Faculty of Engineering

Department of Textile Engineering

Project (Thesis) Report on

Effects of Bleaching in Textile Dyeing Properties

Course Code: TE-4214 Course Tittle: Project (Thesis)

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

Major in Wet Processing Technology

DECLARATION

I hereby announce that this Project (Thesis) report has been prepared by us under the supervision of **Md. Kamrul Islam**, Lecturer, Department of Textile Engineering, Faculty of Engineering, Daffodil International University. We also declare that either this report or any part of it has been submitted for the award of any degree.

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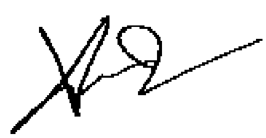
LETTER OF APPROVAL

This Project (Thesis) report has been prepared by **Azfar Ahmed Alvee (ID: 201-23-814) & Sadia Reza Srity (ID: 201-23-770)** has been partially approved to meet the requirements for the degree of **Bachelor of Science in Textile Engineering**. The mentioned students have completed their Project (Thesis) work under my supervision. During the research I found them sincere, hardworking and enthusiastic.



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ACKNOWLEDGEMENT

First of all, I would like to express my gratitude to Almighty Allah for his heavenly blessings that enabled us to successfully complete this Project (Thesis).

We are grateful to our Supervisor **Md. Kamrul Islam**, Lecturer, Department of Textile Engineering, Faculty of Engineering, Daffodil International University. Our supervisor's deep knowledge and keen interest in textile dyeing and finishing influenced us to carry out Project (Thesis) work, his unlimited patience, scholarly direction, constant encouragement, energetic supervision, constructive criticism, valuable advice, much lower reading. This Project (Thesis) has been completed by drafting and revising at all stages.

We would like to thank **Mr. Tanvir Ahmed Chowdhury,** Assistant Professor & Head (In-Charge), Department of Textile Engineering, Daffodil International University for his kind help in concluding our Project (Thesis) report.

Our special thanks go to **Shahin Khalil**, Unit Deputy Manager (Fabric Lab Dip), Interstoff Apparels Ltd. for guiding us during whole thesis and for granting us permission to work in the lab and we also thanks to **Selim-uj-jaman Akash**, Lab Assistant, Textile Wet Processing Laboratory, Daffodil International University for his helpful hand and cordial cooperation.

Finally, we would like to thank our entire course partners at Daffodil International University who participated in the discussion during the completion and writing of the Project (Thesis) report.

This Project (Thesis) report is dedicated to my love

With the affection, love, inspiration and prayers of our parents and teachers, I have been able to achieve such successand respect.

Abstract

In this study, three different bleaching recipes (Full bleaching, Half bleaching, No bleaching) were used on 100% cotton S/J fabric samples before dyeing them in different shades (0.5%, 1%, 1.5% & 2%) using reactive dye to verify possible changes in color of depth of fabric sample. Bleaching agent used in this study is 50% H_2O_2. The color strength (K/S value), Wash fastness, Dry & Wet rubbing fastness, Water fastness & CMC decision were evaluated after the dyeing process. The findings that were collected after testing shows that the Full bleached fabric sample were better than the half & no bleached fabric sample. Half bleached & no bleached fabric sample were more redder or greener and less saturated in shade than full bleached fabric sample. The entire set of full bleached, half bleached & no bleached dyed samples demonstrated good wash and rubbing fastness over a spectrum of different shades.

KEY WORDS: Bleaching & Dyeing, Full Bleached fabric, Half bleached fabric, No bleached fabric, Color Strength, Fastness

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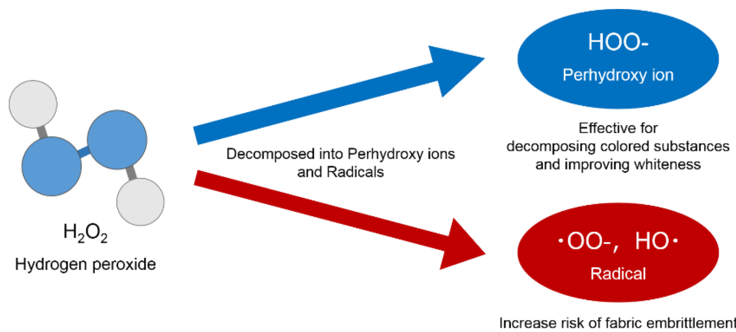
CHAPTER- 01

INTRODUCTION

1.1. Introduction

Bleaching textiles has been practiced for a long time. The chemical treatment known as "textile bleaching" is used to remove natural colors from the cotton fiber. Natural color originates from organic molecules that have conjugated double bonds. A conjugated system's double bonds are most often destroyed when the chromophore is broken by chemical bleaching, resulting in discoloration. For a variety of cotton goods to be produced successfully, bleaching is essential. The main goal of bleaching cotton is to make material whiter and more attractive after dyeing.



Different oxidizing (e.g., H_2O_2, NaOCl, KMnO4) or reducing (e.g., $Na_2S_2O_4$, $NaHSO_3$) agents are used to bleach fabrics [4]. In this study, an experiment was designed to investigate the effects on cotton fabric dyeing of using three types of bleaching recipes that contain 50% hydrogen peroxide (H_2O_2). Three types of bleached & dyed fabrics (Full bleached, Half bleached, No bleached) were evaluated for their color strength (K/S value), followed by evaluation of their washing & rubbing fastness properties.

Here full bleached fabric means the fabric was bleached by following conventional industrial bleaching recipe. Whereas, half bleached fabric refers to the fabric which was bleached by using half quantity of hydrogen peroxide (H_2O_2). And lastly, no bleached fabric is the fabric which is only scoured.

A large volume of waste water was released into the environment because of the chemical used in the dyeing industries. This has a direct impact on rivers, farmland, and the environment. For this reason, if we reduce the usage of chemical in wet processing, it will be very grateful for environment and textile industry.

In this study we can found, the reduction of hydrogen peroxide (H_2O_2) during bleaching does affect the dyeing or not. We will also find out the fastness properties & color strength of full bleached dyed fabric, half bleached dyed fabric & no bleached dyed fabric.

1.2. Objectives

The following is a list of the thesis objectives:

- To find out the effect of bleaching in textile dyeing properties.
- To dye 100% cotton s/j fabric after bleaching that fabric with three different bleaching recipe (Full bleaching, Half bleaching, No bleaching).
- To find shade variation between full bleached, half bleached & no bleached dyed fabric.
- To compare of fastness properties (Wash, Rub & Water) & color strength test between full bleached, half bleached & no bleached dyed fabric.
- To reduce the usage of hydrogen peroxide (H_2O_2).
- To reduce environmental pollution

CHAPTER- 02
LITERATURE REVIEW

2.1. Bleaching

The word "bleach" comes from a French word that means "to whiten." Bleaching basically means eliminating the materials that are responsible for making the material colorful. Bleaching is done in order to make a material whiter. One of the processes in the production process of textiles is the bleaching of textiles, or textile bleaching. Removing the natural color in preparation for subsequent processes like dyeing or printing, or reaching complete whiteness, is the aim of bleaching. The purification of textile materials, scouring and bleaching, followed a characteristic routine in which secret recipes were handed down from father to son. **(N. H. CHAMBERLAIN, An Introduction to Textile Bleaching)** [2]

2.1.1. Types of Bleaching

The following is a list of Types of Bleaching:

- **Oxidative bleaching:** Typically, sulfuric acid, sodium hypochlorite, or sodium chlorite are used in oxidative bleaching methods. Usually, oxidative methods are used to bleach natural textiles like cotton, ramie, jute, wool, and regenerated fibers like bamboo.

- **Oxygen bleaching:** As a bleaching agent, oxygen degrades quickly. It works by "destroying the phenolic groups and the carbon–carbon double bonds" to produce its bleaching effect. H_2O_2, or hydrogen peroxide, is the main chemical bleaching agent. The most popular and ecologically beneficial way to bleach cotton is using H_2O_2. When employing caustic soda, the optimum bleaching whiteness is obtained at pH 11. [3]. It has a single bond, (–O–O–). Approximately 60% of the world's hydrogen peroxide supply is utilized for bleaching textiles. For textile, hydrogen peroxide is the most effective bleaching chemical. **(J. P. Farr, W. Smith, D. Steichen, Bleaching Agents, Survey)** [1]

- **Reductive bleaching:** Sodium hydrosulphite is a strong reducing agent used in reductive bleaching. Reductive bleaching method is useful for bleaching fibers such as Nylon, Acrylic, Acetates etc.

2.1.2. Objectives of Bleaching

- To eliminate the natural color.
- to permanently create a brightening white fabric.
- in order to boost the cloth's ability to absorb water and chemicals.
- to improve the affinity of the dye.
- to guarantee even coloring properties.

- to prepare the fabric for the next procedure.

2.2. Dyeing

Dyeing is the application of dyes or pigments to textile materials such as fibers, yarns, and fabrics to get the desired color and color fastness. Usually, dyeing is done in a specially formulated solution that combines dyes and a particular chemical. The key influencing factors for whether dye molecules link, diffuse, or absorb onto the fiber are temperature and time. In the past, nature has been the main source of dye. Animals or plants are used to extract the colours.

2.3. Dye

In the context of textiles, a dye is a substance that is used to color fibers, yarns, fabrics, or other textile materials. The textile business relies heavily on dyeing since it enables manufacturers to produce fabrics in a variety of hues and designs. The two primary categories of dyes are natural dyes and synthetic dyes.

- Natural Dyes: These dyes come from minerals, plants, or animals. Before synthetic dyes were created, natural dyes were the main method of coloring fabrics in the past. Indigo (made from the indigo plant), madder (from the madder root), and cochineal (from insects) are a few examples of natural dyes.

- Synthetic Dyes: These are dyes that have been chemically manufactured in laboratories. In addition to providing a larger variety of colors than natural dyes, they are frequently more stable and predictable. Due of their adaptability and accessibility, synthetic dyes have largely supplanted natural dyes in the modern textile business.

2.3.1. Introduction to Synthetic Dyes

Synthetic dyes are chemical substances made in labs with the specific purpose of coloring textiles, paper, plastics, and other materials. Due to their many benefits, which include a larger spectrum of hues, increased colorfastness, and ease of manufacture, they represent a huge improvement in the dyeing business and have essentially supplanted natural dyes. Here are some essential traits and details about synthetic dyes:

Wider Color Spectrum: When compared to natural dyes, synthetic dyes offer a wider spectrum of colors. Synthetic dyes are extremely adaptable and can be used in a wide range of applications because chemists can alter the molecular structure of these dyes to produce a huge variety of hues and tones.

Stability: Compared to natural dyes, synthetic dyes are typically more stable and fade-resistant. They frequently offer higher colorfastness, meaning that their color stays unchanged over time despite exposure to things like light, wash, perspiration, rubbing etc.

Availability: The availability of synthetic dyes in commercial quantities makes it possible for producers to effectively meet the demands of large-scale production.

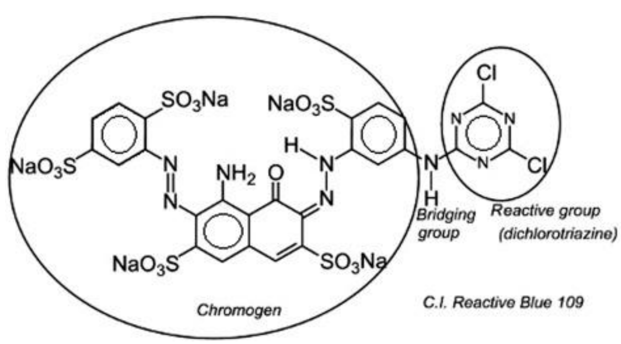
Classification: Synthetic dyes can be grouped according to their chemical constitution and functionality. Azo dyes, anthraquinone dyes, direct dyes, and disperse dyes are a few examples of popular synthetic dye categories. Each category has special traits and uses of its own.

Environmental Concerns: Although synthetic dyes have many benefits, there are some questions about how they may affect the environment. Certain synthetic colors can cause pollution during production and disposal, especially in wastewater.

