Faculty of Engineering

Department of Textile Engineering

Project report on

Comparative study on knit fabric with reactive dye.

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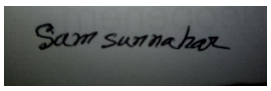
A thesis submitted in partial fulfillment of the requirements for the degree of **Bachelor of Science in Textile Engineering**

Advance in Wet Processing Technology

Spring, 2020

DECLARATION

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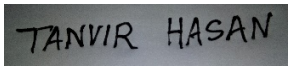

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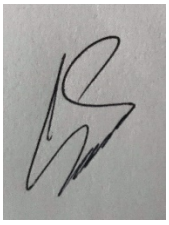
LETTER OF APPROVAL

This project report prepared by Shamsun Nahar Mitu (ID: 162-23-4673) and Sm. Tanvir Hasan (ID: 161-23-4626), 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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ACKNOWLEDGEMENT

Firstly, we express our gratefulness to almighty Allah for his divine blessing makes us possible to complete this project successfully.

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Finally, we would like to express a sense of gratitude to our beloved parents and friends for their mental support, strength and assistance throughout writing the project report.

DEDICATION

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

ABSTRACT

This project report present Comparative study on knit fabric (single jersey, rib and interlock) with reactive dyes.in this report we have try to show the difference of GSM for knit fabric in different stage of production. We have seen that in grey fabric GSM is greater than pretreated GSM and after dyeing GSM is higher than grey and pretreated GSM. For test these fabrics we have done color fastness test, rubbing fastness test.for dyeing these three different knitted fabrics (single jersey, interlock, rib) fabrics we used same chemicals. Before fabric dying we measured Gram per square meter (GSM), Strength, Wales per inch (WPI),then we dyed the fabric and also measured Gram per square meter (GSM), Strength, color fastness. We took the values by the analysis with grey scale (color change and staining). This report takes us through all the details of every knowledge and experience gathered during this internship period.

TABLE OF CONTENTS

Contents Page No.

Contents Page no

List of Figures

List of Tables

Chapter-1
Introduction

Chapter-1
Introduction

Reactive dyes are colored compounds which is capable of reacting chemically with a substrate to form a covalent dye substrate linkage in fiber such as hydroxyl groups in cellulose, amino, thinly and hydroxyl groups in wool or amino groups in polyamides. Between the functional groups bond formation result is high wet fastness properties. Reactive dyes are most commonly used in dyeing of cellulose like cotton, wool is also dyeable with reactive dyes. Reactive dyeing is the most important methods for the coloration of cellulosic fibers.

There are various types of reactive dyes. Among them flurotriazine-vinyl sulphonyl, Trifluro-pyridine-vinyl sulphonyl were used in this project to identifying there color difference and color fastness to wash.

The specific objectives of our research work is-

- To measure the change in stich length and GSM of single jersey, interlock and rib fabric after dyeing with reactive dye.
- To measure the change in WPI of cotton fabric after dyeing with reactive dye.
- To evaluate the color fastness to washing and rubbing of three different fabrics after dyeing with reactive dye.
- Compare the changes in fabric characteristics.

Chapter-2
Literature Review

Chapter-2
Literature Review

2.1 Knitted Fabric:

Knit fabric means which is made by interloping. A knit fabric is mainly made up of a single yarn, looped continuously to produce a braided look.
Knitted fabrics are produced by two common methods- warp knitting, and weft knitting, and each method produces different types of knitted fabrics.

Types of knit fabric-

1. Single jersey fabric- one set needle are used.
2. Double jersey fabric- two set needle are used.[1]

2.2Different types of Knitted fabrics:

- *Rib fabric*
- *Fleece fabric*
- *French terry fabric*
- *Thermal fabric*
- *Interlock fabric*
- *Single jersey fabric*
- *Double jersey fabric*
- *All over print single jersey fabric*

2.2.1Properties of single jersey:

- In this fabric per courses used only series of knitted loop.
- Extensibility in width is about twice than length.

