



Faculty of Engineering

Department of Textile Engineering

**Comparative study between Turquoise color dyeing and  
Normal color dyeing on Cotton fiber**

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A thesis submitted in partial fulfillment of the requirements for the degree  
of **Bachelor of Science in Textile Engineering**

Advance in Wet Processing Technology

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## **DECLARATION**

We hereby declare that, this project has been done by us under the supervision of **Tanvir Ahmed Chowdhury** Assistant professor, Department of Textile Engineering, Faculty of 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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## **LETTER OF APPROVAL**

This project report prepared by Md. Neamul Islam bearing ID: 143-23-4013 and Biswajit Bhattacharjee bearing ID: 143-23-4079, is approved in Partial Fulfillment of the Requirement for the Degree of BACHELOR OF SCIENCE IN TEXTILE ENGINEERING. The said students have completed their project work under my supervision. During the research period I found them sincere, hardworking and enthusiastic.

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*This projects report is dedicated to our beloved parents and teachers*

## **ABSTRACT**

This report presents comparative study between turquoise color dyeing process and normal color (reactive dye) dyeing process. In this report, we discuss about turquoise color dye and normal color dye of reactive dye. We collect required sample and data from Antim Knit Composite Ltd and Niagara Textiles Ltd. Here we also comparing the color fastness to wash and rubbing fastness of turquoise color dyed fabric and normal coloured dyed fabric. We know that turquoise is a hot brand dye where normal color dyeing in lower temperature. After all our study is imperative to make a comparison between turquoise dye and normal color dye.

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# **Chapter 1**

## **Introduction**

## 1.1 Introduction

Dyeing is a process in which color is transformed to a textile material to create permanent or long lasting color. This process is done by different method. There are different types of dyes are used in textile industry for coloration of textile goods. Reactive dye one of them which is suitable for coloration of cellulosic fiber [1]. Reactive dyes are organic colored compounds which are capable of forming covalent bond between reactive group of the dye molecule and nucleophilic groups on the polymer chains within the fiber. Here dye contains a reactive group and this group creates covalent bond with the fiber polymer and act as an integral part of fiber [2]. There are some properties of this dyes these are as follows:

1. It has sulphonic acid groups in the molecules and readily soluble in water.
2. Less substantive than direct dyes, hence more salt is required for exhaustion.
3. Dyestuff reacts and combines chemically (covalently) with cellulose, so called reactive dyes.
4. Easy penetration and good leveling property.
5. Moderate to good light fastness and wash fastness properties.
6. Formation of covalent bond occurs in alkaline medium.
7. These dyes, unlike any other class of dye stuff, react and combine chemically (covalently) with cellulose and this leading to excellent wash fastness.
8. These dyes give very bright shade such as orange, pink, magenta etc, which were not possible with other class of dyes.
9. 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.
10. Reactivity of the dyestuffs can be reduced when desirable by blocking one of the reactive chlorine atoms giving H-type Procions [3].

Reactive dyes are classified in these ways:

1. On the basis of reactive group
2. On the basis of reactivity

Due to different types of classification dye affinity and fastness of the dye to fiber show different characteristics. Turquoise dye is a hot brand reactive dye which have low affinity and less fastness properties than cold brand reactive dyes. In hot brand dyes high temperature around 70 to 90°C is required where cold brand and medium brand are required low temperature. We know fastness properties of reactive dyes are moderate to good. But hot brand dyes like turquoise dye has less affinity and fastness properties because of their molecular structure and reactive group. Here we compare the dyeing process and fastness properties of turquoise hot brand and cold brand dyes.

## 1.2 Objectives

- To know about reactive dyes and its brand and classifications
- To know about the turquoise color.
- To know the properties of turquoise color.
- To know the dyeing process of Turquoise (Hot brand) dyes and normal (cold brand) dyes
- To know the fastness properties of Turquoise (hot brand) dyes and normal color (cold brand) dyes.
- To make the comparison between Turquoise dyes and Normal color reactive dyes.

## 1.3 Limitations

- It was not possible to collect all data from dyeing section because of factory limitations.
- It has taken much time to collect data list from employees because they were too much busy for obtaining required production in time.

## **Chapter – 2**

### **Literature Review**

## 2.1 Type of the Thesis

Experimental Studies

### 2.2 Turquoise color

This type of dyes contains low reactivity reactive groups. So high temperature is required for dyeing. Turquoise is a color composed of green and blue. Due to low reactivity towards fibers dyeing is carried out at the temperature between 70 to 90°C. These types of dyes also require strong alkaline medium the range of pH is around 10.5-11.

Example: PROCION H, CIBACRON [2]

Turquoise color is obtaining from hot brand reactive dyes. These dyes having lower reactivity towards cotton fiber.

Turquoise color is mainly invented from reactive dye dyeing system. It is generally hot brand dye and the dyeing process or color obtaining process is slightly complex than reactive dyes normal color dyeing process. It is mostly produced by 70% blue and 30% green.