2.3.2. Reactive Dyes

Reactive dyes are a class of synthetic dyes primarily used for coloring textiles, including cotton, wool, silk, and other natural fibers. Since they create a covalent link between the dye and the fiber molecules through chemical reactions, these dyes are referred to as "reactive" dyes. Reactive dyes are more colorfast and resistant to fading, washing, and light exposure than other dyes because of this chemical bond. Reactive dyes contain reactive groups that form covalent bonds with functional groups present in the textile fibers, such as hydroxyl (-OH), amino ($-NH_2$), or sulfonate ($-SO_3H$) groups. Reactive dyes can be applied to textiles using various methods, including exhaust dyeing, continuous dyeing, and printing. Reactive dyes are widely used in the textile industry due to their excellent colorfastness, vibrant colors, and compatibility with cellulosic fibers, making them a preferred choice for dyeing cotton and other natural textiles.

2.3.2.1. Structure of Reactive Dye



2.3.2.2. Properties of Reactive Dye

- Reactive dye is anionic in nature.
- Reactive dye is soluble in water.
- They establish a covalent connection with the textile material.
- For dying cellulosic textiles, reactive dyes are widely utilized.
- Additionally, they can be utilized to color protein fibers.
- They obtain a 6 grade for light fastness.
- Because they form a strong chemical bond with the fibers through a covalent bond, they have good wash fastness (graded 4-5).
- They rub fastness is moderate.
- Fixation and the dyeing process take place in an alkaline environment.
- The dyeing process requires a large amount of electrolyte.
- comparatively inexpensive

2.4. Types of Fabric

Fabric is a flexible material typically composed of yarn or thread, which is made by weaving, knitting, felting, or bonding fibers together. It is one of the primary components used in textile production and is utilized for various purposes, including clothing, upholstery, bedding, and industrial applications.

There are many types of fabric:

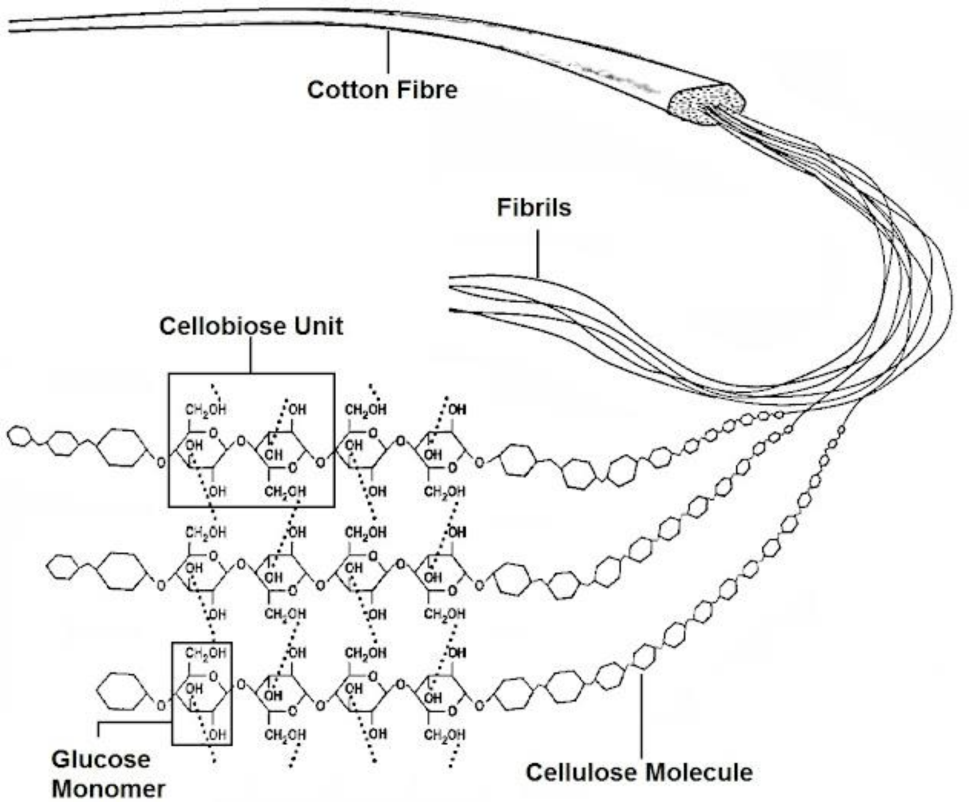
- **Synthetic fabric** (Polyester, Nylon, Spandex etc.)
- **Natural fabric** (Jute, Hemp, Cotton, Wool, Silk etc.)

2.4.1. Cotton Fabric

One of the most popular and versatile fabric in the world is cotton. It is created from cotton fibers, which are mostly made up of cellulose, a natural polymer. Cotton fabric is prized for its softness, breathability, toughness, and flexibility, which make it ideal for a variety of uses, from apparel to home textiles. Cotton fabric is known for its smooth and comforting feel next to the skin. Cotton fabric has a great capacity for air circulation, which facilitates the quick drying out of moisture. Cotton fibers are able to take in and hold onto moisture from the skin due to their high absorbency rate. It is also strong and durable. Cotton fibers have good tensile strength. Cotton is an environmentally favorable material for textiles since it is a natural fiber that is renewable and biodegradable. Cotton fabric is a popular option for a variety of apparel, home textiles, and other uses because of its value mix of comfort, breathability, durability, and versatility.

2.4.2. Structure of Cotton Fiber

Cotton fibers are renowned for feeling smooth and comfortable on the skin. Since cotton fibers naturally have a smooth surface, its softness can be attributed to this feature.



2.4.3. Properties of Cotton Fiber

- **Physical Properties:**

  - **Elongation:** We cannot stretch Cotton so easily. Its elongation (5-10%).
  - **Elasticity:** (2-5%)
  - **Strength:** 6 CN/Tex
  - **Effect of moisture:** It has a moisture regain of 8.5% & water absorbency (25-27%).

- **Chemical Properties:**

  - **Effect of acid:** Cotton is highly affected by hot dilute acids.
  - **Effect of alkalis:** Cotton has an excellent resistance to alkalis.
  - **Effect of micro- organism:** Cotton gets attacked by fungi & bacteria.

2.5. Function of Dyestuffs & Chemicals used in this study

- **Reactive Dye:** The coloring substance used to produce color in cotton fabric. Two different shades of reactive dye (Blue & Navy) used in this study.

- **Hydrogen peroxide (H_2O_2):** Used as bleaching agent to remove natural color of cotton fabric in order to produce a permanent white effect.

- **Peroxide Stabilizer:** It controls the rate at which hydrogen peroxide decomposes during peroxide bleaching by behaving as a regulator or controller.

- **Levelling agent:** This type of chemical agent contributes to achieve even dyeing by causing the dyes to be distributed uniformly throughout the fibers.

- **Caustic Soda (NaOH):** It removes the natural impurities of cotton fiber during scouring process.

- **Detergent:** It removes the added impurities of cotton fiber like dirt, dust etc. during scouring process.

- **Soda Ash (Na_2CO_3):** It is used to control the pH of reactive dyeing bath. Soda ash is also used in dyeing of cotton goods to fix dyes with the fiber by covalent bond formation.

- **Glauber Salt:** Used as an electrolyte in reactive dyeing to neutralize the negative charge of cotton fiber so that the affinity of reactive dye gets increased towards cotton fiber.

- **Wetting agent:** To remove surface tension of water so that the dye and other chemicals can easily penetrates to the fiber molecule.

- **Sequestering agent**: To remove hardness of water.

CHAPTER- 03
MATERIALS AND METHODS

3.1. Materials used in this study

3.1.1. Fabric

Composition: 100% Cotton
Type: Knit
Structure: Single Jersey
GSM: 160

3.1.2. Dyes

In this Study, Novacron and Levafix brand reactive dyes are used. For Novacron dyes 0.5%, 1%, 1.5% and 2% shade has been performed. For Levafix dyes 0.2%, 0.5%, 1% and 1.5% shade has been performed. All the dyes were collected from Interstoff Apparels Ltd.

3.1.3. Chemicals & Auxiliaries

For Scouring & Bleaching, 50% hydrogen peroxide (H_2O_2), Peroxide Stabilizer, Wetting agent, Sequestering agent, Caustic soda (NaOH) & Detergent were used. 50% hydrogen peroxide (H_2O_2) were collected from the Magpie knit composite Ltd. The other chemicals were collected from the Wet processing laboratory of Daffodil International University.

For Dyeing, Glauber Salt, Soda Ash, Wetting agent & Sequestering agent were used. All the chemicals were collected from the Interstoff Apparels Ltd.

3.2. Machines used in this study

3.2.1. GSM Cutter

GSM indicates the measurement of fabric weight. GSM means gram per square meter. So, GSM indicates the weight of one square meter fabric in gram. By using GSM cutter, we can calculate the GSM of a given fabric. Fig. 3.1. represents the GSM Cutter that have been used in this study.

Fig. 3.1. GSM Cutter

3.2.2. Electrical Balance

Electrical Balance were used to weigh the fabric, dyes, chemicals and auxiliaries in gm. Fig. 3.2. represents the electrical balance that have been used in this study.

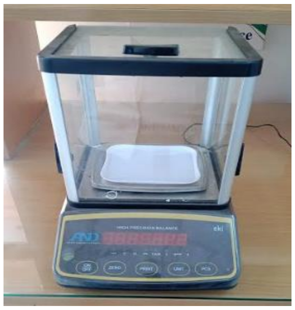


Fig. 3.2. Electrical Balance

3.2.3. DIU dyeing Machine

For Scouring & Bleaching of cotton fabric sample the machine that is shown in Fig. 3.3. were used.

Fig. 3.3. DIU dyeing Machine

3.2.4. dyeing Machine

For dyeing with reactive dyestuffs, chemicals & auxiliaries, the machine that is shown in Fig. 3.4. were used.

Fig. 3.4. dyeing Machine

3.2.5. Dryer

To Dry the fabric Sample after dyeing, the dryer that is shown in Fig. 3.5. have been used

Fig. 3.5. Dryer

3.2.6. Light Box

Light box was used to check shade variation of dyed sample fabric. In light box, we had used the illuminants D65 & TL84 to assess the shade variation. Fig. 3.6. represents the Light Box that have been used in this study.

Fig. 3.6. Light Box

3.2.7. Spectrophotometer

A spectrophotometer was used to measure the dyed sample's reflectance values. The color strength (K/S) of the full bleached dyed, half bleached dyed & no bleached dyed samples were measured by using spectrophotometer. The spectrophotometer that is used in this study have been displayed in Fig. 3.7.

Fig. 3.7. Spectrophotometer

3.2.8. Crock-meter

To measure the wet & dry rubbing fastness, the machine that has been displayed in Fig. 3.8. were used.

Fig. 3.8. Crock-meter

3.2.9. Washing Machine

To measure the washing rubbing fastness, the washing machine that has been displayed in Fig. 3.9. were used.

Fig. 3.9. Washing Machine

3.2.10. pH Paper

To determine the pH of wet process solution pH Paper have been used. pH Paper is displayed in Fig. 3.10.

Fig. 3.10. pH Paper

3.3. Process Sequence

3.3.1. Process Sequence of Scouring & Bleaching

Grey Fabric Preparation

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Recipe Formulation

↓

Stock Sol^n Preparation

↓

Liquor Bath Preparation

↓

Scouring & Bleaching

↓

Washing

↓

Drying

3.3.1.1. Grey Fabric Preparation for Scouring & Bleaching

At first, we had taken 100% cotton S/J grey fabric. Then We had cut 24 sample swatch , each weighs 10 gm.

3.3.1.2. Recipe Formulation for Scouring & Bleaching

In this study, we had followed the following recipe for Scouring & Bleaching in combined stage.

Name of the Chemicals	Concentration		
	Full Bleaching	**Half Bleaching**	**No Bleaching**
Wetting Agent	1 g/L	1 g/L	1 g/L
Sequestering Agent	1 g/L	1 g/L	1 g/L
Detergent	2 g/L	2 g/L	2 g/L
Caustic Soda (NaOH)	2 g/L	2 g/L	2 g/L
50% hydrogen peroxide (H_2O_2)	3 g/L	1.5 g/L	----
Peroxide Stabilizer	0.5 g/L	0.5 g/L	----
Temperature	100°C		
Time	30 minutes		
pH	12.5		
M:L	1:25		

3.3.1.3. Stock Solution Preparation

For solid chemicals, x% stock solution was prepared by adding x gm chemical in to 100 ml water.

For liquid chemicals, x% stock solution was prepared by adding x ml chemical in to (100-x) ml water.

