



Faculty of Engineering  
Department of Textile Engineering

REPORT ON

**STUDY OF THE EFFECTS OF DYEING  
PROCESS WITH REACTIVE DYES ON COTTON  
KNIT FABRICS**

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This Report Presented in Partial Fulfillment of the Requirements for the Degree  
of **Bachelor of Science in Textile Engineering**.

Advance in Textile Wet Processing Technology

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## **DECLARATION**

I hereby declare that, this work has been done by me and not copied from elsewhere. I 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 research entitled ‘Study of The Effects of Dyeing Process with Reactive Dyes on Cotton Knit Fabrics’ on Spring-2018 Semester prepared and submitted by **Md. Al Mamun Rashid(Id: 093-23-1661)** in partial fulfillment of the requirement for the degree of BACHELOR OF SCIENCE IN TEXTILE ENGINEERING has been examined and hereby recommended for approval and acceptance.

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This thesis report is dedicated  
to  
My loving parents

## **ABSTRACT**

Dyeing is one the most important part in the textiles manufacturing. Various types of fabric coloration are performed in dyeing section based on the requirements and demand of the buyer. Lots of traditional dyeing processes are running industrially in different manufacturing unit to dye the fabric. Different dyeing factories perform different dyeing process. But all of the dyeing processes are not practically suitable for the coloration of the fabric to maintain the exactly required shade and quality of colored fabric. Dyeing process is very common in textile industry and this process changes the physical and chemical property of fabric. There are various types of properties changes during knit cotton dyeing. It is very important that the changing property measurement. In this study I investigate the changing property such as WPI, CPI, Stitch Length, GSM, color fastness to Rubbing and color fastness to washing on cotton knit fabric that ensure to get the required product. For uniform dyeing, the fabric absorbency must be uniform. Here I investigated thus property of cotton knit fabric dyeing with reactive dyes. This paper tries to find out the major changes property of knit fabric from grey to finish. Hope this paper will help those people who are in textile dyeing industry.

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**CHAPTER-01**  
**INTRODUCTION**

# CHAPTER-01

## INTRODUCTION

### 1.1 Introduction

Textile sector is the largest sector in Bangladesh. It is also highest foreign currency earning sector in Bangladesh. Now Bangladesh earns near about 80% of its foreign revenue from this sector. Cheap labor has made it easier to spread textiles based industries. More than 5.7 million of people are working in this sector now. Most of them are women. This sector is helping women to be self-reliant. Normally in Bangladesh single jersey fabric such as plain, pique etc. cotton fabrics and reactive dyes are mostly used in our country. Reactive dyes are widely used for the dyeing of cotton. These dyes are anionic in character and in general are water soluble due to the presence of (SO<sub>3</sub><sup>-</sup>) groups in the chemical structure. There are different technical parameters involved in the knit fabric such loop structure, stitch length, CPI, WPI, GSM, etc. Color fastness is very important property for a dyed fabric. In this study I tried to find out the changes property of cotton knit fabric as WPI, CPI, Stitch Length and GSM. Also the color fastness to rubbing and color fastness to washing of different types of cotton knit fabric, which is dyed with reactive dyes.

Thus property measurement is very important for finished fabric. Thus properties can be ensuring the final required product. Measurement of changing property from grey fabric to finished fabric and color fastness of finished fabric.

## 1.2 Objectives of the Study

The **broad objective** of the work is ‘The Effects of Dyeing Process with Reactive Dyes on Cotton Knit Fabrics’.

The **specific objectives are:**

- To know about different types of grey and finished cotton knit fabric inspection.
- To know the effect of Reactive dyes on cotton knit fabric.
- To know about the changes of WPI, CPI, Stitch Length and GSM of knit fabric.
- To know about the result of color fastness to rubbing and washing.

### **1.3 Importance of the Study**

A cost saving approach in garments production Units. This article explains the causes of dyeing and changes properties in readymade garments. Dyeing and finishing is very important section and widely faced by garment manufacturers. It is very difficult to get rid of it completely. Some aspects of the dyeing fault formation and changes various types of property like WPI, CPI, and stitch length etc are discussed in this article. The questions whether the level of a fault is acceptable or not depends largely on the type of fabric and the type of fault. Major faults occurring during this process adversely affect the product quality and product efficiency, and also increase the production cost. The aim of this study is to investigate of WPI, CPI, Stitch Length and GSM variation in knit fabric to maintain the final property of the product. Make suggestion for improving the quality control. By this study I demonstrated that the investigation of GSM and fastness property to make significant contribution to produce quality garment and prepare more effective the improvement plans.