Figure: single jersey fabric

- Unraveling the fabric from both sides is possible.
- The thickness of fabric is almost twice the diameter of yarn used.
- Identical right and wrong side of the fabric.[4]

2.2.2Properties of interlock:

- Thickness of the fabric is almost twice then single jersey
- Interlock fabric the plain of technical face on both sides so that the face and back side are same. It also called reversible type of fabric.
- More stable.

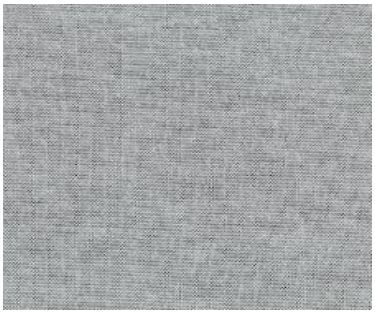


Figure: Interlock knit fabric

2.2.3Properties of rib:

- Two sets of needle are produced by the rib.
- The balance structure are perfect in rib.
- Rib used for socks, cuffs of sleeves etc.
- Almost identical right and wrong side of the fabric.

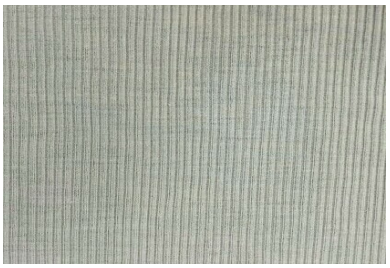


Figure: Rib fabric

2.3 Characteristics of knit fabric:

- It's have elastic nature
- Comfortable
- Lightweight
- Shrink or wrinkle resistant/ anti-wrinkle
- Manufacturing process is comparatively easy
- Comes in every color
- Wrinkle resistant
- Constructed into small pieces

2.4Advantage and disadvantage of knit fabric:

- Great flexibility
- Great extensibility and productivity
- Soft texture
- Moisture permeability
- Easy to disperse
- Dimensional stability is poor
- Anti-wrinkle[1]

2.4Application and uses of knitted fabric

- Nets
- Stitch bonded fabric
- Medical treatment
- Construction Industry
- Spacer fabric-Car seat covers etc.
- Sweaters, Scarfs etc.
- End uses-Swimwear, T-shirt, jackets etc.[1]

2.6 Reactive dye:

Reactive dyes are the water soluble anionic dyes. They react with the fiber to form covalent bonds. Reactive dyes are huge uses dyes all over the world.
Reactive dyes forming a permanent attachment in the fiber and could not removed by repeated treatment with boiling water under neutral condition.[5]

Reactive dyes are found in powder, liquid and print paste form.

In dyeing cellulose fiber (cotton) with reactive dyes the following chemicals and auxiliaries are used:

- Alkali (sodium carbonate, bicarbonate and caustic soda)
- Salt (mainly sodium chloride and sulphate)
- In continuous processes urea may be added to the padding liquor.
- In cold pad batch method may be added sodium silicate.

Reactive dyes consist of four parts:
- The chromogenic or the chromophoric part, it contributes to the color of the dye.
- A bridging unit that joins the chromophoric part to the reactive system.

2.6.1 Classification of reactive dye:

Reactive dyes are classified in various ways as bellow-

1) On the basis of reactivity:

    a) Lower reactive dye
    b) Higher reactive dye

2) On the basis of temperature:

   a) Cold brand
   b) Medium brand
   c) Hot brand

3) On the basis of reactive group:

   a) Halogen derivatives of nitrogen containing heterocycle- 3 types
      Triazine group
      Pyrimidine group
      Quinoxaline

   b) Activated vinyl compound
      Vinyl sulphone
      Vinyl acrylamide
      Vinyl sulphonamide