The amount of chemicals was taken from the stock solution using the following formula:

$$\text{Req. amt. of chemicals} = \frac{\text{gpl of chemical} \times \text{total amount of liquor}}{1000 \times \text{stock solution concentration}}$$

3.3.1.4. Bath Preparation for Scouring & Bleaching

At first, all the required chemicals were taken in to the beaker according to the recipes. Then required amount of fresh water were added in the beaker according to the M:L followed by the immersion of grey fabric sample.

3.3.1.5. Scouring & Bleaching

In this study, Scouring & Bleaching have been done in combined stage by using the chemicals like 50% hydrogen peroxide (H_2O_2), Peroxide Stabilizer, Wetting agent, Sequestering agent, Caustic soda (NaOH) & Detergent. All these chemicals were added in to the beaker at 30°C and then after adding water, the liquor is ready for processing. The beaker is set to the machine and temperature is raised to 100°C at 5°C/min. Then continued the process for 30 minutes. After completion of process, the beakers were taken out from the machine, cooled down and drained the liquor.

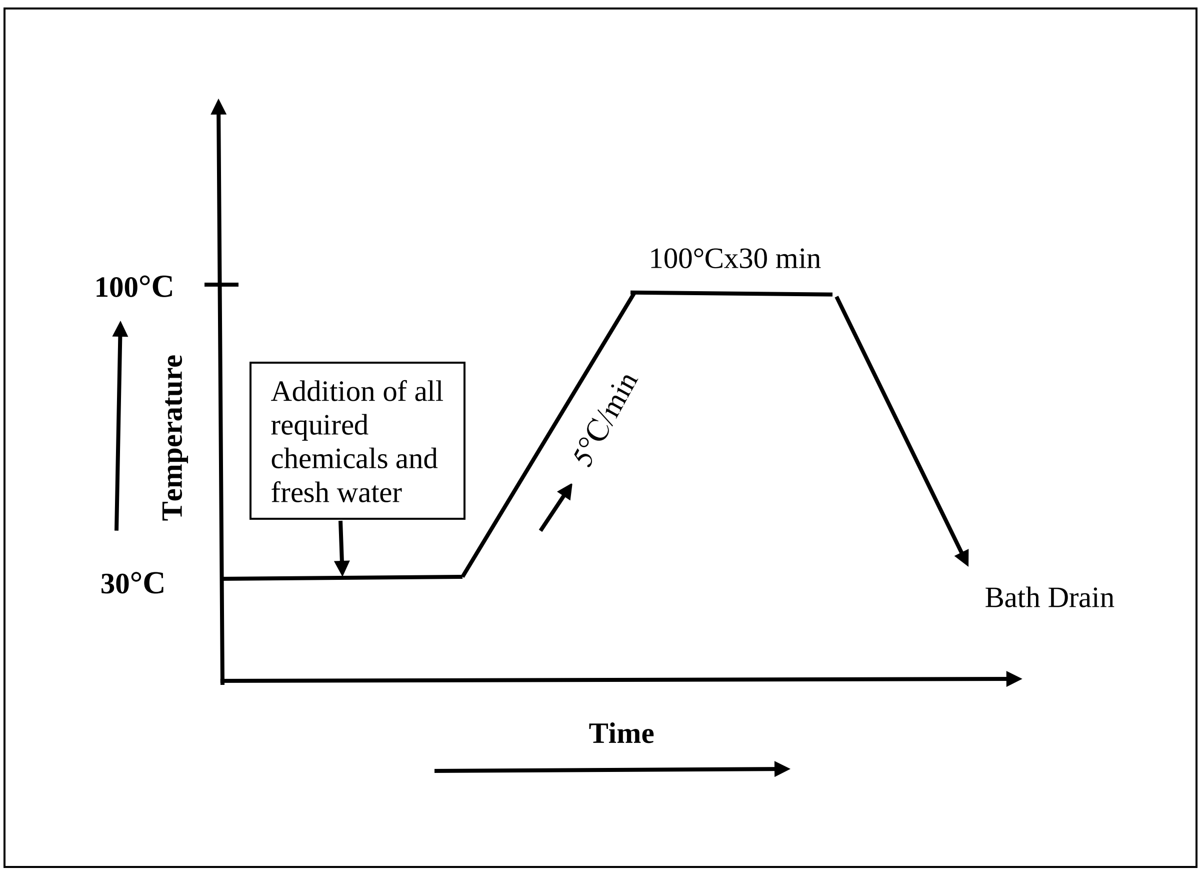


Fig. 3.11. Process Curve of Scouring & Bleaching

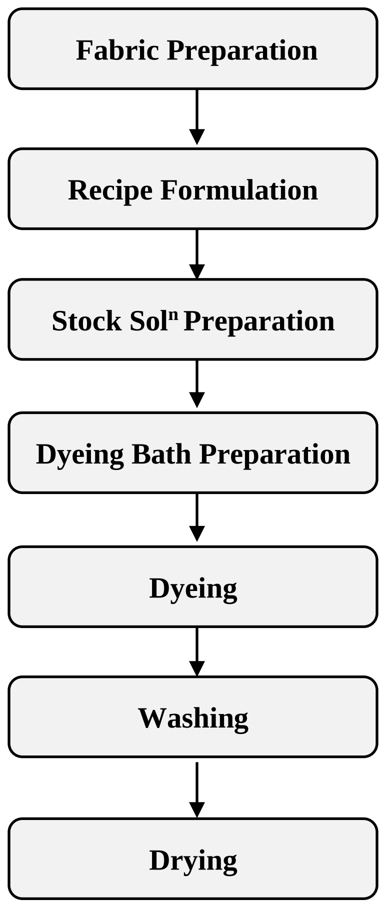
3.3.1.6. Washing and Rinsing of Pretreated sample

At first, sample fabric was cold washed for 5 minutes. Then the pretreated sample gets rinsed 3-4 times. All the samples were washed and rinsed with similar process.

3.3.1.7. Drying of Pretreated sample

Pretreated samples were dried at 100°C for 5-7 minutes at drying machine of wet processing lab of DIU. All the pretreated samples were dried with similar process.

3.3.2. Process Sequence of Dyeing



3.3.2.1. Pretreated Fabric Preparation for dyeing

We divided the 24 pretreated samples for 2 dyes. 12 for Navy color and rest 12 for Blue color.

For Navy color, we had taken,

- 4 full bleached sample fabric
- 4 half bleached sample fabric
- 4 No bleached sample fabric

For Blue color, we had taken,

- 4 full bleached sample fabric
- 4 half bleached sample fabric
- 4 No bleached sample fabric

3.3.2.2. Recipe Formulation for Dyeing

In this study, we had followed the following recipe for dyeing the 100% cotton S/J pretreated sample fabric with reactive dye

Dyeing Recipe of Full Bleached Fabric (using Novacron Brand Navy Reactive Dyes):

Name of the Dyes/Chemicals	Concentration			
Novacron Navy SGI	0.5%	1%	1.5%	2%
Glauber Salt	25 g/L	35 g/L	50 g/L	50 g/L
Soda Ash (Na_2CO_3)	10 g/L	10 g/L	15 g/L	15 g/L
Temperature	60°C			
Time	60 minutes			
pH	10.5-11.5			
M:L	1:8			

Dyeing Recipe of Half Bleached Fabric (using Novacron Brand Navy Reactive Dyes):

Name of the Dyes/Chemicals	Concentration			
Novacron Navy SGI	0.5%	1%	1.5%	2%
Glauber Salt	25 g/L	35 g/L	50 g/L	50 g/L
Soda Ash (Na_2CO_3)	10 g/L	10 g/L	15 g/L	15 g/L
Temperature	60°C			
Time	60 minutes			
pH	10.5-11.5			
M:L	1:8			

Dyeing Recipe of No Bleached Fabric (using Novacron Brand Navy Reactive Dyes):

Name of the Dyes/Chemicals	Concentration			
Novacron Navy SGI	0.5%	1%	1.5%	2%
Glauber Salt	25 g/L	35 g/L	50 g/L	50 g/L
Soda Ash (Na_2CO_3)	10 g/L	10 g/L	15 g/L	15 g/L
Temperature	60°C			
Time	60 minutes			
pH	10.5-11.5			
M:L	1:8			

Dyeing Recipe of Full Bleached Fabric (using Levafix Brand Blue Reactive Dyes):

Name of the Dyes/Chemicals	Concentration			
Levafix Bright Blue EFFN	0.2%	0.5%	1%	1.5%
Glauber Salt	17 g/L	25 g/L	35 g/L	50 g/L
Soda Ash (Na_2CO_3)	8 g/L	10 g/L	10 g/L	15 g/L
Temperature	60°C			
Time	60 minutes			
pH	10.5-11.5			
M:L	1:8			

Dyeing Recipe of Half Bleached Fabric (using Levafix Brand Blue Reactive Dyes):

Name of the Dyes/Chemicals	Concentration			
Levafix Bright Blue EFFN	0.2%	0.5%	1%	1.5%
Glauber Salt	17 g/L	25 g/L	35 g/L	50 g/L
Soda Ash (Na_2CO_3)	8 g/L	10 g/L	10 g/L	15 g/L
Temperature	60°C			
Time	60 minutes			
pH	10.5-11.5			
M:L	1:8			

Dyeing Recipe of No Bleached Fabric (using Levafix Brand Blue Reactive Dyes):

Name of the Dyes/Chemicals	Concentration			
Levafix Bright Blue EFFN	0.2%	0.5%	1%	1.5%
Glauber Salt	17 g/L	25 g/L	35 g/L	50 g/L
Soda Ash (Na_2CO_3)	8 g/L	10 g/L	10 g/L	15 g/L
Temperature	60°C			
Time	60 minutes			
pH	10.5-11.5			
M:L	1:8			

3.3.2.3. Stock Solution Preparation

For solid chemicals, x% stock solution was prepared by adding x gm chemical in to 100 ml water.

For liquid chemicals, x% stock solution was prepared by adding x ml chemical in to (100-x) ml water.

The amount of chemicals was taken from the stock solution using the following formula:

$$\text{Required amount of chemicals} = \frac{\text{gpl of chemical} \times \text{total amount of liquor}}{1000 \times \text{stock solution concentration}}$$

The amount of dyestuffs was taken from the stock solution using the following formula:

$$\text{Required amtount of dye} = \frac{\text{percentage of dye} \times \text{weight of fabric}}{100 \times \text{stock solution concentration}}$$

3.3.2.4. Bath Preparation for Dyeing

At first, all the required dyestuffs, chemicals & auxiliaries were taken in to the beaker according to the recipes. Then required amount of fresh water were added in the beaker according to the M:L followed by the immersion of pretreated fabric sample.

3.3.2.5. Dyeing

At first, according to the recipe calculations, the fresh water is taken at the dyeing beaker while keeping the liquor ratio of 1:8. Dyestuffs, chemicals & auxiliaries from the stock solution were added at 30°C. Fabric samples were put in the beaker and their pH was checked before dyed started. The beakers were then placed in the dyeing machine, and the temperature was increased to 60°C at 5°C/min in order to start the dyeing process. The dyeing process was continued for 60 minutes at 60°C. Then the beakers are cooled to room temperature and returned to their original temperature after 60 minutes. Following that, dyed samples are ready for washing once the dye liquor has been drained.