**CHAPTER-02**  
**LITERATURE REVIEW**

# **CHAPTER-02**

## **LITERATURE REVIEW**

### **2.1 Cotton**

All aspects of the cotton plant can be utilized. The long cotton fibers are utilized to make material, the short fibers can be utilized as a part of the paper industry. You can make oil or margarine out of the seeds of the cotton plant. The leaves and stalks of the cotton plant are furrowed into the ground to improve the dirt. Different parts of the plant are encouraged to creatures.

Cotton is a subtropical plant that develops in numerous warm regions of the world. It began as a plant of the tropics however today it is developed in other warm territories that have no less than 200 ice free days. The most critical cotton-developing nations are the USA, China, India, Pakistan and Australia.

China delivers around 30% of the world's cotton fiber, for the most part in the eastern piece of the nation. In the United States cotton is developed in the southern states, the greatest cotton maker is Texas.

#### **History of Cotton**

Cotton was first developed in Pakistan and the Nile valley around 3,000 years back. Local Americans began developing cotton in the meantime in North America. Europe was acquainted with cotton through Arab traders at around 800 A.D. By 1500 cotton was known everywhere throughout the world. At the point when Europeans established provinces in America they depended on cotton to bring home the bacon. In the good 'old days, developing and collecting cotton was a difficult activity that was done physically by slaves.

In 1793 an American, Eli Whitney, concocted the cotton gin, a machine that isolated seeds from fiber. This new development enabled homesteads to create much more cotton.

In the second piece of the twentieth century individuals began to create manufactured fibers, similar to nylon and acrylic. The significance of cotton fiber started to drop. By the center of the 1970s cotton made up just a single third of all fibers around the world. Numerous cotton ranchers needed to close their homesteads. Governments, particularly in America, needed to help cotton agriculturists amid this monetarily troublesome period. By 1990 the interest for cotton garments

wound up greater, essentially in light of the fact that individuals saw that cotton was a characteristic fiber and extremely agreeable to wear. By the turn of the thousand years cotton recovered its significance.

Towards the finish of the twentieth century ranchers began trying different things with natural cotton, developed without chemicals or pesticides. Such cotton has ended up being more costly than ordinary cotton.

### **Properties of cotton fiber**

The cotton fiber originates from the fruit of the cotton plant which develops in tropical districts. The fiber is known as 'seed hair' since it is the sinewy fleecy material which originates from the seeds of the plant. The cushioned material covering the seed is additionally called 'ball'.

### **Physical and properties of cotton fiber:**

**Tenacity:** The quality of cotton fiber is credited to the great arrangement of its long polymers i.e. its polymer framework is around 70% crystalline, because of the innumerable nonstop hydrogen bond arrangements between nearby polymers, and the spiraling fibrils in the essential and optional cell dividers. It is one of only a handful couple of fibers which picks up quality when wet. This happens because of the enhanced arrangement of polymers and increment in hydrogen bond numbers.

**Elasticity:** Relatively it is versatile because of its crystalline polymer framework and for this reason cotton materials wrinkle and wrinkle promptly.

**Hyroscopic Nature:** The cotton fiber is a result of spongy, inferable from the innumerable polar OH gatherings. In its polymers, these pull in water atoms which are additional polar. The hydroscopic nature normally restricts cotton material materials from creating electricity produced via friction. The extremity of the water atoms pulled in to the hydroxyl bunches on the polymers disseminate any static change which may create.

**Thermal properties:** Cotton isn't thermoplastic and henceforth over the top use of warmth vitality reasons the cotton fiber to singe and bum, without earlier softening.

**Luster:** Lin-treated cotton has no articulated luster. In this manner keeping in mind the end goal to make it glossy they should be mercerized.



### **Chemical properties of cotton fiber:**

**Action with alkali:** Here, preventive power is good. Alkali does not damage cotton fiber.

**Action with acid:** Strong acid damage the fiber Concentrated sulphuric acid and hydrochloric acid damage the fiber. But weak acid does not damage the fiber.