Turquoise is sometimes described as a mixture of green color and blue color. It is a mediocre shade of blue green combination.[6]

### 2.2 Normal color (cold brand) Reactive dyes

According to the reactivity of reactive dyes cold brand dyes contains reactive group of high reactivity. So dyeing is done in low temperature. These dyes have good fastness properties and suitable for application on all dyeing process. The dyeing temperature is around 35 to 60°C.[6]

Example: PROCION M, LIVAFIX E [2].



Figure 2.1: Normal color dye

## 2.3 Turquoise Dyestuff

It is one of the most popular color in present days. Dyeing of turquoise color is very critical. Because of poor washing fastness properties of turquoise dyestuff. Dyeing procedure of turquoise color is slightly different from other dyeing.[4]

## 2.4 Turquoise Variations

1. Celeste
2. Light Turquoise
3. Turquoise blue
4. Medium turquoise
5. Dark turquoise

### 2.4.1 Celeste/ Gray Blue

The color Gray blue/ Celeste is also known as Sky bluish turquoise



Figure 2.2: Gray blue/ Celeste

### 2.4.2 Light turquoise

Light Turquoise is a lighter tone of turquoise blue.

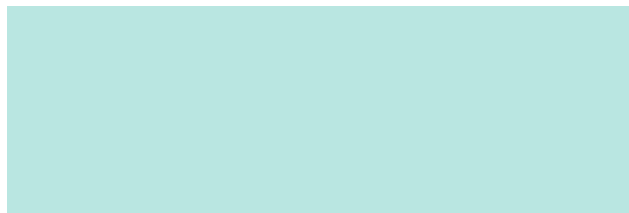


Figure 2.3: Light turquoise



### **2.4.3 Turquoise blue**

In 1900, the first turquoise blue was named as color and colored was used in that time firstly.



Figure 2.4: Turquoise Blue

### **2.4.4 Medium turquoise**

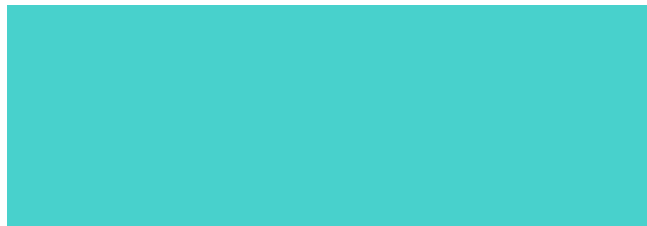


Figure 2.5: Medium turquoise

### **2.2.4.5 Dark turquoise**

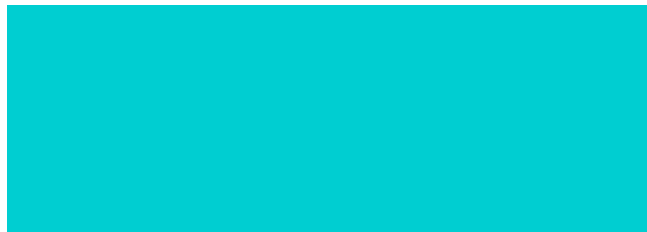


Figure 2.6: Dark turquoise

## 2.5 Some turquoise example with features

Now a day's turquoise color commonly used in our country. So, some of turquoise dye with its features are mention below:

1. Direct Turquoise Blue
2. Reactive Turquoise Blue 21
3. Reactive Turquoise Blue H5G [6]

### 2.5.1 Direct turquoise blue

Direct Turquoise Blue is used in different textile factories for coloration.

Features,

- Precisely formulated
- High solubility
- Excellent coloring nature

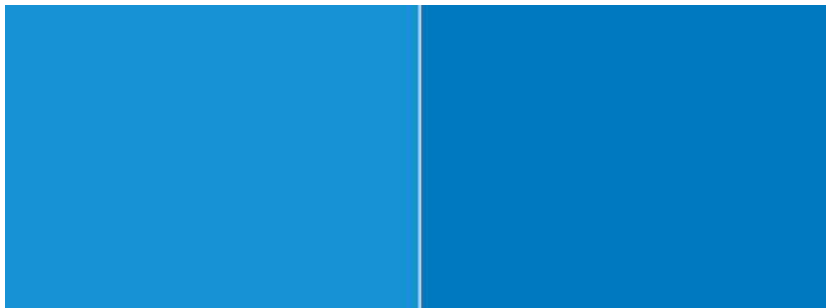


Figure 2.6 Direct Turquoise blue

### 2.5.2 Reactive turquoise blue 21

Reactive Turquoise Blue 21 is a chemical dye that is used for dyed materials like cotton, wool, silk and other polyamide textiles.

Features of these dye,

- Odorless
- Electrolyte stability is in optimum situation
- Nonflammable & non hazards
- Water soluble



Figure 2.8: Reactive turquoise blue 21

### **2.5.3 Reactive turquoise blue H5G**

Used in textile industries for dyeing linen, cotton, silk and other fibers. It has excellent fastness properties.

Features of this dye,

- Excellent solubility
- Optimum colorfastness
- Suitable for various shades

Application area,

- Dyeing
- printing



Figure 2.9 Reactive turquoise H5G

## **2.6 Dyeing of turquoise various shade**

Dyeing of turquoise color is slightly complex than normal color dyeing. Turquoise color dyeing is mainly used for produce a specific color.