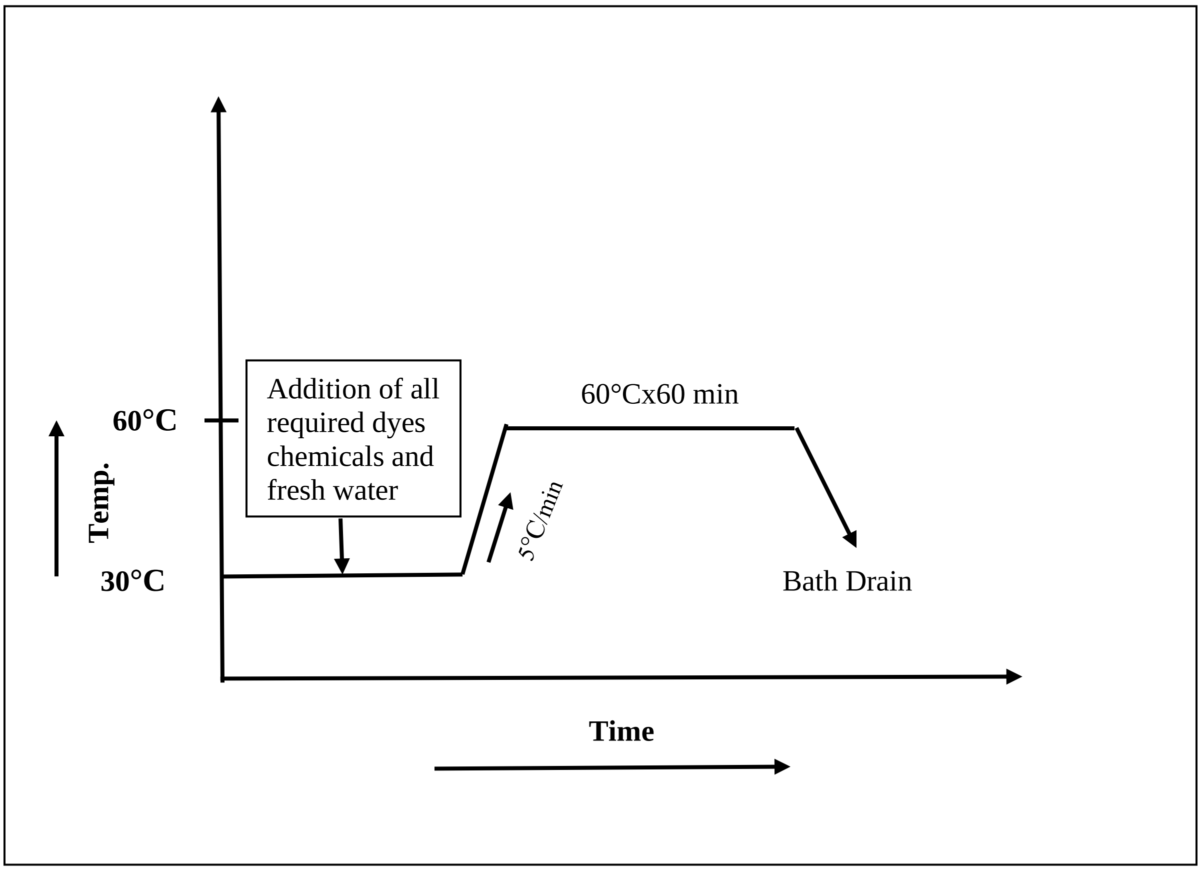


Fig. 3.12. Process Curve of Reactive Dyeing

3.3.2.6. Washing and Rinsing of dyed sample

At first, dyed sample fabric was cold washed for 5 minutes. Then hot washed for 10 minutes at 80°C. Lastly, the dyed sample gets rinsed 3-4 times. All the dyed samples were washed and rinsed with similar process.

3.3.2.7. Drying of Dyed sample

Dyed samples were dried at 100°C for 5-7 minutes at drying machine of Interstoff Apparels Ltd. All the dyed samples were dried with similar process.

3.4. Color Strength and Fastness Test Procedures

3.4.1. Procedures of measuring K/S value

To achieve precise findings, the Data color spectrophotometer is calibrated before any measurements are taken. Cutting the colored sample into an even size and shape is the first step in preparing it for the measurement K/S value. After that, the sample is put into the spectrophotometer's specimen holder. By using a controlled light source to illuminate the sample, the gadget calculates how much light at different wavelengths is reflected by the sample. The K/S value is determined by the device's software after the reflected light is detected by a detector.

Fig. 3.13. Spectrophotometer

3.4.2. Testing of Color Fastness

3.4.2.1. Color Fastness to Wash

<u>Test Method:</u>

ISO C06 C2S

Apparatus:

- Thermostatically controlled water bath (Rota Wash)
- Multifiber DW Fabric
- Dryer
- Grey Scale
- Light Box

Recipe:

Chemicals / Parameter	Concentration
ECE detergent	4 g/L
Na-perborate	1 g/L
Steel balls	25 pcs
Temperature	60°C
Time	30 minutes

Working Procedure:

- Cut a piece of specimen measuring 10 cm by 4 cm.
- Cut a piece of multifiber fabric measuring 10 cm by 4 cm.
- Used a price tag gun to attach the multifiber to the specimen. Keep a piece of cloth that has not been washed for assessment.
- Wash the sample with 25 steel balls in a 50 ml solution that contains 4 g/L ECE detergent and 1 g/L sodium perborate. Proceed according to test method ISO C06 C2S for 30 minutes at 60°C.
- Dried the Sample in accordance with the care recommendations.

Fig. 3.14. Washing machine for wash fastness test

3.4.2.2. Color Fastness to Rubbing

Test Method:

ISO 105 X12:2002

Apparatus:

- Crockmeter
- Crocking cloth
- Distilled water
- Grey Scale
- Light Box

Working Procedure:

The term "Rubbing Fastness" describes how quickly a colored sample changes its color as a consequence of rubbing. Rubbing fastness test can be done on both dry & wet condition.

- **Dry rubbing test:** A white rubbing cotton cloth is used to implant the crockmeter's finger using a clip during the specimen setting process. After that, placed the finger over the specimen and move the finger to and fro ten times in ten seconds.

- **Wet rubbing test:** The only difference between wet rubbing test and the dry rubbing test is that a wet crocking cloth is used in place of the dry one.

3.4.2.3. Color Fastness to Water

Test Method:

ISO 105 EO1

Apparatus:

- Perspirometer
- Incubator
- Multi fibre fabric
- Grey scale
- Light box
- Acrylic resin plates
- Weight 12.5 kPa or 5kg pressure

Working Procedure:

- At first, we had cut the sample and multifiber fabric by 10x4 cm^2 and sewn together.
- Then immersed the sample with multifiber fabric in distilled water at room temperature and wait until sample sucks water.
- Then placed the sample in acrylic resin plate and then placed it in perspirometer followed by adding pressure on perspirometer.
- Then kept the perspirometer along with sample in Incubator for 4 hours where the temperature was 37°C.
- After 4 hours, the specimen was dried at 60°C.
- Lastly, the sample was assessed with the help of grey scale

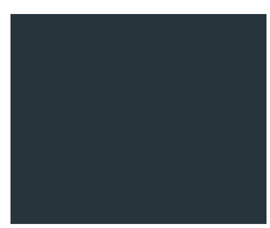
CHAPTER- 04
RESULTS & DISCUSSIONS

4.1. Shade Variation of dyed Sample fabric

4.1.1. Shade Variation for Navy Color

After completing dyeing of 12 sample with the same dye color (Novacron Navy reactive) having different dye shade% (0.5%, 1%, 1.5%, 2%), same pH & temperature, just bring change in the recipe of bleaching, the following shade is obtained. Here 4 sample shade is produced on full bleached fabric, 4 sample shade is produced on half bleached fabric and other 4 sample shade is produced on no bleached fabric.

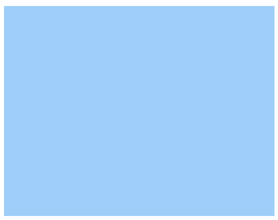
Table no. 1: Shade Variation for Navy Color

Dye concentration	**Full Bleached Fabric**	**Half Bleached Fabric**	**No Bleached Fabric**
0.5% (Novacron Navy reactive)			
1% (Novacron Navy reactive)			
1.5% (Novacron Navy reactive)			
2% (Novacron Navy reactive)			

4.1.2. Shade Variation for Red Color

After completing dyeing of 12 sample with the same dye color (Levafix Bright Blue EFFN) having different dye shade% (0.2%, 0.5%, 1%, 1.5%), same pH & temperature, just bring change in the recipe of bleaching, the following shade is obtained. Here 4 sample shade is produced on full bleached fabric, 4 sample shade is produced on half bleached fabric and other 4 sample shade is produced on no bleached fabric.

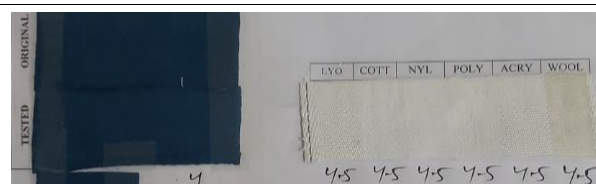
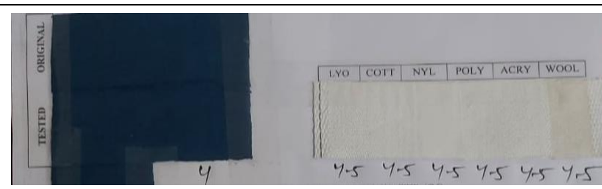
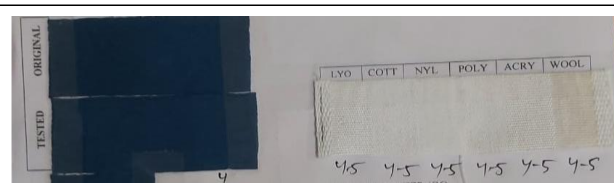
Table no. 2: Shade Variation for Blue Color

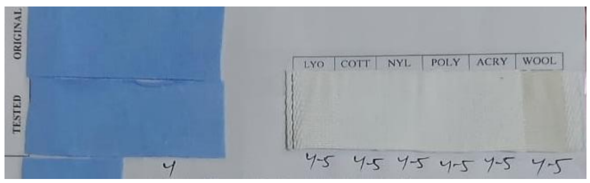
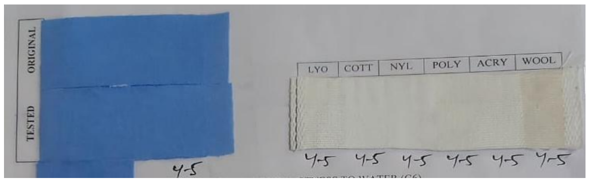
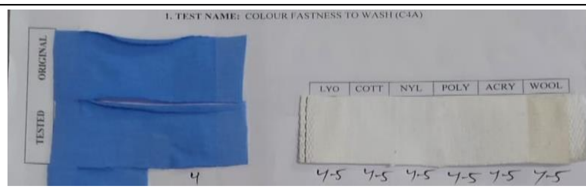
Dye concentration	**Full Bleached Fabric**	**Half Bleached Fabric**	**No Bleached Fabric**
0.2% (Levafix Bright Blue EFFN)			
0.5% (Levafix Bright Blue EFFN)			
1% (Levafix Bright Blue EFFN)			
1.5% (Levafix Bright Blue EFFN)			

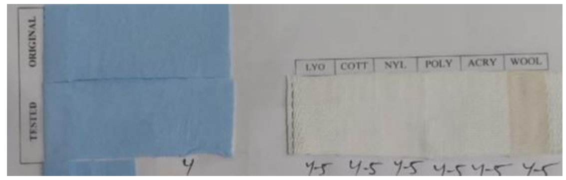
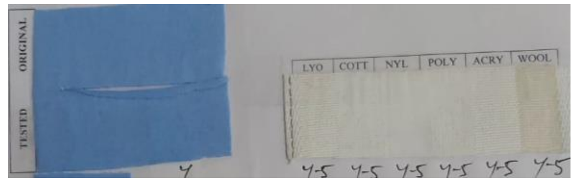
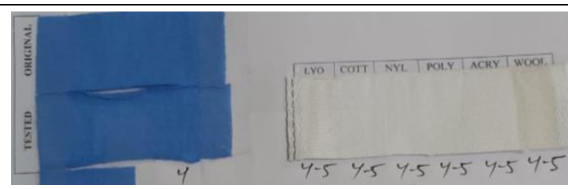
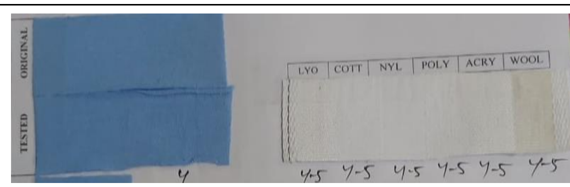
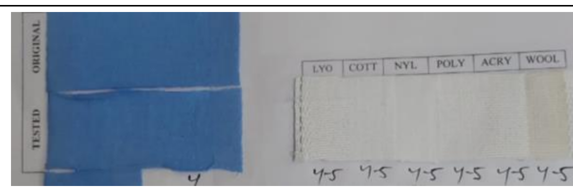
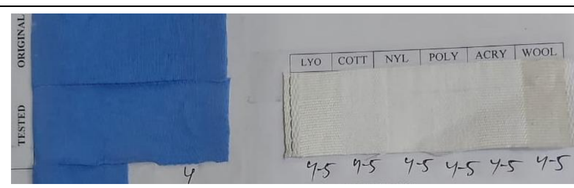
4.2. Testing Sample Attachment