**Action with bleaching:** No damaging event is occurred here. Cotton is converted into oxi-cellulose in strong oxidizing bleaching.

**Action with organic solvent:** Resistance so dry is possible here.

**Sunlight preventive power:** Ultraviolet ray converts the cotton into oxi-cellulose.

## **2.2 Knitting**

A knitted fabric might be made with a solitary yarn which is shaped into interlocking loops with the assistance of snared needles. As per the motivation behind the fabric, the loops might be freely or nearly built. Stitched fabric is the least complex case of sewing where a chain of loops is developed from a solitary string with the assistance of a snare. As the loops are interlocked in a knitted fabric, it can extend toward any path notwithstanding when a poor quality yarn having little flexibility is utilized.

### **History of Knitting**

Weaving is accepted to have started in the Middle East in the fifth century and went to Europe with fleece merchants soon thereafter. Strangely, the cases of early sewing from Egypt are really produced using cotton strands, not fleece. A significant number of them have Arabic favors knitted into them, or image to avert misfortune. In the fourteenth century, the knitted material frame was utilized by anglers to make warm, woolen, weatherproof jumpers for excursions to ocean. By the sixteenth century, weaving machines were utilized to sew hosiery for exclusive classes.

Weaving soon turned into a nearby industry in the Highlands and Scotland, utilizing men in production lines to sew tights that were sent out to whatever is left of Europe. Before long, caps, shawls, packs, jumpers and different types of knitwear were accessible in the market. The principal sewing loom was worked in 1816 and woolen factories were set up to make costly pieces of clothing. Eugene Rodier set up the principal woolen material production line in 1853.

By the twentieth century, knitwear was a piece of standard design. With the presentation of pullover dresses, cardigans and jumpers by mold marks like Chanel, knitwear was a viable, chic and current decision for people.

The weaving procedure fundamentally includes ceaselessly interlinking or hitching arrangement of loops of yarn utilizing needles. These successive loops are intermeshed into the past circle structure. In this way the new fasten secures the circle structure by locking the past join that are suspended from it, in the end making a sheet of material. Much the same as in weaving, this sheet of materials is a two-dimensional fabric. The distinction, nonetheless, is that the strings run straight or parallel in weaved material, though the yarns take after a winding way in sew fabric. The symmetric circling of yarn makes the subsequent fabric be versatile and stretchy, an exceedingly attractive property that makes knitwear a closet staple in winters.

## **Knitwear**

Numerous sewers timid far from knit fabrics, maybe befuddled by the wide assortment accessible or uncertain of what sort of piece of clothing to build from a specific knit. I trust the more you think about a fabric, the less demanding it is to assess how to utilize it. What's more, knits are unquestionably worth becoming acquainted with they are significantly less demanding to fit than woven oppose wrinkles by and large, are awesome to deal with; and are amazingly agreeable to wear. Also, nowadays you can locate a noteworthy scope of knits in different filaments, among them, material, silk, fleece, Tencel, polyester, cotton, and cotton mixes.

When I'm inquired as to whether an example will work with a specific knit, I need to state that the appropriate response is imbued in my fingers. Dealing with the fabric triggers now-natural learning got from years of sewing with knits and retaining each piece of data I've ever found out about them. I'd get a kick out of the chance to give you a diagram of essential realities about knit fabrics to enable you to build up your own particular store of information that will soon discover its way into your fingertips.

### **Different Types of knit fabric (Grey + Finished):**

- S/J (100% cotton)
- Jacquard Interlock (100% cotton)
- Double Jacquard (100% cotton)
- French Terry (100% cotton)
- Slub Jersey (100% cotton)

## **2.3 Reactive Dye**

A dye whose artificially dynamic radical gatherings respond synthetically with filaments is named as Reactive dyes, or reactive dyes. Created by the British organization, Imperial Chemical Industries, first in 1956, the vast majority of the Reactive dyes break down in water, and the sub-atomic structure incorporates parent dyes and dynamic gatherings.