Turquoise color has mainly 3 shades namely

- light shade
- medium shade
- dark shade

## **2.7 Review of the Previous Studies**

There are many researches have been done previously related to Turquoise Reactive dye. A research paper- “Coloration technique of turquoise tints with in depth analysis on shade, utility consumption and physic-chemical properties concerning batches of identical hue” by Shamim Al Azad, Hridam Deb, Md. Abdul Mueeid Alam published in February 2, 2017 which is related to turquoise coloration on knit fabric and the development of shade. Here discussed about the color fastness to wash and rubbing fastness of turquoise color. Utility consumption and physico-chemical analysis of batches is also discussed.

Another article named –“Comparison of properties of cotton fabric dyed with pigment and reactive dye” by Tanveer Hussain & Rasid Ali Published on 2 March, 2009 is related to difference and comparison shade , dyeing process and fastness of reactive dye and pigment dye when dyed to cotton fabrics.

There has no journal report made based on comparison of Turquoise dyes and normal color (cold brand) reactive dyes. But having few journal and books published on based on reactive dyes and turquoise dyeing process.

## **Chapter 3**

### **Experimental details**

### 3.1 Equipment List

- Beaker
- Digital Balance
- Glass Rod
- Gas Burner
- Tri-pod Stand
- Crock Meter
- Scissor
- Light Box
- Gray Scales
- Fabric inspection glass
- Crock cloth
- Multi-fibre

### 3.2 Textile Materials

We have done all of our experiments by using only one type of textile fabric which is a single jersey knitted fabric. The samples are dyed. We collected those dyed sample from a knit composite industry during our internship period.

### 3.3 Experimental Procedure

Our experimental project based on three different shade percentage of turquoise dyes and cold brand dyes which for light shade, medium shade and dark shade. Our experiment is about difference of dyeing processing and fastness between Turquoise hot brand and cold brand reactive dyes. So dyeing of turquoise dye and cold brand dye is done and then fabric is collected. After dyeing and finishing fabric is tested to measure rubbing fastness and color fastness to wash.

### 3.4 Basic Difference between Reactive dye normal colour & Turquoise color.

Table 3.1 Difference between reactive dye and turquoise dye dyeing

Sl. no.	Turquoise dyeing	Normal (cold brand)dyeing
Process	Slightly complex than any other dyeing	More easier than turquoise dyeing.

Cost	Comparatively cheap	Comparatively higher than turquoise
Dyeing temp	High temperature	Low temperature
Reactivity	Lower	Higher
Fastness properties	Comparatively less	Good
Affinity	Turquoise dye has less affinity but quality of dye and company play an important role for good dye fastness	Good affinity than turquoise.

### 3.5 Turquoise color dyeing Process

#### 3.5.1 Recipe

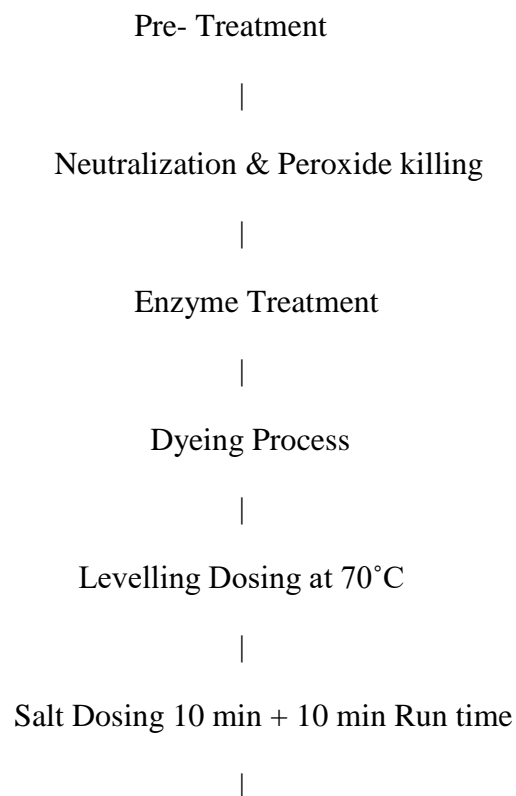
Table 3.2 Recipe of Turquoise Dye Dark shade (Hot Brand)

Process parameter	Unit	Dosing
Corazol Turquoise Blue	% (owf)	5
Corazol Yellow RD	% (owf)	0.03
Corazol Bri Sky Blue	% (owf)	0.3
Levelling Agent	g/L	0.5
Glauber Salt	g/L	50
Soda	g/L	10
pH		11-12
Temperature	°C	70 to 90
Time	Minute	120 to 150
M:L		1:6
Fabric Type		Single Jersey
Fabric Weight	Kg	160

Table 3.3 Recipe of Turquoise light shade (Hot Brand)

Process parameter	Unit	Dosing
Corazol Turquoise Blue	% (owf)	1
Corazol Bri. Sky Blue	% (owf)	0.1
Levelling Agent	g/L	0.5
Glauber Salt	g/L	20
Soda	g/L	5
pH		11-12
Temperature	°C	70 to 90
Time	Minute	120 to 150
M:L		1:8
Fabric Type		Single Jersey
Fabric Weight	Kg	160