4.2.1. Wash Fastness test Sample

Table no. 3: Wash Fastness test Sample

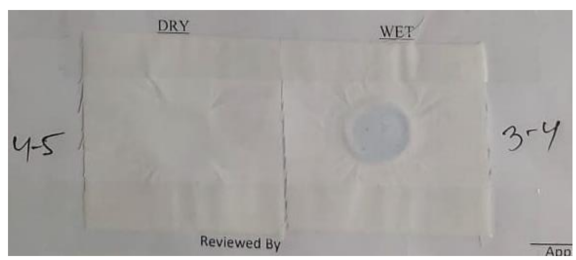
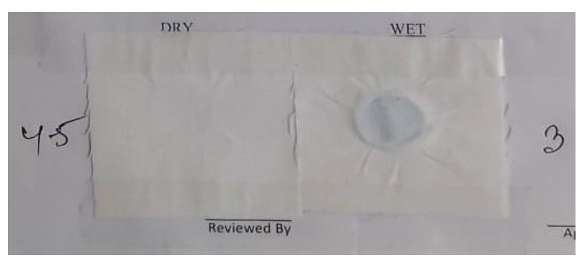
Dye	Sample	Shade%	Attachment
Novacron Navy reactive	Full Bleached Dyed Sample	0.5%	
	Full Bleached Dyed Sample	1%	
	Full Bleached Dyed Sample	1.5%	
	Full Bleached Dyed Sample	2%	
	Half Bleached Dyed Sample	0.5%	
	Half Bleached Dyed Sample	1%	
	Half Bleached Dyed Sample	1.5%	

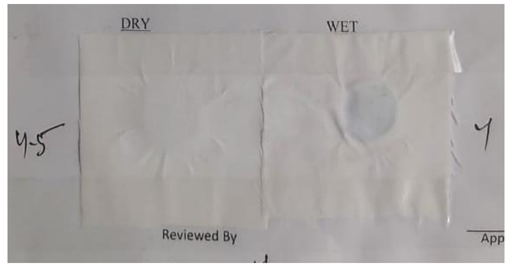
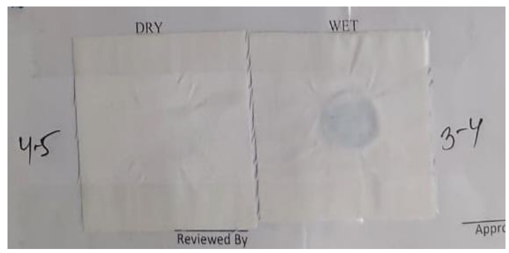
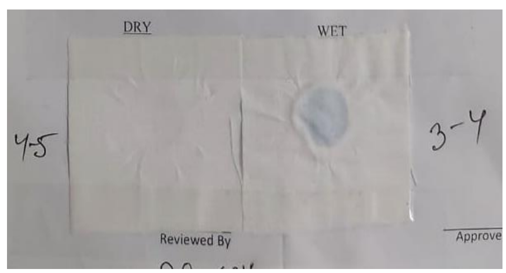
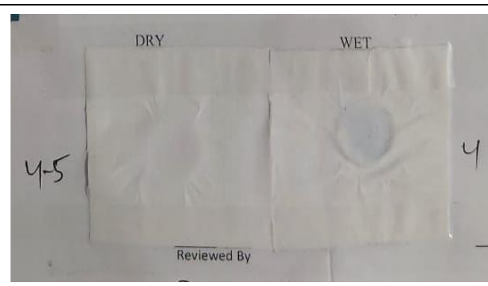
Novacron Navy reactive	Half Bleached Dyed Sample	2%	
	No Bleached Dyed Sample	0.5%	
	No Bleached Dyed Sample	1%	
	No Bleached Dyed Sample	1.5%	
	No Bleached Dyed Sample	2%	
Levafix Bright Blue EFFN	Full Bleached Dyed Sample	0.2%	
	Full Bleached Dyed Sample	0.5%	
	Full Bleached Dyed Sample	1%	
	Full Bleached Dyed Sample	1.5%	

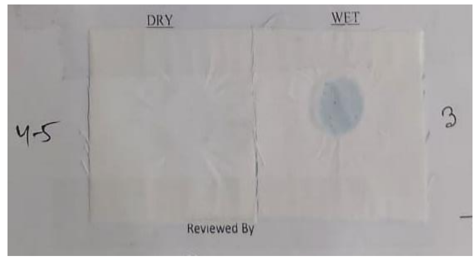
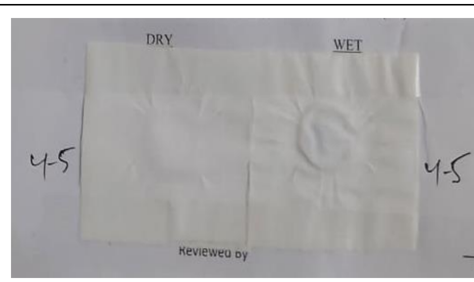
Levafix Bright Blue EFFN	Half Bleached Dyed Sample	0.2%	
	Half Bleached Dyed Sample	0.5%	
	Half Bleached Dyed Sample	1%	
	Half Bleached Dyed Sample	1.5%	
	No Bleached Dyed Sample	0.2%	
	No Bleached Dyed Sample	0.5%	
	No Bleached Dyed Sample	1%	
	No Bleached Dyed Sample	1.5%	

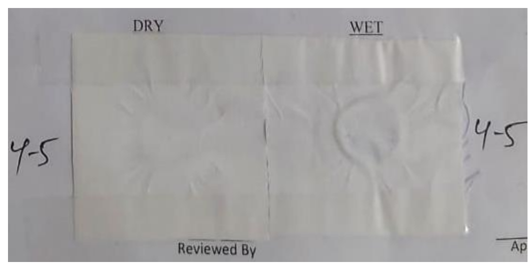
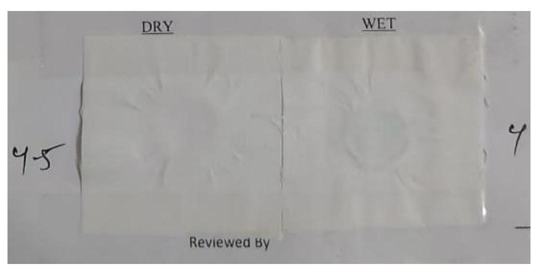
4.2.2. Rubbing Fastness test Sample

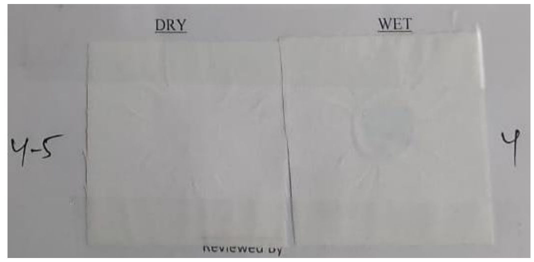
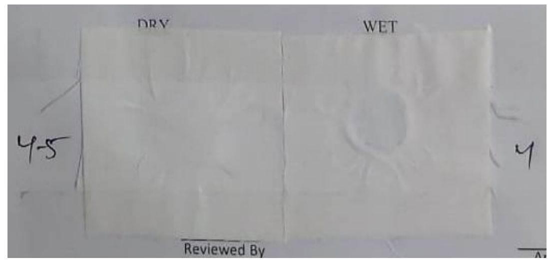
Table no. 4: Rubbing Fastness test Sample

Dye	Sample	Shade%	Attachment
Novacron Navy reactive	Full Bleached Dyed Sample	0.5%	
	Full Bleached Dyed Sample	1%	
	Full Bleached Dyed Sample	1.5%	
	Full Bleached Dyed Sample	2%	

Novacron Navy reactive	Half Bleached Dyed Sample	0.5%	
	Half Bleached Dyed Sample	1%	
	Half Bleached Dyed Sample	1.5%	
	Half Bleached Dyed Sample	2%	
	No Bleached Dyed Sample	0.5%	
	No Bleached Dyed Sample	1%	

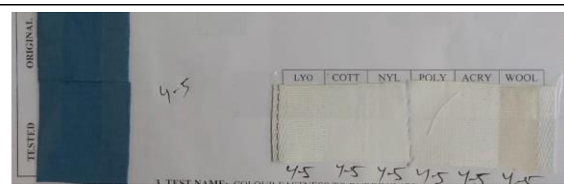
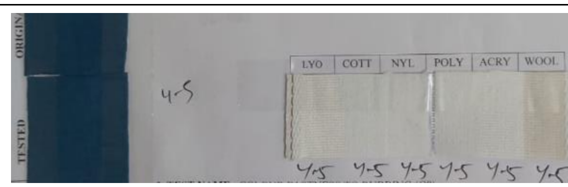
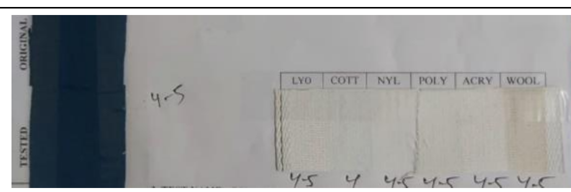
	No Bleached Dyed Sample	1.5%	
	No Bleached Dyed Sample	2%	
Levafix Bright Blue EFFN	Full Bleached Dyed Sample	0.2%	
	Full Bleached Dyed Sample	0.5%	
	Full Bleached Dyed Sample	1%	
	Full Bleached Dyed Sample	1.5%	

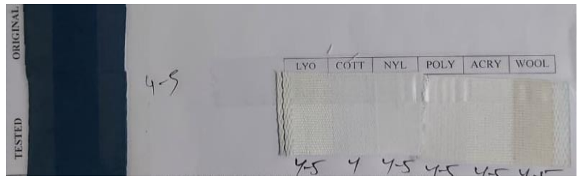
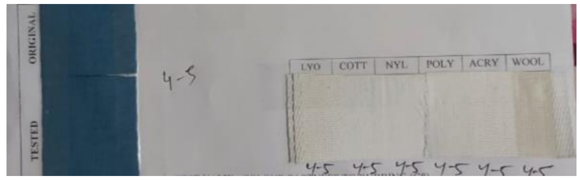
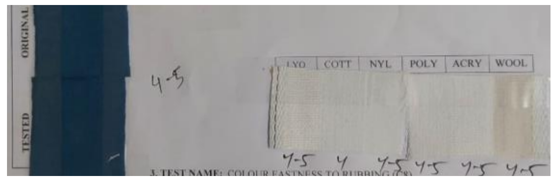
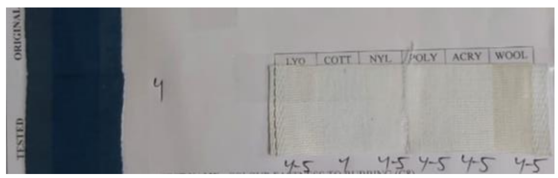
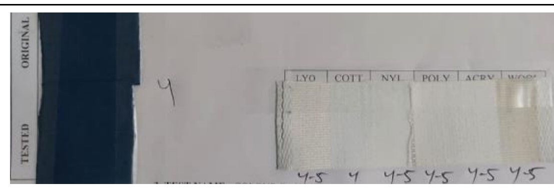
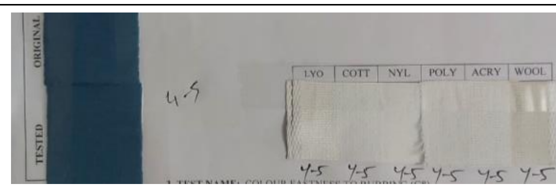
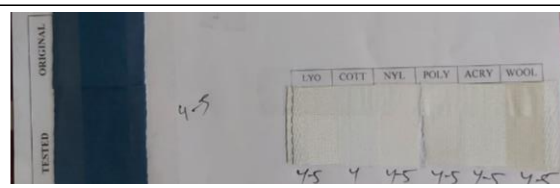
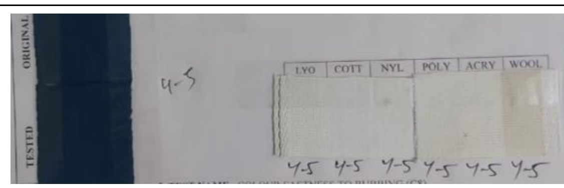
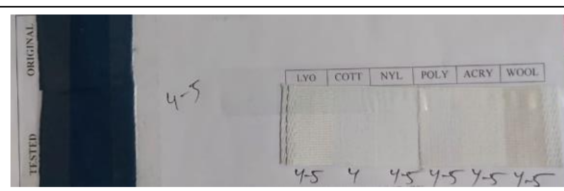
	Half Bleached Dyed Sample	0.2%	
	Half Bleached Dyed Sample	0.5%	
	Half Bleached Dyed Sample	1%	
Levafix Bright Blue EFFN	Half Bleached Dyed Sample	1.5%	
	No Bleached Dyed Sample	0.2%	
	No Bleached Dyed Sample	0.5%	