It contains bunches that can respond with fiber in particle of Reactive dyes. Synthetic responses happened amongst dyes and strands amid the technique of dyeing and produced new covalent bonds, accordingly extraordinarily enhancing the shading quickness, particularly wet speed. Reactive Dyes, connected for an assortment of filaments, for example, cotton, material, rayon, fleece, silk and mixed fabric for dyeing and printing, are anything but difficult to utilize, and possess splendid shading and the chromatography is more total with bring down cost. When dyeing, it is joined by hydrolysis of the Reactive dyes. Along these lines, notwithstanding the dye, strong shading, there is post-handling stage with a specific end goal to completely wash hydrolyzed dyes. Dye settling rate is for the most part close to 70% and to enhance it, there happens Reactive dyes with a composite action gatherings (particles containing at least two dynamic gatherings) lately, whose obsession rate is of 85% to 95%.

### **Applications of Reactive Dyes**

Rayon, cotton, flax and other cellulosic fibers

Polyamide and wool fabrics

Acetate and silk fibers

### **Characteristics of Reactive Dyes**

#### **Light-fastness**

Typically fabric dyed with reactive dye does not blur when presented to daylight. The light-speed of dye can be appraised around 6. It has solid electron content and is known to show an incredible protection from the corrupting impact of the bright substance of the daylight. Likewise accessible are some reactive dyes that show not out of the question light quickness.

#### **Washing-off**

Material substances dyed with reactive dyes are flushed and scoured appropriately. Reactive dyes are known to respond with the hydroxyl fragments of the water atom to make dye particles with poor substantively for the material. To avert this poor substantively these particles need to washoff

Through a washing-off process that contain flushing and scouring or else such atoms of dye may prompt poor rub-quickness.

### **Wash Fastness**

Material fabrics having hued with reactive dyes shows an incredible wash speed, which can be appraised at around 4-5. This is an extraordinary attribute to the amazing stable covalent affiliation that is found between the dye component and the fiber polymer.

### **Impact of Acids**

The improvement of the covalent bond amongst fiber and dye generally happens under antacid conditions. The acids can possibly turn around this procedure. Air contamination and sweat both contain a type of corrosive which way impact material materials dyed with reactive dyes and may prompt a type of blurring in the fabric.

### **Impact of Chlorine**

At first, when reactive dyes were presented it was sees that a couple of the reactive dyes were unfavorably influenced by chlorine based dyes.

### **Synopsis**

Generally reactive dyes are anionic dyes broadly known to dye cellulose, protein and polyamide strands. These could be found in fluid, control, or even print glue frame. Considering the properties of these reactive dyes it ought to be utilized and connected in differing scope of material fabric to get the ideal outcomes and engaging material shading.

### **Winch Dyeing Machine**

A dyeing machine comprising basically dye vessel fitted with a determined winch (generally over the liquor level) which turns and draws a length of texture, ordinarily joined end to end, through the liquor.

Winch dyeing machine is a fairly old dyeing machine for textures in rope shape with stationary liquor and moving material. The machine works at a most extreme temperature of 95-98°C. The liquor proportion is for the most part very high (1:20-1:40). Winch dyeing machines are a minimal effort plan that is easy to work and keep up, yet adaptable in application demonstrating priceless for readiness, washing or after medicines and the dyeing stage itself. In all winch dyeing machines a

progression of texture ropes of equivalent length are submerged in the dye shower yet part of each rope is assumed control two reels or the winch itself. The rope of texture is flowed through the dye shower being pulled up and over the winch over the span of the dyeing task. Dyestuff and auxiliaries might be dosed physically or naturally as per the recipe technique.

### **Description and Dyeing Method on Winch Dyeing Machine**

The fundamental standard of all winch dyeing machines is to have various circles or ropes of the texture in the dye shower, these ropes are of equivalent length, which are for the most part inundated in the liquor in the shower. The upper piece of each rope keeps running more than two reels which are mounted over dye shower. At the front of the machine, over the highest point of the dye liquor, is a littler reel, which is called maneuver or fly roller.

The fly rollers stay freewheeling alongside texture rope. At the back of winch tank is the winch wheel, which pulls the texture rope from the dye shower over the move reel for dropping in the dye shower for drenching. From the dropped area, the texture rope goes back, to be lifted and bolstered to winch wheel.