### 3.5.2 Flowchart of Turquoise dyeing





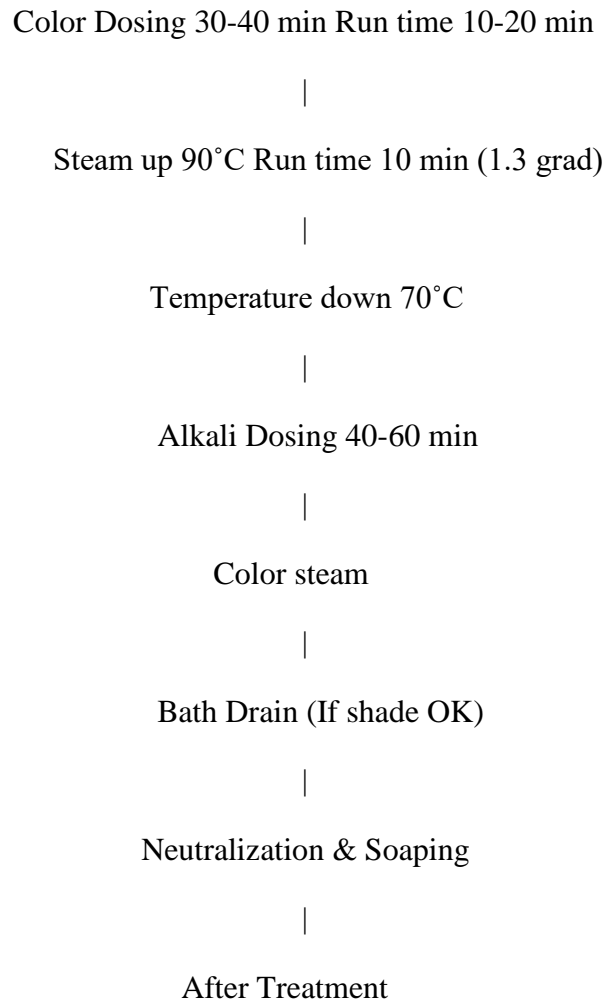


Figure 3.1: Process flowchart of Turquoise dyeing (Hot brand)



Figure 3.2: Sample color of turquoise dye

## 3.6 Normal color dyeing process

### 3.6.1 Recipe

Table 3.4 Recipe for normal color reactive dye light shade (Cold Brand)

Process parameter	Unit	Dosing
Corazol Bri. Blue	% (owf)	0.5
Corazol Bri Yellow 3GL	% (owf)	1
Corazol Red RD	% (owf)	0.1
Levelling Agent	g/L	0.5
Glauber Salt	g/L	50
Soda	g/L	5
pH		11-12
Temperature	°C	60
Time	Minute	120 to 150
M:L		1:6
Fabric Type		Single Jersey
Fabric Weight	Kg	50

Table 3.5 : Dyeing recipe of normal color Reactive Dye Dark shade (cold brand)

Process parameter	Unit	Dosing
Corazol Yellow RD	% (owf)	0.03
Corazol Bri. Blue RN	% (owf)	5
Levelling Agent	g/L	0.5
Glauber Salt	g/L	50
Soda	g/L	10
pH		11-12
Temperature	°C	60
Time	minute	120 to 150
M:L		1:6
Fabric Type		Single Jersey
Fabric Weight	Kg	160