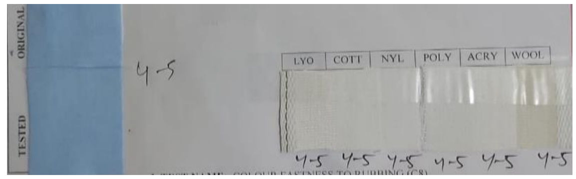
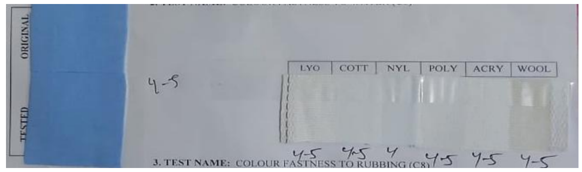
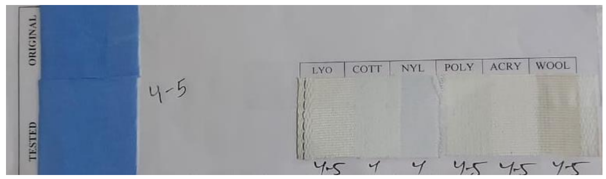
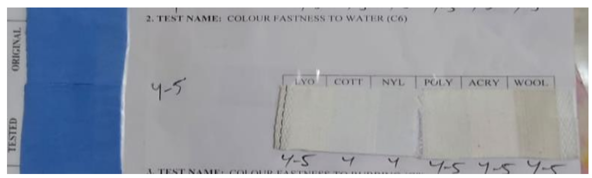
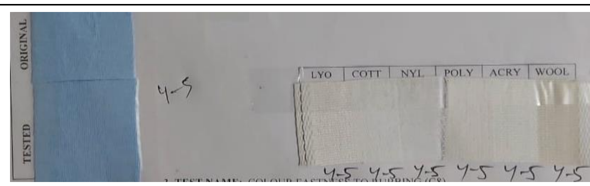
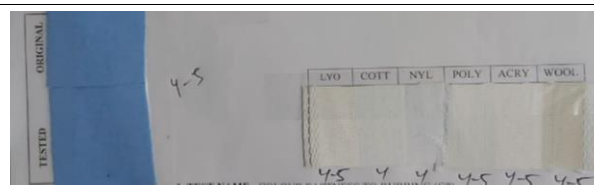
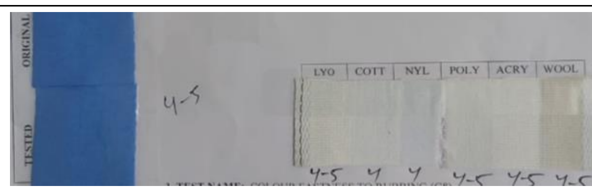
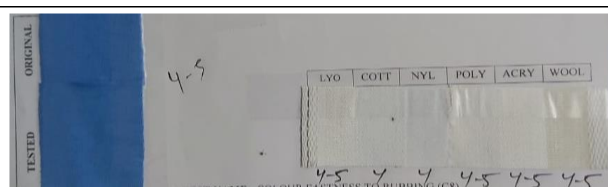
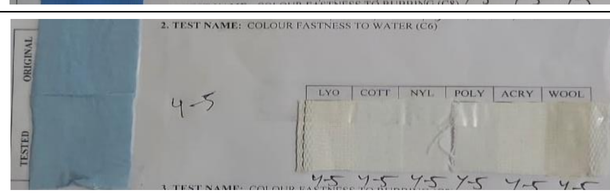
	No Bleached Dyed Sample	1%	
	No Bleached Dyed Sample	1.5%	

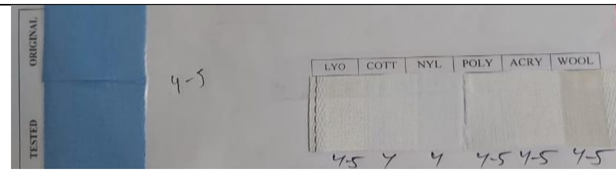
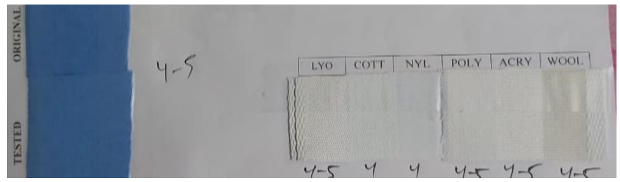
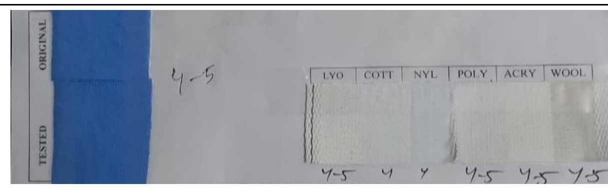
4.2.3. Fastness to Water test Sample

Table no. 5: Water Fastness test Sample

Dye	Sample	Shade%	Attachment
	Full Bleached Dyed Sample	0.5%	
	Full Bleached Dyed Sample	1%	
	Full Bleached Dyed Sample	1.5%	

Novacron Navy reactive	Full Bleached Dyed Sample	2%	
	Half Bleached Dyed Sample	0.5%	
	Half Bleached Dyed Sample	1%	
	Half Bleached Dyed Sample	1.5%	
	Half Bleached Dyed Sample	2%	
	No Bleached Dyed Sample	0.5%	
Novacron Navy reactive	No Bleached Dyed Sample	1%	
	No Bleached Dyed Sample	1.5%	
	No Bleached Dyed Sample	2%	

Levafix Bright Blue EFFN	Full Bleached Dyed Sample	0.2%	
	Full Bleached Dyed Sample	0.5%	
	Full Bleached Dyed Sample	1%	
	Full Bleached Dyed Sample	1.5%	
	Half Bleached Dyed Sample	0.2%	
	Half Bleached Dyed Sample	0.5%	
Levafix Bright Blue EFFN	Half Bleached Dyed Sample	1%	
	Half Bleached Dyed Sample	1.5%	
	No Bleached Dyed Sample	0.2%	

	No Bleached Dyed Sample	0.5%	
	No Bleached Dyed Sample	1%	
	No Bleached Dyed Sample	1.5%	

4.3. Color Strength (K/S Values)

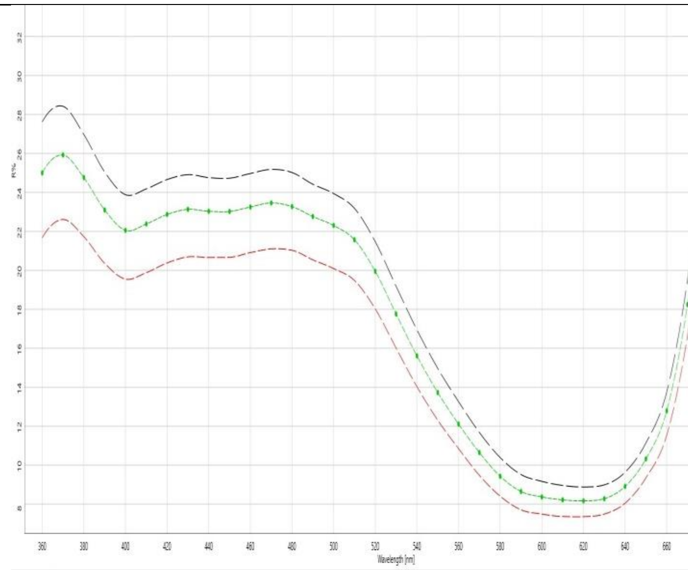
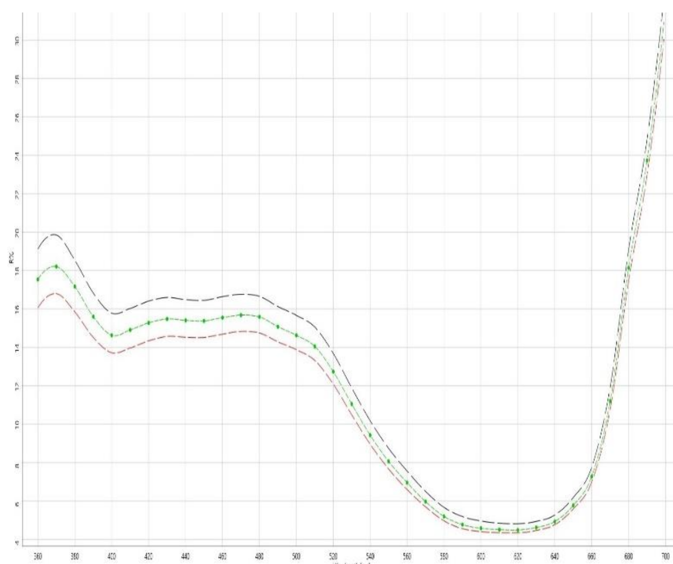
4.3.1. Evaluation of reflectance (%) & color strength (K/S) when dyeing with Novacron Navy reactive dye

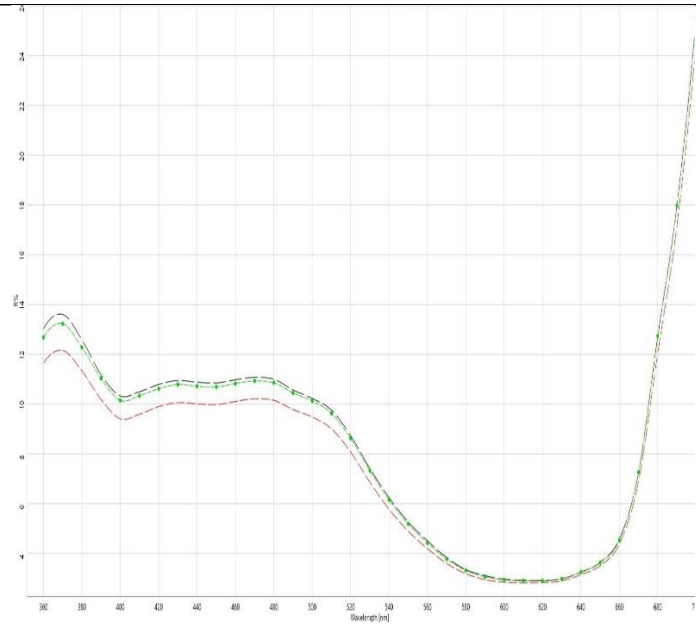
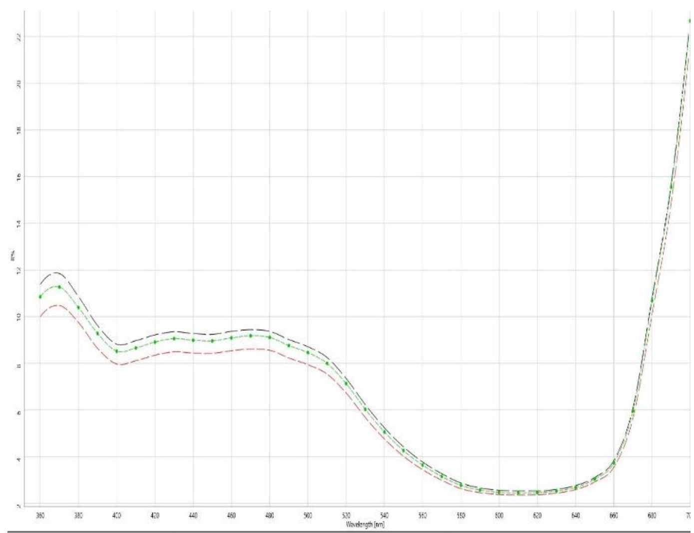
Consider,

Standard = The full bleached sample dyeing with Novacron Navy reactive dye
Trial 1 = The half bleached sample dyeing with Novacron Navy reactive dye
Trial 2 = The no bleached sample dyeing with Novacron Navy reactive dye

Table no. 6: Evaluation of reflectance (%) & color strength (K/S) when dyeing with Novacron Navy reactive dye

Shade %	**Sample**	**Minimum R%**	**K/S = $(1-R)^2$ /2R**	**Result from Data color**
0.5%	Standard (Full bleached sample)	9%	4.6	

