey fabric and then the garments are dyed in required color and shade called garments dyeing. | 1. Fabric dyeing is the method after weaving, knitting or non woven to make fabric. This is a very popular method of dyeing of the dyed fabrics will be processed further to garments industries very easily. |
| 2. Less time is required. | 2. More time is required. |
| 3. Comparatively low cost of production. | 3. Comparatively higher cost of production then garments dyeing process. |
| 4. For direct dyeing M: L ratio maintained between 1: 10 | 4. For reactive dyeing M: L ratio maintained between 1: 8 |
| 5. Wales per centimeter is not increases after dyeing process. | 5. Wales per centimeter increases after dyeing process. Because during dyeing fabric is continuously revolved. Therefore fabric gets lengthwise tension & it causes increases of WPCM. |
| 6. GSM is increase after dyeing. | 6. GSM is also increase after dyeing. |
| 7. Generally Belly machine is used for garments dyeing. | 7. Generally Jet/Jigger/Pad/ Winch dyeing machine are used |
| 8. Less production than Fabric Dyeing. | 8. Higher production than Garments Dyeing. |
| 9. Comparatively lower space is needed. | 9. Comparatively higher space is needed. |
| 10. No possibility of shade variation. | 10. It has possibility of shade variation. |
| 11. For direct dye pH is needed 4-7. | For reactive dye pH is needed 9-11. |
| 12. Sewing thread used for making the garments should be of same fiber like the garments fabric, otherwise color difference may occur between garments fabric and sewing thread. | 12. No need of sewing thread. |
| 13. After dyed garments no need processed further to garments industries. | 13. After dyed fabrics must be processed further to garments industries. |

## V. CONCLUSION

We find out that different type of using pH shade variation occur in fabric dyeing. But the garment dyeing has less shade variation. From the recipe of garments dyeing and fabric dyeing we realize that garments dyed needed M: L 1: 10. But for the fabric dyeing needed M: L 1:8 for the reason of production. After dyed garment no need processed to garments industries but for fabric dyeing fabric must be processed further to garments industries. Because garment dyeing is done after finished garments and fabric dyeing is done after weaving process. Time variation occur between two dyeing method. Because fabric dyeing is a long process and garments dyeing is a short process. Production occurs in garments dyeing is low and fabric dyeing is a high production. The capacity of fabric dyeing machine is low than the fabric dyeing machine.

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