2.6.2 Uses of Reactive dye:

Reactive dyes are mainly used in cellulosic fibers like cotton or flax, and polyamide fiber, but also wool is dyeable with reactive dyes.
Reactive dyes are also called fiber reactive group because of it contain reactive group which reacts chemically with fiber polymer molecules and form covalent bond.[6]

2.6.3 Structure of reactive dye:

General structure of reactive dye is: D-B-G-X

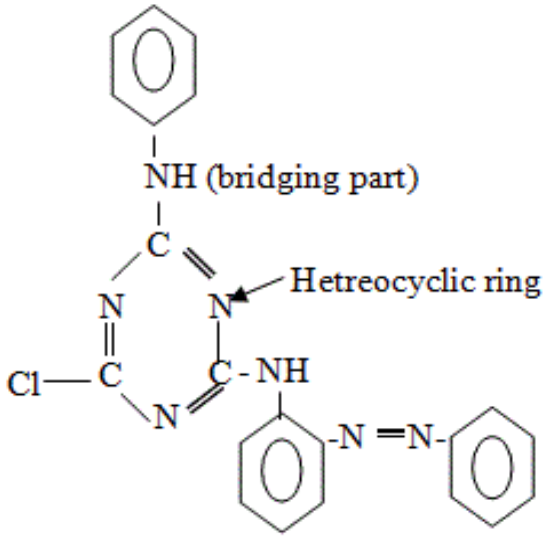
Here,
D = Dye part or chromogen (color producing part)

B = Bridging part
(It may be –NH- group or –NR- group)

G = Reactive group bearing part

X = Reactive group

Chemical structure of reactive dye is:



2.7 History of Reactive dyes:

Reactive dyes first emerged commercially in 1956, after their invention in 1954 by Rattee and Stephens at the Imperial Chemical Industries Dyestuffs Division site in Bleckley, Manchester, United Kingdom (UK).

Reactive dyeing is now the most significant method for the coloration of cellulosic fibers. They are principally used for dyeing and printing of cellulosic fibers, have been used for important outlets in the coloration of wool and silk.

Reactive dyes have good fastness properties due to the bonding that occurs during dyeing. Cotton is made of cellulose molecules which react with the dye.
During reactive dyeing the H atom in the cellulose molecule combines with the cl atom in the dyeing process and results in a bond. Trifunctional dyestuff also exist. [6, 10]

2.8 Various types and classes of dyes are listed below:

1. Acidic dyes
2. Synthetic dyes
3. Natural dyes
4. Direct dyes
5. Disperse dye
6. Sulfur dye
7. Azo dye
8. Naphthol dyes
9. Vat dyes
10. Pigment dyes
11. Reactive dyes
12. Pigment dyes
13. Macromolecular dyes
14. Basic dyes

2.9 Properties of reactive dye:

1. This dyes are available in powder, liquid and print paste forms.
2. It have good light fastness with rating about 6.
3. it's used for dyeing cellulose, protein and polyamide fibers.
4. This dyes are comparatively cheap in price.
5. This dyes have good perspiration fastness.
6. It is anionic in nature.
7. Water soluble dye.
8. For dyeing alkaline condition is must require.
9. It forms strong covalent bond with fiber.
10. During application a certain amount of dyes are hydrolyzed.
11. Better substantivity.
12. Electrolyte is must for exhaustion.
13. Wide range of color can be produce.
14. its perspiration fastness are also good[6,10]

2.10 Influencing factor of dyeing fiber with reactive dye:

- pH
- Time
- Temperature
- Liquor ratio
- Electrolyte concentration

- Salt
- Soda
- Levelling agent
- Sequestering agent
- Wetting agent

2.11Application method:

These are 3 application methods-

1. Discontinuous method-

    - Conventional method
    - Exhaust or constant temperature method
    - High temperature method

2. Continuous method-

    - Pad-steam method
    - Pad dry method
    - Pad thermo fix method

3. Semi continuous method-

    - Pad roll method
    - Pad jig method
    - Pad batch method[6]