### 3.6.2 Flowchart of dyeing normal color

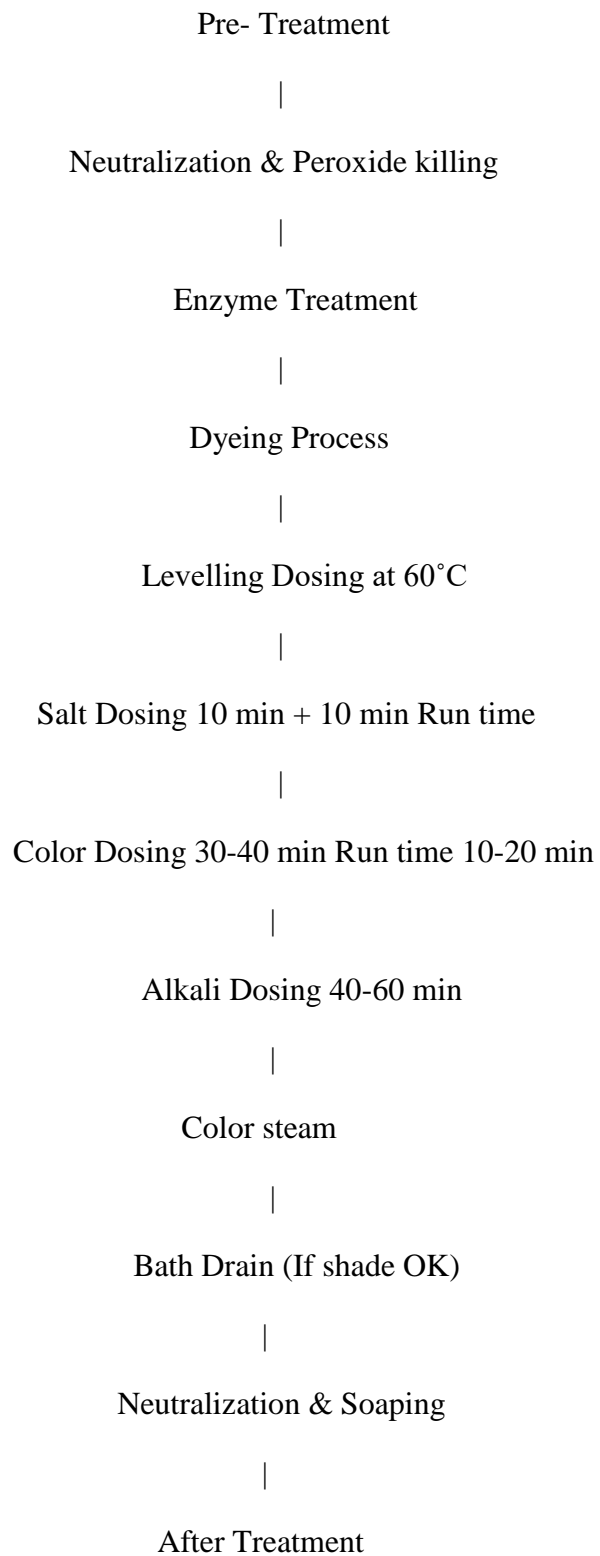


Figure 3.3: Process flowchart of cold brand dye



Figure 3.4 sample of normal color ( cold brand) dyes

### 3.7 Testing of color fastness to wash

Table 3.5: Recipe for color fastness to wash

Process Parameter	Unit	Dossing	Stock Solution
Detergent	g/L	4	1%
Sodium Perborate	g/L	1	1%
Stainless Steel Ball		10	
M:L		1:50	
Temperature	°C	40	
Time	min	30	

#### 3.7.1 Calculation:

$$\text{Total Liquor:} = 50\text{mL}$$

$$\begin{aligned} \text{Detergent :} &= \frac{50 \times 4}{1\% \times 1000} \text{ mL} \left( \frac{\text{Total Liquor} \times \text{chemical amount in gm/L}}{\text{Stock solution} (\%) \times 1000} \right) \\ &= 20\text{mL} \end{aligned}$$

$$\begin{aligned} \text{Sodium Perborate :} &= \frac{50 \times 1}{1\% \times 1000} \text{ mL} \left( \frac{\text{Total Liquor} \times \text{chemical amount in gm/L}}{\text{Stock soluti on} (\%) \times 1000} \right) \\ &= 5\text{mL} \end{aligned}$$

Required initial water = Total Liquor - (chemicals)  
= 50 - (20+5)mL  
= 50-25 mL  
= 25mL