	Trial 1 (Half bleached sample)	8.1%	5.21	
	Trial 2 (No bleached sample)	6.5%	6.72	
1%	Standard (Full bleached sample)	4.9%	9.23	
	Trial 1 (Half bleached sample)	4.4%	10.39	
	Trial 2 (No bleached sample)	4.3%	10.65	
1.5%	Standard (Full bleached sample)	2%	24.01	

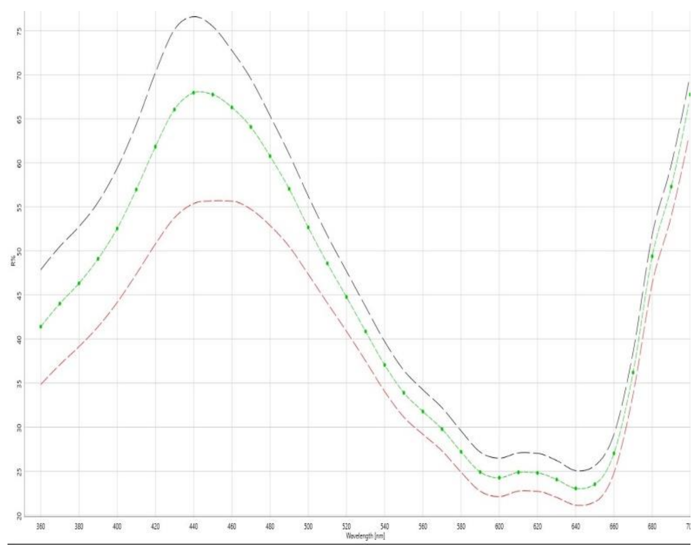
	Trial 1 (Half bleached sample)	1.9%	25.33	
	Trial 2 (No bleached sample)	1.8%	26.79	
2%	Standard (Full bleached sample)	2.35%	20.29	
	Trial 1 (Half bleached sample)	2.3%	20.75	
	Trial 2 (No bleached sample)	2.2%	21.74	

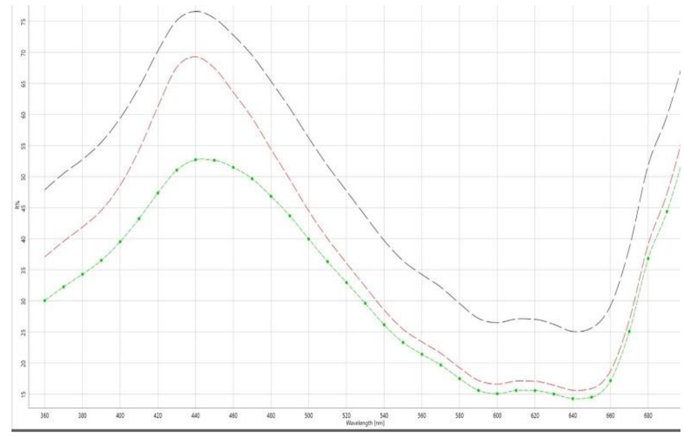
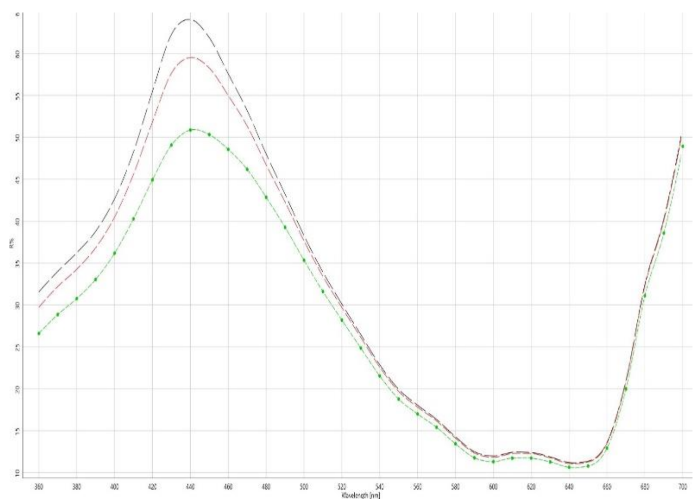
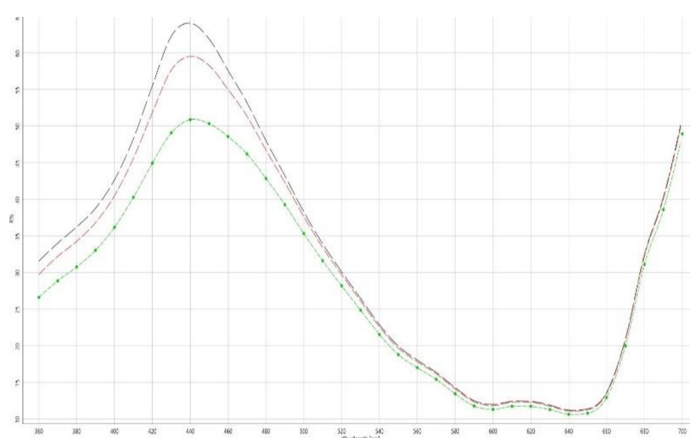
4.3.2. Evaluation of reflectance (%) & color strength (K/S) when dyeing with Levafix Bright Blue EFFN dye

Consider,

Standard = The full bleached sample dyeing with Levafix Bright Blue EFFN dye
Trial 1 = The half bleached sample dyeing with Levafix Bright Blue EFFN dye
Trial 2 = The no bleached sample dyeing with Levafix Bright Blue EFFN dye

Table no. 7: Evaluation of reflectance (%) & color strength (K/S) when dyeing with Levafix Bright Blue EFFN dye

Shade %	**Sample**	**Minimum R%**	**K/S = $(1-R)^2/2R$**	**Result from Data color**
0.2%	Standard (Full bleached sample)	25%	1.125	
	Trial 1 (Half bleached sample)	23.5%	1.25	
	Trial 2 (No bleached sample)	21.5%	1.433	
0.5%	Standard (Full bleached sample)	`25%	1.125	

	Trial 1 (Half bleached sample)	13%	2.91	
	Trial 2 (No bleached sample)	15.5%	2.3	
1%	Standard (Full bleached sample)	11%	3.6	
	Trial 1 (Half bleached sample)	10.5%	3.81	
	Trial 2 (No bleached sample)	10.9%	3.64	
1.5%	Standard (Full bleached sample)	11%	3.6	
	Trial 1 (Half bleached sample)	10.5%	3.81	

	Trial 2 (No bleached sample)	10.5%	3.64	

4.4. CMC Decision

4.4.1. Evaluation of CMC decision when dyeing with Novacron Navy reactive dye

Table no. 8: Evaluation of CMC decision when dyeing with Novacron Navy reactive dye

Shade%	Standard	Trial/Batch	Illuminance	DE*	DL*	Da*	Db*	DC*	DH*	Strength	Comment
0.5%	Full Bleached	Half Bleached	D65 10 Deg	1.67	-1.66	0.18	0.14	-0.21	0.08	110.36%	Batch is darker, less saturated & more red
			F11 10 Deg	1.69	-1.66	0.28	0.13	-0.24	0.20		
			A 10 Deg	1.67	-1.63	0.29	0.17	-0.30	0.15		
		No Bleached	D65 10 Deg	3.90	-3.79	0.42	0.79	-0.89	-0.09	124.73%	Batch is darker, less saturated & more green
			F11 10 Deg	3.89	-3.74	0.59	0.89	-1.06	0.13		
			A 10 Deg	3.88	-3.68	0.77	0.94	-1.21	0.13		
1%	Full Bleached	Half Bleached	D65 10 Deg	1.36	-1.30	0.30	0.22	-0.34	0.14	108.06%	Batch is darker, less saturated & more red
			F11 10 Deg	1.35	-1.28	0.35	0.26	-0.38	0.22		
			A 10 Deg	1.36	-1.25	0.42	0.30	-0.48	0.20		
		No Bleached	D65 10 Deg	2.37	-2.16	0.54	0.79	-0.96	0.06	111.93%	Batch is darker, less saturated & more red
			F11 10 Deg	2.36	-2.06	0.61	0.96	-1.13	0.18		
			A 10 Deg	2.44	-2.03	0.92	0.99	-1.33	0.26		

1.5%	Full Bleached	Half Bleached	D65 10 Deg	0.24	-0.19	0.08	0.13	-0.15	0.01	100.38%	Batch is darker, less saturated & more red
			F11 10 Deg	0.26	-.017	0.10	0.17	-0.19	0.03		
			A 10 Deg	0.30	-0.17	0.19	0.16	-0.23	0.08		
		No Bleached	D65 10 Deg	1.42	-1.06	0.54	0.78	-0.94	0.10	103.25%	Batch is darker, less saturated & more red
			F11 10 Deg	1.47	-0.96	0.58	0.96	-1.10	0.21		
			A 10 Deg	1.64	-0.92	0.91	1.00	-1.33	0.29		
2%	Full Bleached	Half Bleached	D65 10 Deg	0.49	-0.46	0.12	0.12	-0.16	0.05	103.31%	Batch is darker, less saturated & more red
			F11 10 Deg	0.51	-0.47	0.17	0.12	-0.16	0.12		
			A 10 Deg	0.51	-0.44	0.20	0.15	-0.23	0.10		
		No Bleached	D65 10 Deg	1.47	-1.27	0.43	0.60	-0.73	0.11	107.49%	Batch is darker, less saturated & more red
			F11 10 Deg	1.50	-1.21	0.52	0.70	-0.83	0.26		
			A 10 Deg	1.56	-1.16	0.70	0.77	-1.02	0.24		

4.4.2. Evaluation of CMC decision when dyeing with Levafix BRI Blue EFFN reactive dye

Table no. 9: Evaluation of CMC decision when dyeing with Levafix BRI Blue EFFN reactive dye

Shade%	Standard	Trial/Batch	Illuminance	DE*	DL*	Da*	Db*	DC*	DH*	Strength	Comment
0.2%	Full Bleached	Half Bleached	D65 10 Deg	4.95	-2.12	-2.11	4.65	-3.77	-3.44	114.21%	Batch is darker, less saturated & more green
			F11 10 Deg	5.86	-1.97	-1.46	5.32	-4.84	-2.66		
			A 10 Deg	4.95	-1.92	-0.27	4.55	-4.05	-2.10		
		No Bleached	D65 10 Deg	11.27	-5.57	-3.08	9.31	-7.49	-6.32	138.44%	Batch is darker,

			F11 10 Deg	12.06	-5.14	-2.18	10.69	-9.66	-5.08		less saturated & more green
			A 10 Deg	10.74	-5.05	0.26	9.47	-8.62	-3.93		
0.5%	Full Bleached	Half Bleached	D65 10 Deg	3.63	-2.11	-1.66	2.45	-2.12	-2.06	114.67%	Batch is darker, less saturated & more green
			F11 10 Deg	3.72	-2.08	-1.21	2.84	-2.64	-1.60		
			A 10 Deg	3.10	-2.05	-0.52	2.27	-1.94	-1.28		
		No Bleached	D65 10 Deg	9.99	-4.86	-3.87	7.82	-6.71	-5.58	131.11%	Batch is darker, less saturated & more green
			F11 10 Deg	10.53	-4.59	-2.83	9.04	-8.38	-4.41		
			A 10 Deg	9.01	-4.50	-0.59	7.78	-6.97	-3.51		
1%	Full Bleached	Half Bleached	D65 10 Deg	3.22	-0.92	-1.82	2.50	-2.31	-2.05	105.59%	Batch is darker, less saturated & more green
			F11 10 Deg	3.36	-.087	-1.36	2.95	-2.82	-1.61		
			A 10 Deg	2.59	-0.83	-0.55	2.39	-2.07	-130		
		No Bleached	D65 10 Deg	9.35	-2.77	-4.37	7.79	-7.09	-5.43	113.07%	Batch is darker, less saturated & more green
			F11 10 Deg	10.06	-2.48	-3.27	9.19	-8.74	-4.33		
			A 10 Deg	8.22	-2.36	-0.68	7.84	-7.11	-3.38		
1.5%	Full Bleached	Half Bleached	D65 10 Deg	8.15	-1.92	-4.07	6.79	-6.38	-4.69	106.63%	Batch is darker, less saturated & more green
			F11 10 Deg	8.86	-1.65	-3.11	8.12	-7.84	-3.78		
			A 10 Deg	7.09	-1.53	-0.57	6.90	-6.30	-2.86		
		No Bleached	D65 10 Deg	2.79	-0.45	-1.55	2.28	-2.19	-1.68	101.28%	Batch is darker, less saturated & more green
			F11 10 Deg	3.04	-0.39	-1.19	2.77	-2.70	-1.35		
			A 10 Deg	2.30	-0.34	-0.29	2.26	-2.05	-1.00		

4.5 Assessment of Washing Fastness

The result of this assessment displays the test specimen's color changes as well as the staining of the multifiber fabric, which are evaluated using a grey scale.