2.12 Advantage of reactive dye:

1. Applicable to natural and synthetic fiber.
2. Good color fastness properties.
3. Quick sampling and high printing speed.
4. Easily applicable.
5. Easy wash.
6. Wide range of color can be produce.
7. Can be used for dope dyeing for filament yarn.
8. Extremely well suited for color resistant effects.[10]

2.13 Disadvantage of reactive dye:

1. The utilization rate is not high enough.
2. Initial investment is high.
3. Synthetic filaments liquefy and consume effectively.[6,10]

2.12Trade names of reactive dye: [6]

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

CHAPTER-3
METHODOLPGY

CHAPTER-3
Experimental Details/Methodology

3.1 Sample:

Doing our experimental work we took 3 kind of knit fabric each type of sample weight is 25 gm.

3.2 Specification of sample:

Sample no	Sample name	GSM (cm)	SL (mm)
01	Single Jersey	98	2.13
02	Interlock	152	2.86
03	Rib	160	2.95

3.3 Scouring and bleaching

In scouring process all natural and adventitious are removed to produce hydrophilic and clean textile material. In wet processing scouring is one of the important process.
It also increase absorbency of textile material.

Bleaching is done for ensure pure and permanent basic white color fabric. It is a chemical treatment employed for the removal of natural color. [4]

3.4 Recipe of scouring and bleaching:

Detergent =1g/L

NaOH = 1g/L

Sequestering agent = 1g/L

Hydrogen per-oxide =4g/L

Peroxide Stabilizer =1.5g/L

Sample weight =75 gm

M: L =1:30

Temperature = 100 C

Time = 60 min

PH =12

Process Sequence: [9]

Collection of 100% cotton fabric

↓

Scouring and Bleaching at 100°C

↓

Cold Rinsing

↓

Hot wash

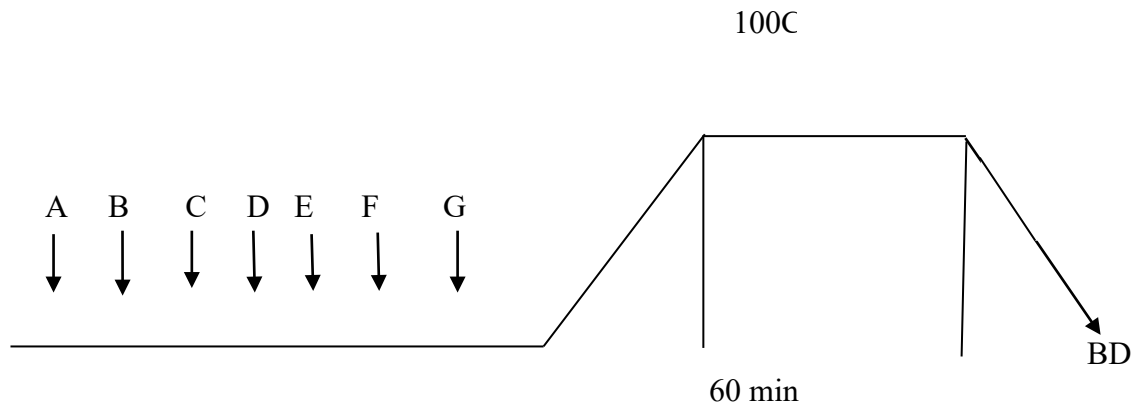
↓

Cold Rinsing

↓

Drying

Process curve for scouring and bleaching:



:process curve for scouring and Bleaching

A = Water

B = Detergent

C = H_2O_2

D = Peroxide stabilizer

E = Sequestering agent

F = NaOH

G = Fabric

3.5Function of using dyes and chemicals:

1. **Wetting agent:** It is use to reduce the surface tension of water and fabric.
2. **Soda ash:** Control pH of reactive dye bath.
3. **Sequestering agent:** It is used to remove hardness of water.
4. **Detergent:** It is used to cleaning agent.
5. **Hydrogen peroxide:** It is used to improve the consistency of dye transfer to the fabric.
6. **Peroxide stabilizer:** The decomposition of peroxide under the influence of alkali is adjusted by the stabilizer.
7. **Glauber salt:** It is use as electrolyte. It is used for increasing the affinity of the dye towards the cellulose substrate and also increases the exhaustion rate of reactive dye stuffs
8. **Levelling agent:** It is used for distribution of dyes and chemicals equally.