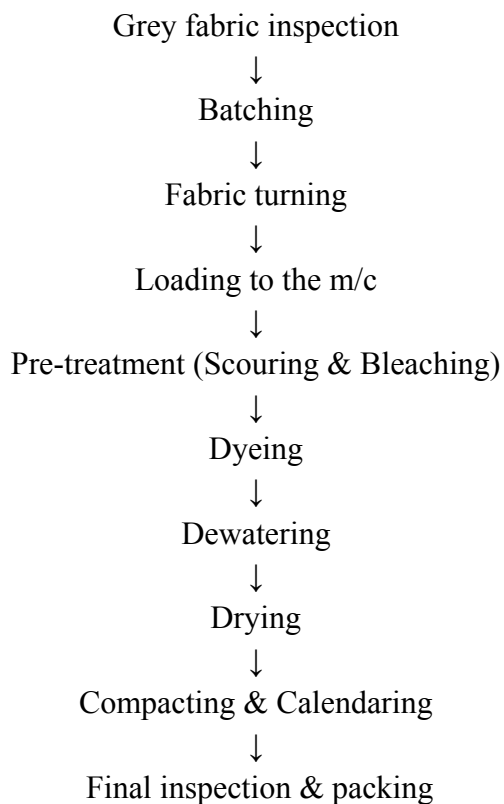
The dyeing procedure on winch dyeing machines depends on higher M: L as contrasted and other dyeing machines. The procedure is directed with almost no tension. The aggregate dyeing time is lengthier when contrasted with different machines.

### **Dyeing Process**

Dyeing is a method which imparts beauty to the textile by applying various colors and their shades on to a fabric. Dyeing can be done at any stage of the manufacturing of textile- fiber, yarn, fabric or a finished textile product including garments and apparels. The property of color fastness depends upon two factors- selection of proper dye according to the textile material to be dyed and selection of the method for dyeing the fiber, yarn or fabric.

## Flow Chart of Knit Fabric Dyeing Process:

### Sequence of operation for Knit Fabric Dyeing:



### Dyeing Recipe:

SL	Process Parameter	Unit	Dossing	Stock Soln.
01	Dyes	%	2	1%
02	Levelling Agents	g/L	1	1%
03	Glauber Salt	g/L	40	15%
04	Soda Ash	g/L	10	10%
05	Sample Weight	gm	5	.....
06	M:L	.....	1:30	.....
07	Temperature	°C	60	.....
08	Time	min	20	.....

## 2.4 WPI, CPI and Stitch Length of Knit Fabric:

### Courses per Inch (CPI)

Courses per inch (CPI) indicate the numbers of courses in one inch of fabric.



Figure 01. Course of knitted fabric

### Wales per Inch (WPI)

Wales per inch (WPI) indicate the total numbers of Wales in one inch of fabric.



Figure 02. Wales of knitted fabric

### Stitch length

Stitch length is theoretically the single length of yarn which include one needle loop and half of a sinker loop between that needle loop and the adjacent needle loop. The length is measured in millimeter (mm).

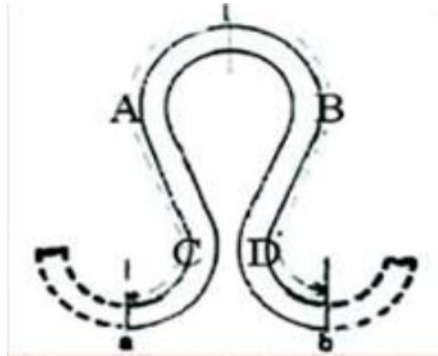


Figure 03. Stitch Length

## 2.5 Fabric GSM

### GSM

GSM means grams per square meter of a fabric. It is essential to know the weight of the fabric before manufacturing and after getting the finished fabric. It needs to measure the weight of the fabric to be sure about the finished weight of the fabric. This test can be carried out in different ways but it is very easy to know the weight of the fabric by cutting the fabric with the GSM cutter.

### Importance of GSM Measurement:

- Have to maintain the perfect weight of the product.
- Long lasting or better quality.
- The higher of effect the price.