The Following table shows the rating of fastness to wash of dyed sample using Novacron Navy SGI Reactive dye:

Table no. 10: Assessment of Washing Fastness of dyed sample using Novacron Navy SGI Reactive dye:

Dye	Shade%	Sample Fabric Type	Change of Color	Staining					
				Lyocell	Cotton	Nylon	Polyester	Acrylic	Wool
Novacron Navy SGI Reactive dye	0.5%	Full Bleached	4	4/5	4/5	4/5	4/5	4/5	4/5
		Half Bleached	4	4/5	4/5	4/5	4/5	4/5	4/5
		No Bleached	4	4/5	4/5	4/5	4/5	4/5	4/5
	1%	Full Bleached	4	4/5	4/5	4/5	4/5	4/5	4/5
		Half Bleached	4	4/5	4/5	4/5	4/5	4/5	4/5
		No Bleached	4	4/5	4/5	4/5	4/5	4/5	4/5
	1.5%	Full Bleached	4	4/5	4/5	4/5	4/5	4/5	4/5
		Half Bleached	4	4/5	4/5	4/5	4/5	4/5	4/5
		No Bleached	4	4/5	4/5	4/5	4/5	4/5	4/5
	2%	Full Bleached	4	4/5	4/5	4/5	4/5	4/5	4/5
		Half Bleached	4	4/5	4/5	4/5	4/5	4/5	4/5
		No Bleached	4	4/5	4/5	4/5	4/5	4/5	4/5

The Following table shows the rating of fastness to wash of dyed sample using Levafix Bright Blue EFFN Reactive dye:

Table no. 11: Assessment of Washing Fastness of dyed sample using Levafix Bright Blue EFFN Reactive dye:

Dye	Shade%	Sample Fabric Type	Change of Color	Staining					
				Lyocell	Cotton	Nylon	Polyester	Acrylic	Wool
Levafix Bright Blue EFFN Reactive dye	0.2%	Full Bleached	4	4/5	4/5	4/5	4/5	4/5	4/5
		Half Bleached	4	4/5	4/5	4/5	4/5	4/5	4/5
		No Bleached	4	4/5	4/5	4/5	4/5	4/5	4/5
	0.5%	Full Bleached	4	4/5	4/5	4/5	4/5	4/5	4/5
		Half Bleached	4	4/5	4/5	4/5	4/5	4/5	4/5
		No Bleached	4	4/5	4/5	4/5	4/5	4/5	4/5
	1%	Full Bleached	4/5	4/5	4/5	4/5	4/5	4/5	4/5
		Half Bleached	4	4/5	4/5	4/5	4/5	4/5	4/5
		No Bleached	4	4/5	4/5	4/5	4/5	4/5	4/5
	1.5%	Full Bleached	4	4/5	4/5	4/5	4/5	4/5	4/5
		Half Bleached	4	4/5	4/5	4/5	4/5	4/5	4/5
		No Bleached	4	4/5	4/5	4/5	4/5	4/5	4/5

4.6 Assessment of Rubbing Fastness

The result of this assessment displays the test specimen's color changes as well as the staining of the multifiber fabric, which are evaluated using a grey scale.
The Following table shows the rating of fastness to rubbing of dyed sample using Novacron Navy SGI Reactive dye:

Table no. 12: Assessment of Rubbing Fastness of dyed sample using Novacron Navy SGI Reactive dye:

Dye	Shade%	Sample Fabric Type	Rating	
			Dry Rub	Wet Rub
Novacron Navy SGI Reactive dye	0.5%	Full Bleached	4/5	4
		Half Bleached	4/5	4
		No Bleached	4/5	4
	1%	Full Bleached	4/5	4
		Half Bleached	4/5	4
		No Bleached	4/5	3/4
	1.5%	Full Bleached	4/5	3/4
		Half Bleached	4/5	3/4
		No Bleached	4/5	3
	2%	Full Bleached	4/5	3
		Half Bleached	4/5	3/4
		No Bleached	4/5	3

The Following table shows the rating of fastness to rubbing of dyed sample using Levafix Bright Blue EFFN Reactive dye:

Table no. 13: Assessment of Rubbing Fastness of dyed sample using Levafix Bright Blue EFFN Reactive dye:

Dye	Shade%	Sample Fabric Type	Rating	
			Dry Rub	Wet Rub
Levafix Bright Blue EFFN Reactive dye	0.2%	Full Bleached	4/5	4/5
		Half Bleached	4/5	4/5
		No Bleached	4/5	4/5
	0.5%	Full Bleached	4/5	4/5
		Half Bleached	4/5	4/5
		No Bleached	4/5	4/5
	1%	Full Bleached	4/5	4/5
		Half Bleached	4/5	4/5
		No Bleached	4/5	4
	1.5%	Full Bleached	4/5	4/5
		Half Bleached	4/5	4
		No Bleached	4/5	4

4.7 Assessment of Water Fastness

The result of this assessment displays the test specimen's color changes as well as the staining of the multifiber fabric, which are evaluated using a grey scale.

The Following table shows the rating of fastness to water of dyed sample using Novacron Navy SGI Reactive dye:

Table no. 14: Assessment of Water Fastness of dyed sample using Novacron Navy SGI Reactive dye:

Dye	Shade%	Sample Fabric Type	Change of Color	Staining					
				Lyocell	Cotton	Nylon	Polyester	Acrylic	Wool
Novacron Navy SGI Reactive dye	0.5%	Full Bleached	4/5	4/5	4/5	4/5	4/5	4/5	4/5
		Half Bleached	4/5	4/5	4/5	4/5	4/5	4/5	4/5
		No Bleached	4/5	4/5	4/5	4/5	4/5	4/5	4/5
	1%	Full Bleached	4/5	4/5	4/5	4/5	4/5	4/5	4/5
		Half Bleached	4/5	4/5	4	4/5	4/5	4/5	4/5
		No Bleached	4/5	4/5	4	4/5	4/5	4/5	4/5
	1.5%	Full Bleached	4/5	4/5	4	4/5	4/5	4/5	4/5
		Half Bleached	4	4/5	4	4/5	4/5	4/5	4/5
		No Bleached	4/5	4/5	4/5	4/5	4/5	4/5	4/5
	2%	Full Bleached	4/5	4/5	4	4/5	4/5	4/5	4/5
		Half Bleached	4	4/5	4	4/5	4/5	4/5	4/5
		No Bleached	4/5	4/5	4	4/5	4/5	4/5	4/5

The Following table shows the rating of fastness to wash of dyed sample using Levafix Bright Blue EFFN Reactive dye:

Table no. 15: Assessment of Water Fastness of dyed sample using Levafix Bright Blue EFFN Reactive dye:

Dye	Shade%	Sample Fabric Type	Change of Color	Staining					
				Lyocell	Cotton	Nylon	Polyester	Acrylic	Wool
Levafix Bright Blue EFFN Reactive dye	0.2%	Full Bleached	4/5	4/5	4/5	4/5	4/5	4/5	4/5
		Half Bleached	4/5	4/5	4/5	4/5	4/5	4/5	4/5
		No Bleached	4/5	4/5	4/5	4/5	4/5	4/5	4/5
	0.5%	Full Bleached	4/5	4/5	4/5	4	4/5	4/5	4/5
		Half Bleached	4/5	4/5	4	4	4/5	4/5	4/5
		No Bleached	4/5	4/5	4	4	4/5	4/5	4/5
	1%	Full Bleached	4/5	4	4	4/5	4/5	4/5	4/5
		Half Bleached	4/5	4/5	4	4	4/5	4/5	4/5
		No Bleached	4/5	4/5	4	4	4/5	4/5	4/5
	1.5%	Full Bleached	4/5	4/5	4	4	4/5	4/5	4/5
		Half Bleached	4/5	4/5	4	4	4/5	4/5	4/5
		No Bleached	4/5	4/5	4	4	4/5	4/5	4/5

CHAPTER- 05
CONCLUSION

5.1. Conclusion

The primary observed factor in this research is the effect of bleaching in textile dyeing properties of 100% s/j fabric. In this study, three types of bleached sample (full bleached, half bleached & no bleached) were dyed with same concentration reactive dye, pH & temperature. After successful completion of dyeing, we had tried to evaluate the CMC decision, compare between K/S value & different types of fastness properties of three types of bleached sample (full bleached, half bleached & no bleached).

We have used two types of reactive dyes (Novacron Navy & Levafix BRI Blue EFFN) in this study. After dyeing three types of bleached sample (full bleached, half bleached & no bleached) with Novacron Navy Reactive dye, we had tried to find the shade variation among the sample by using spectrophotometer. We had seen that, Half bleached & No bleached samples were darker, less saturated & redder than the full bleached sample which is mentioned in the table no. 8. We had also noticed K/S value of full bleached fabric was lower due to bleaching effect which is mentioned in the table no. 6. But for higher dye concentration, the K/S value of three types of bleached sample (full bleached, half bleached & no bleached) was found quite similar.

After dyeing three types of bleached sample (full bleached, half bleached & no bleached) with & Levafix BRI Blue EFFN Reactive dye, we had tried to find the shade variation among the sample by using spectrophotometer. We had seen that, Half bleached & No bleached samples were darker, less saturated & greener than the full bleached sample which is mentioned in the table no. 9. We had also noticed K/S value of full bleached fabric was lower due to bleaching effect which is mentioned in the table no. 7. But for higher dye concentration, the K/S value of three types of bleached sample (full bleached, half bleached & no bleached) was found quite similar.

In this study, we had tried to evaluate the Wash fastness, Rubbing fastness & Water fastness Properties of three types of bleached sample (full bleached, half bleached & no bleached). The evaluation of rubbing fastness was done by using crockmeter. After dyeing, the rubbing fastness rating of three types of bleached sample (full bleached, half bleached & no bleached) were found similar. Both dry and wet rubbing rating of three types of bleached sample (full bleached, half bleached & no bleached) were similar. which is mentioned in the table no. 12 (after dyeing using Novacron Navy Reactive dye) & table no. 13 (after dyeing using Levafix BRI Blue Reactive dye)

After dyeing, the Washing fastness rating of three types of bleached sample (full bleached, half bleached & no bleached) were found similar. which is mentioned in the table no. 10 (after dyeing using Novacron Navy Reactive dye) & table no. 11 (after dyeing using Levafix BRI Blue Reactive dye)

After dyeing, the Water fastness of three types of bleached sample (full bleached, half bleached & no bleached) were found similar. But we had also noticed that there was some staining occurred in cotton and nylon part of multifiber fabric. which is mentioned in the table no. 14 (after dyeing using Novacron Navy Reactive dye) & table no. 15 (after dyeing using Levafix BRI Blue Reactive dye)

After reviewing the entire project, it is acceptable to conclude that the bleaching process has a reasonable effect in textile dyeing properties. Bleaching makes the grey fabric permanent white and as a result the reflectance% of bleached fabric is higher than the unbleached fabric. Which makes the unbleached fabric darker than the bleached fabric. But for higher dye concentration, bleaching does not affect the reflectance% of dyed sample. Hence, we can use less bleaching agent in bleaching before dyeing the fabric with higher dye concentration. It will reduce the cost as well as reduce the water & environment pollution.

5.2. Limitations

Although this study was successful, there were a number of limitations. They are-

- This study was completed by dyeing with light shade only (up to 2%). More dark shade can be performed and tested in further study.
- In this study, we could not evaluate the bleaching effect by using Leucometer.
- We had determined just 3 types of fastness rating of all the dyed sample (fastness to wash, fastness to rubbing, fastness to water). More fastness test like fastness to light, fastness to perspiration etc. can be done for better result of this study.
- The weight of each sample was just 10 gm. In further study, we may take large size sample to check if there is any running shade or uneven shade on half bleached and no bleached sample.
- We had evaluated the CMC decision under the illuminance (D65, F11, A). More illuminance like TL84, CWF etc. can be used in further study to evaluate the CMC decision.

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