3.6Dyeing of fabric with reactive dye:

Theory:
A dye which is capable of reacting chemically with a substrate to form a covalent dye substrate linkage is known as a reactive dyes. Here the dye contains a reactive group and this reactive group makes covalent bond with the fiber polymers and act as an integral part of the fiber. This covalent bond is formed between the dye molecules and the thermal- OH (hydroxyl) group cellulosic fibers or between the dye molecules and the thermal –NH_2 (amino) group of polyamide fibers. [10]

3.7Recipe of dyeing:

Reactive Red	=1%owf
Glauber salt	=40 g/L
Soda ash	=6 g/L
Levelling agent	=1g/L
Wetting agent	=1 g/L
Sample weight	=15 gm
M: L	=1:40
Temperature	=60C
Time	=20 min
PH	=11

Process Sequence

Collection of pre-treated sample

↓

Set water level

↓

Add levelling agent

↓

Add wetting agent

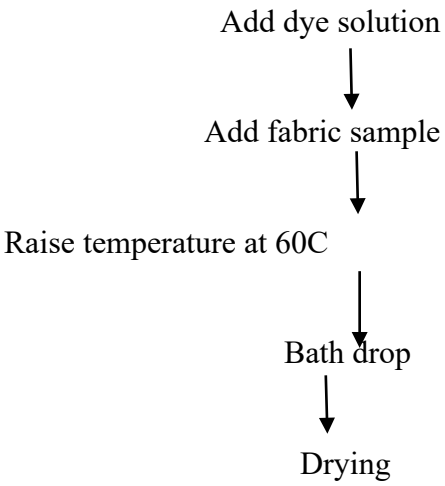
↓

Add salt solution

↓

Add soda ash

↓



Process curve of dyeing fabric with reactive dye:

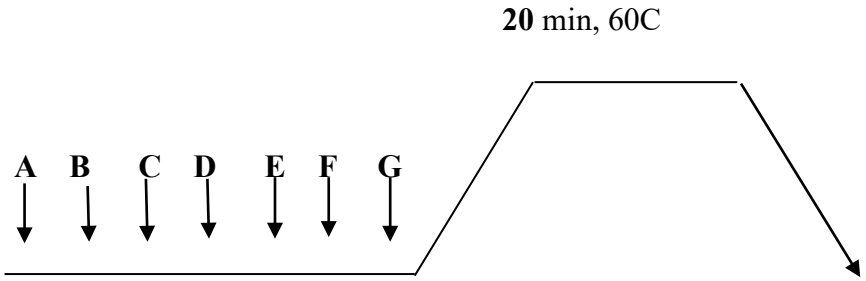


Fig: 3.7 dyeing fabric with reactive dye

A = Water

B = Levelling agent

C = Wetting agent

D = Salt

E = Soda

F = Dye

G = Fabric

3.8Measurement the GSM and stitch length of knitted fabric:

GSM means grams per square meter that is weight of fabric in gram per one square meter. It is the main parameter for knitting fabric.

1. At first we count loop number by using counting glass and the unwrapped yarn from the fabric which one marking in 1 inch and the measured the course length by the scale. After that we calculated the equation:

SL= course_length/ No of loops

2. For calculating GSM, first we cut 1 inch square fabric in gm. Then we converted 1 inch square into 1 meter square, then we calculating GSM by the following measure.