### 3.7.2 Process Flow chart

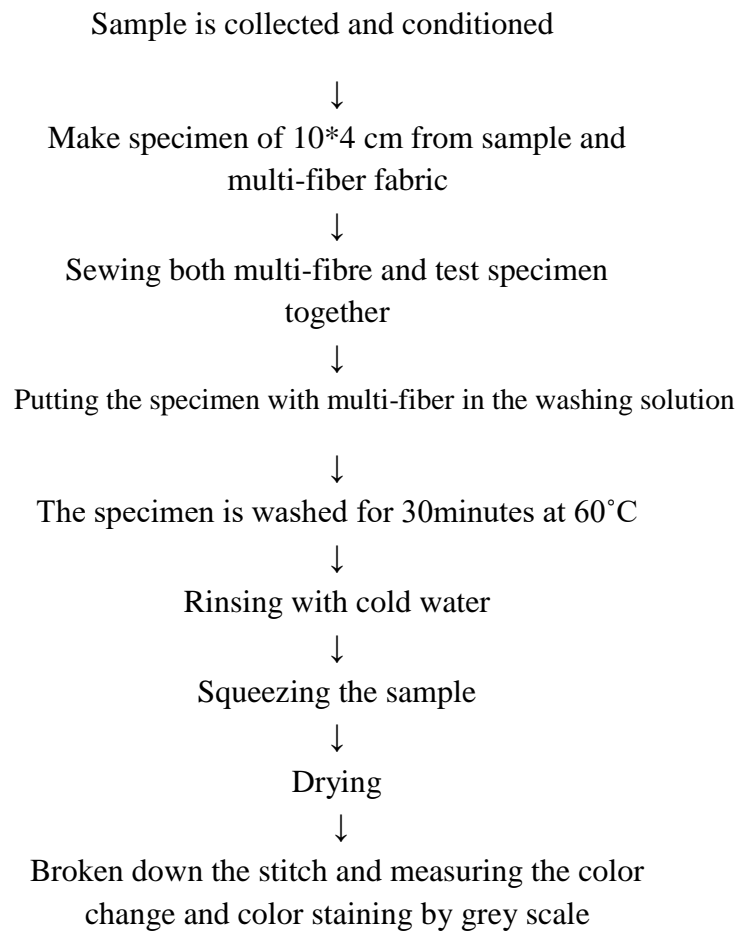


Figure 3.5: Process flowchart of color fastness to wash

### 3.7.3 Process curve

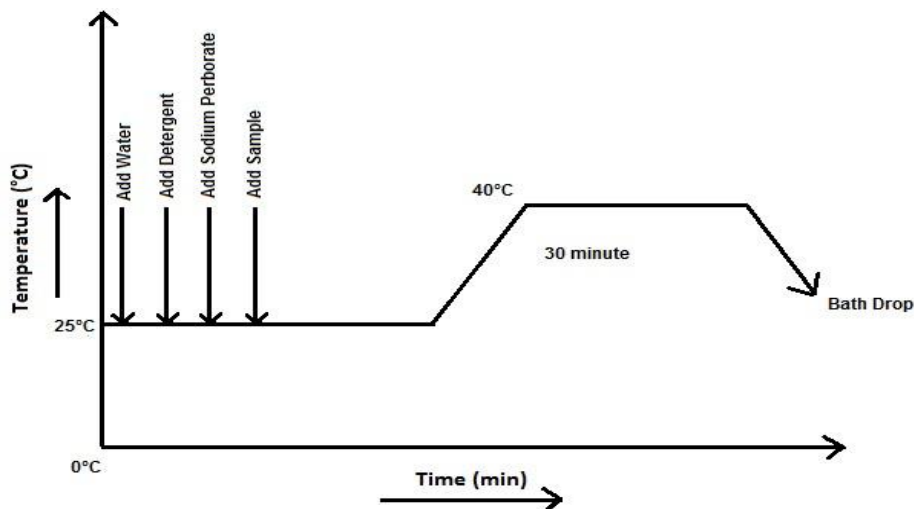


Figure 3.6: Process curve of color fastness to wash

## 3.8 Testing of Color Fastness to rubbing

Two types of rubbing test are done:

- ❖ Dry rub
- ❖ Wet rub

### 3.8.1 Testing Procedure

- Test specimen 15cm x 5cm is placed on the base of the Crock meter.
- A square of white test cloth (5cm x 5cm) which is of plain weave, desized, bleached but without finished cotton fabric (as ready to dye) is taken. □ White test cloth is attached to the finger of the crock meter.
- This finger is used in rubbing action on the sample specimen
- Rubbing is done to and fro, 10 cycles at 10seconds, i.e.20 rubs in 10s and finger pressure on the specimen is 9N.
- Rubbing test is done both for warp way and weft way.
- For dry and wet rubbing test, separate sample is used.
- For wet rubbing, the sample is dry but crocking cloth is wet. For wetting, M:L ratio is maintained not less than 1:50,water is drained after wetting and not squeezed.

### 3.8.2 Assessment Technique

- The tested sample compared with dyed sample and under light box using D65 light source and rated by the help of color change gray scale.
- The Dry rubbed crock cloth also visually assessed under light box with D65 light source and rated with the help of color staining gray scale.
- In case of wet rubbed cloth at first it assessed after drying the crock cloth the procedure was same as dry rubbed crock cloth

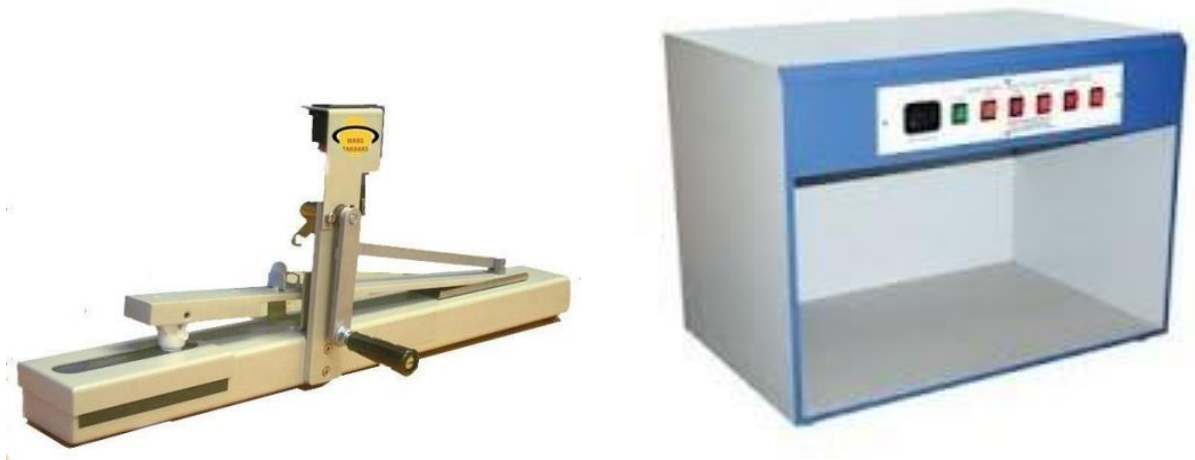


Figure 3.7 : Crock Meter (Left) & Light Box (Right)