## 2.6 Color Fastness

We can define colorfastness as, having color that will not run or fade with washing or wear. That means characterizes a material's color's resistance to fading or running. Clothing is colorfast if its colors and dyes do not bleed or run from the clothing. Clothing should be tested for colorfastness before using any type of bleach or bleaching solution, or strong cleaning product. Colorfastness is very important factor for buyer. Color fastness properties of textiles are an important measure of quality of a product.



## **Importance of color fastness**

- Throughout the history of dyeing, the dyer has always been willing to pay more for products with better color fastness, because customers were willing to pay more for color which would stay on the fiber and look the same many years afterwards as it did when originally purchased.
- The modern dyer and consumer are no different. Both have an interest in the color remaining on the fibers for the life of the textile concerned. Generally, the better the fastness properties, the greater the dyeing cost, both in respect to dyes and methods. A product with poor fastness will result in customer dissatisfaction, returns and failure to repurchase brand names that show inadequate fastness properties.
- Another reason for requiring good color fastness is that when fiber is dyed at an early stage of processing it must be fast to subsequent wet processing and heat treatments that are experienced after weaving and knitting. In this case, the water and washing fastness properties which will eventually be required in the finished products will be gained as a result of the need for further processing after dyeing.

## **Different Types of Color Fastness**

There are various types of color fastness test for fabric. Important color fastness tests are given below:

- Color Fastness to Washing
- Color Fastness to light
- Color Fastness to perspiration
- Color Fastness to Water
- Color Fastness to Rubbing
- Color fastness to sea water
- Color fastness to hot pressing
- Color fastness to chlorinated water

## **Color Fastness to Wash**

It is the resistance of a material to change in any of its color characteristics as result of washing with household detergent. Color fastness to wash is very important for Lab-dip in dyeing factory. It is one of the most important and mostly used color fastness tests. There are varieties of testing procedure, because:

- Washing conditions may vary from one country to another.
- To evaluate repeated washing accelerated test methods are used.
- The methods on the use of dyed goods.

The accelerated washing tests are designed for evaluating the color fastness to washing of textile, which are expected to withstand frequent washing. The color loss and surface changes resulting from detergent solution

### **Color Fastness to Rubbing**

Colorfastness to rubbing is an essential test utilized by clients to decide the nature of a hue texture and has been a region of worry for processors for a long time. The processor must know about the required principles and relate them to the conceivable restrictions of what can be accomplished on the completed items. It comprehends the test itself, since there are couples of zones which are missed by in-house research a center which may prompt contrasts in comes about.

### **Grey Scale**

The Gray Change and Gray Stain scales are each in light of a gray arrangement of visual paint chips. The two scales measure color-fastness of textile dyes. Gray Scale for color change shows the measure of fading or color adjustment with ecological presentation or washing, and gray scale for staining demonstrates the measure of staining of neighboring materials that happens with washing of an example. Both scales are based on relative small differences between a product standard and lot sample of any color in comparison to these two gray scales (5 = no difference; 1 = most difference).

### **Types of Grey Scale**

#### **A. Gray Scale for Color Change**

The loss of color utilizing the gray change scale is assessed by correlation with five sets of gray guidelines like those demonstrated as follows. One portion of every standard is dependably of indistinguishable chroma to the beginning example. The second half ranges from the beginning chroma (no loss of color) to white (loss of all color). The measure of difference between the treated and untreated texture is identified with one of the standard sets to yield the gray scale rating. On this scale, 5 demonstrate that alongside no color was lost, and show that most color was lost.

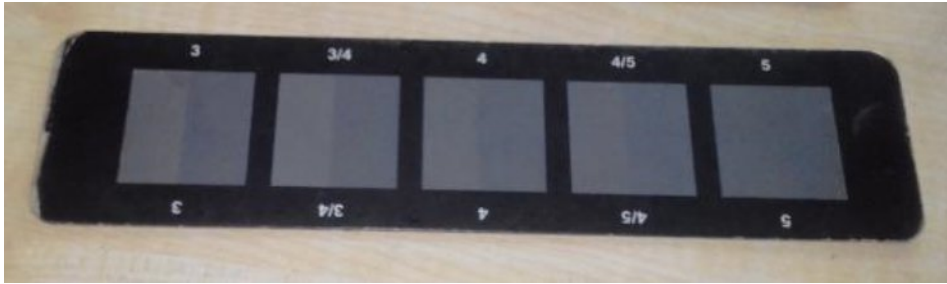


Figure 04. Gray Scale for Color Change

### **B. Gray Scale for Staining**

The transference of color from the test specimen to an adjacent specimen is evaluated in a manner very similar to that of gray change. Again, five standard pairs are used. One half of each standard is white, and the second half ranges from white (no staining) to a gray with the chroma value of the test specimen (great deal of staining). A value of 5 corresponds to virtually no staining, whereas 1 indicates poor color-fastness.