   1 inch square = 0.0006451 meter square

   For example,

   Weight of 0.0006451 meter square fabric (single jersey) = 0.303 gsm

   Weight of 1 meter square fabric (single jersey) = 0.303/0.0006451 gsm =469 gsm

CHAPTER-4

Discussion of Results/Finding

Chapter-4
Discussion of Results/Findings

Table 4.1 Change in GSM of cotton fabrics after dyeing with reactive dye:

Sample No	Sample name	GSM in gray fabric (cm)	GSM in pretreated fabric (cm)	GSM in dyed fabric (cm)	Change in GSM after dyeing (cm)	% of change GSM
1	Single jersey	150	147	154	7	2.67
2	Interlock	220	212	222	10	0.90
3	Rib	250	242	262	20	4.8

Here the table indicates change of GSM. The table indicates the % of changes in GSM. For different change of change in GSM for different kinds of fabrics. In the uses of reactive dye, we can see that, the GSM of grey single jersey fabric is 150, GSM of pretreated single jersey fabric is 147.but we get the GSM after dyed that same fabric is 154. So we get the change of GSM are 7 and the percentage (%) of change GSM is 2.67.

In the uses of reactive dye, we can see that, the GSM of grey interlock fabric is 220, GSM of pretreated interlock fabric is 212But we get the GSM after dyed that same fabric is 222. So we get the change of GSM are 10 and the percentage (%) of change GSM is 0.90.

And also, in the uses of reactive dye, we can see that, the GSM of rib fabric is 250, GSM of pretreated Rib fabric is 242 but we get the GSM after dyed that same fabric is 262. So we get the change of GSM are 20 and the percentage (%) of change GSM is 4.8.

Table 4.2 Change in SL of cotton fabrics after dyeing with reactive DYE:

Sample No	Sample name	SL in Grey fabric (mm)	SL in pretreated fabric (mm)	SL in dyed fabric (mm)	Change in SL after dyeing (mm)
1	Single Jersey	2.65	2.33	2.6	0.27
2	Interlock	2.87	3.02	3.24	0.22
3	Rib	2.7	2.81	2.58	-0.23

Here the table indicates change of SL. The table indicates the % of changes in SL. For different change of change in SL for different kinds of fabrics. In the uses of reactive dye, we can see that, the SL of grey single jersey fabric is 2.65. But we get the SL after dyed that same fabric is 142. So we get the change of SL is 0.27. SL of pretreated single jersey fabric is 2.33.

In the uses of reactive dye, we can see that, the SL of grey interlock fabric is 2.87. But we get the SL after dyed that same fabric is 3.24. So we get the change of SL is 0.22. SL of pretreated interlock fabric is 3.02.

In the uses of reactive dye, we can see that, the SL of grey rib fabric is 2.7. But we get the SL after dyed that same fabric is 2.58. So we get the change of SL is -0.23. SL of pretreated rib fabric is 2.81.

Table 4.3 Change in WPI of fabric after dyeing with reactive dye:

Sample No	Sample name	WPI in grey fabric	WPI in pretreated fabric	WPI in dyed fabric	Change in WPI after dyeing	% of change WPI
1	Single jersey	54	51	48	-5	-5.89
2	Interlock	30	35	37	2	5.71
3	Rib	51	49	57	8	16.33

Here the table indicates change of WPI. The table indicates the % of changes in WPI.
For different change of change in WPI for different kinds of fabrics. In the uses of reactive dye, we can see that, the WPI of grey single jersey fabric is 54. But we get the WPI after dyed that same fabric is 48. So we get the change of WPI is -5. WPI of pretreated single jersey fabric is 51.

In the uses of reactive dye, we can see that, the WPI of grey interlock fabric is 30. But we get the WPI after dyed that same fabric is 37. So we get the change of WPI is 5. WPI of pretreated interlock fabric is 35.

In the uses of reactive dye, we can see that, the WPI of grey rib fabric is 51. But we get the WPI after dyed that same fabric is 57. So we get the change of WPI is 8. WPI of pretreated rib fabric is 49.