## **Chapter 4**

### **Discussion of Result**



## 4.1 Color fastness to wash testing result

### 4.1.1 Result of Turquoise color (Light shade)



Figure 4.1: Multi-fibre after washing with light shade

Table 4.1.: Rating of staining (Multi-fibre) for light shade

Acetate	Cotton	Nylon	Polyester	Acrylic	Wool
4\5	4	4	5	5	5

**Rating for color change: 4**

### 4.1.2 Result of Turquoise Color (Medium shade)



Figure 4.2: Multi-fibre after washing with medium shade

Table 4.2: Rating of staining (Multi-fibre) for medium shade

Acetate	Cotton	Nylon	Polyester	Acrylic	Wool
4\5	3\4	4	5	4\5	5

**Rating for color change: 3\4**

### 4.1.3. Result of Turquoise Color (Dark shade)



Figure 4.3: Multi-fibre after washing with dark shade

Table 4.3: Rating of staining (Multi-fibre) for dark shade

Acetate	Cotton	Nylon	Polyester	Acrylic	Wool
4	3	4	4\5	4\5	4\5

**Rating for color change: 3\4**

### 4.1.4 Result of Normal color Reactive dye (Light shade)



Figure4.4: Multi-fibre after washing with light shade

Table 4.4: Rating of staining (Multi-fibre) for light shade

Acetate	Cotton	Nylon	Polyester	Acrylic	Wool
5	4\5	5	5	5	4\5

**Rating for color change: 4\5**

#### 4.1.5 Result of Normal color Reactive dye (Medium shade)



Figure4.5: Multi-fibre after washing with medium shade

Table 4.5 Rating of staining (Multi-fibre) for medium shade

Acetate	Cotton	Nylon	Polyester	Acrylic	Wool
4\5	4\5	5	5	5	5

**Rating for color change: 4**

#### 4.1.6 Result of Normal color Reactive dye (Dark shade)



Figure4.6: Multi-fibre after washing with dark shade

Table 4.6 Rating of staining (Multi-fibre) for dark shade

Acetate	Cotton	Nylon	Polyester	Acrylic	Wool
4\5	4	4	5	4\5	5

**Rating for color change: 4**

## 4.2 Assessment for Rubbing fastness of turquoise dye

Table 4.7: Color Fastness to Rubbing for light shade

<b>Dry Rub</b>	<b>Wet Rub</b>
4\5	4

Table 4.8: Color Fastness to Rubbing for medium shade

<b>Dry Rub</b>	<b>Wet Rub</b>
4\5	3\4

Table 4.9: Color Fastness to Rubbing for dark shade

<b>Dry Rub</b>	<b>Wet Rub</b>
4\5	2\3

## 4.3 Assessment for Rubbing fastness of Normal color Reactive dye

Table 4.10: Color Fastness to Rubbing for light shade

<b>Dry Rub</b>	<b>Wet Rub</b>
5	4

Table 4.11: Color Fastness to Rubbing for medium shade

<b>Dry Rub</b>	<b>Wet Rub</b>
4\5	4

Table 4.12: Color Fastness to Rubbing for dark shade

<b>Dry Rub</b>	<b>Wet Rub</b>
4	3\4

## 4.6 Differences of the results between Reactive normal color (cold brand) and Turquoise color

After doing all of those tests we found a comparative result between Turquoise (Hot brand) and cold brand of reactive dye. The result of color fastness to wash is shown in **Table-4.13**, the result of color fastness to rubbing is shown in **Table-4.14**

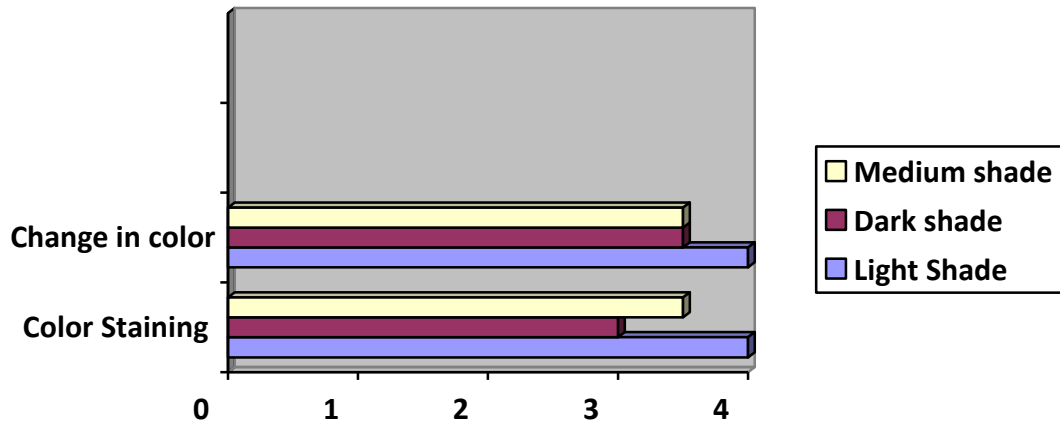
Table 4.13: Comparison of color fastness to wash between turquoise and cold brand reactive dye

Turquoise dye (Hot brand)			Cold brand dye		
Shade	Color staining	Change of color	Shade	Color staining	Change of color
Light shade	4	4	Light shade	4\5	4\5
Medium Shade	3\4	3\4	Medium shade	4	4\5
Dark shade	3	3\4	Dark shade	4	4