Table: 4.4 Assessment of color fastness to wash:

Color fastness to washing means, a sample of the textile is mechanically ignited in soap solution under described conditions of time and temperature in contact with one or two specific adjacent fabrics, then washed and dried. The pattern changes color and the adjacent fabric stain with gray fabrics.

1) At first, we collect dyed sample and multi-fiber and stitch them together. Then we set bath and take chemicals.

2) Then we immersed sample to the bath and heated it up to 40C for 30 minutes.

3) After the process dry the sample and compare with grayscale to color staining for multi-fiber.

4) We compare our sample with gray scale of color change and compare our multi-fiber with grey scale of color staining, and the rating for color change is 2-3

Table: 4.5 assessment of color fastness to rubbing:

Color fastness is a term used in the textile industry to describe the resistance of a fabric to color fading or color transfer.
There are different color fastness tests, rubbing fastness test is one of them.
In this test determine the degree of color that may transfer from the colored fabric to other surface by rubbing.

Determine the rubbing fastness on color by using crock meter in two process dry and wet. In wet process distilled water are used.
The operating handle is operated by using of hand.
We give 10 stocks the direction of every stock is 1 seconds.
Then the sample and crocking cloth is collected and compare with gray scale.

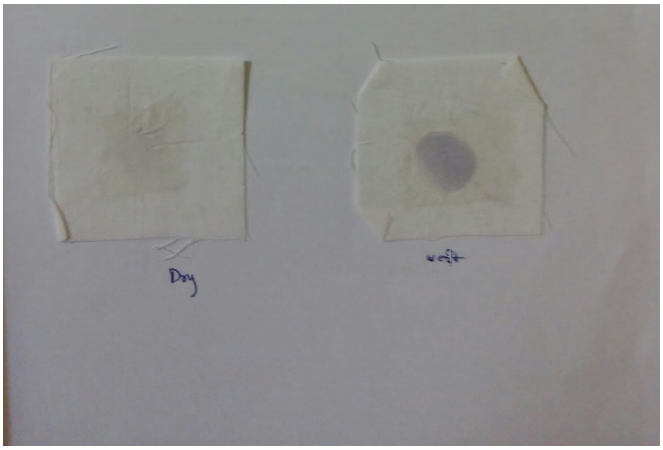


Figure: Color fastness of rubbing

Results:

Dry-1/2
Wet-4/5

Chapter-5
CONCLUSION

Chapter-5
CONCLUSION

In our research we used 3 types of knit fabric (single jersey, rib and interlock) before and after dyed with reactive dyes to observe the rating of colorfastness to rubbing & color fastness to washing. We have found that color fastness to rubbing and color fastness to wash is better in rib fabric then interlock and then single jersey. Also some information about GSM are given below:

In the uses of reactive dye, we can see that, the GSM of grey single jersey fabric is 150, GSM of pretreated single jersey fabric is 147.but we get the GSM after dyed that same fabric is 154. So we get the change of GSM are 7 and the percentage (%) of change GSM is 2.67.

We can see that, the GSM of grey interlock fabric is 220, GSM of pretreated interlock fabric is 212But we get the GSM after dyed that same fabric is 222. So we get the change of GSM are 10 and the percentage (%) of change GSM is 0.90.

We can see that, the GSM of rib fabric is 250, GSM of pretreated Rib fabric is 242 but we get the GSM after dyed that same fabric is 262. So we get the change of GSM are 20 and the percentage (%) of change GSM is 4.8.

After doing this experiment we learn a lot of things like about knitted fabrics, types of knitted fabric, reactive dyes etc. By doing that we faces some of problems and we overcome that successfully.

At the end of our experiment, we can say that we have successfully completed our experiment .Every operation we should do work attentively and regularly because it minimizes the gap between our theoretical as well as practical knowledge. After the completion of the experiment we have gained a lot of practical knowledge about the Knit Fabrics manufacturing process, structures, quality of fabrics, industrial management and the working environment that will help us to build our future carrier.

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