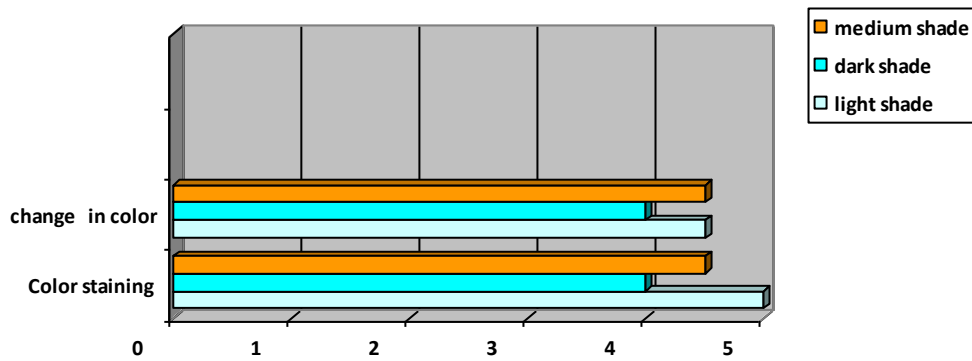
Table 4.14: Comparison of rubbing fastness between turquoise and normal color of reactive dye

Turquoise dye (Hot brand)			Cold brand dye		
Shade	Dry	Wet	Shade	Dry	Wet
Light shade	4\5	4	Light shade	4\5	4
Medium Shade	4\5	3\4	Medium shade	4\5	4
Dark shade	4	2\3	Dark shade	4	3\4

## 4.8 Result in Chart

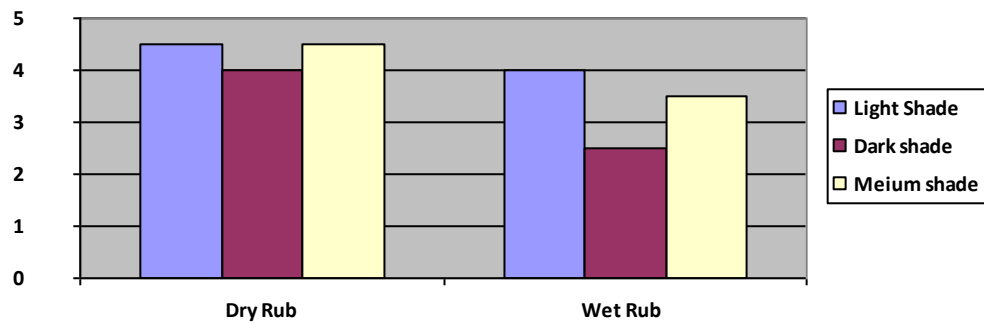


Graph 4.1: Wash fastness result of Turquoise color

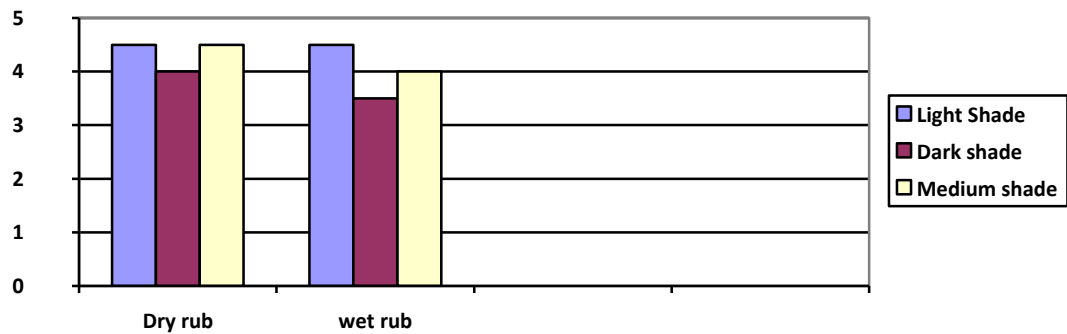


Graph 4.2: Wash fastness result for Normal color

## 4.9 Result in Chart for Rubbing fastness



Graph 4.3: Rubbing fastness result of Turquoise color



Graph 4.4: Rubbing fastness result of Normal color

The higher the dye shade% the poorer the fastness properties. When the shade% is less, the fastness properties for both turquoise and cold brand dyes are almost same but when the shade% is increased the turquoise dyed samples provide less fastness than the cold brand dyed sample.



## **Chapter 5**

### **Conclusion**

## **Conclusion**

We know that now a day's reactive dye is the most popular dyes to dye the cellulosic fibers because of great affinity towards cellulosic fiber. By forming covalent bond reactive dye molecule linkage with fiber structure and show moderate to good fastness properties. According to the reactivity of these dye turquoise dye which is hot brand dye has less affinity than cold brand dye. So during dyeing with turquoise dye due to less affinity high temperature is required for color producing to the fabric where cold brand required less temperature than hot brand dye. This poor affinity to fiber also cause of weak color fastness properties for the fabric and for good affinity of cold brand dyes its showing better fastness properties than turquoise dye. For light shade both dye show almost similar fastness properties but in medium and dark shade we see the difference. Though turquoise dye has less affinity but quality of dye and company play an important role for good dye fastness. We hope that this work will be imperative and helpful for the readers and industry people to do further work with turquoise.

## References

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- [5] [Sky blue - Wikipedia](#) (22-7-18; 11 Am)
- [6] [Turquoise \(color\) - Wikipedia](#) (22-7-18; 11 am)