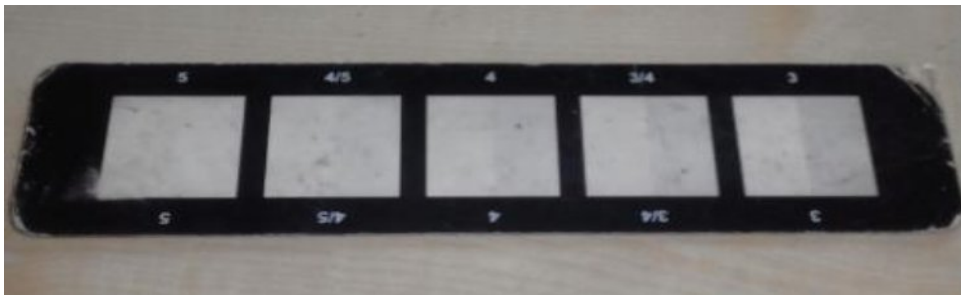


Figure 05. Gray Scale for Staining

**CHAPTER-03**  
**EXPERIMENTAL DETAILS**

## CHAPTER-03

### EXPERIMENTAL DETAILS

#### 3.1 Measurement of WPI (Grey + Finished):

In fabric structure; it is important to know, how much yarn is in length wise and width wise. To know the number of yarn in a specific fabric a measurement is done for this. For this yarn in inch is measured by the magnifying glass setting multiplier. It is an off line quality assurance system.

In knit fabric yarn is measure in course and Wales direction. CPI means yarn is in course per inch and WPI means Wales per inch.

Measure the CPI & WPI with the magnifying glass setting multiplier:

- Take the fabric & marking 1 inch with the ball pen according to the Course & Wales wise of a knitted fabric.
- Then set the marking point with the multiplier scale & counting the CPI & WPI of knitted fabric in 1 inch.
- Wales per inch and course per inch is counted by the magnifying counting glass.

Table 01: Measurement of WPI (Grey + Finished)

<b>Fabric Name</b>	<b>WPI (Grey)</b>	<b>WPI (Finished)</b>
S/J	29	31
Jacquard Interlock	31	33
Double Jacquard Interlock	37	39.2
French Terry	28	30
Slub Jersey	29	31.3

### 3.2 Measurement of CPI (Grey + Finished):

Table 02: Measurement of CPI (Grey + Finished)

<b>Fabric Type</b>	<b>CPI (Grey)</b>	<b>CPI (Finished)</b>
S/J (100% cotton)	55	57
Jacquard Interlock	58	60
Double Jacquard Interlock	67	70
French Terry	49	51
Slub Jersey	53	56

### 3.3 Measurement of Stitch Length

Stitch length is theoretically a single length of yarn which includes one needle loop and adjacent needle loops on either side of it. Loop exits in course in coarse length and it is that which influence fabric dimension and other properties including weight. In order to determine the stitch length the reading is found in mm unit.

Table No: 03 Measurement of Stitch Length (Grey + Finished)

<b>Fabric Type</b>	<b>S/L (Grey) in mm</b>	<b>S/L (Finished) in mm</b>
Single Jersey	2.56	2.48
Jacquard Interlock	2.05	1.96
Double Jacquard	2.63	2.51
French Terry	2.20	2.11
Slub Jersey	2.92	2.82

### 3.4 Measurement of GSM by the GSM Cutter:

It is one type of physical test of the fabric which is known as off line quality assurance system. By the following way we can measure the weight of the fabric.

#### **GSM Cutter:**

GSM cutter is a circular cutter. GSM cutter cuts 1/100 of a square meter of fabric area.

#### **GSM Calculation Method Using GSM Cutter:**

GSM calculation method using GSM cutter is not same as we have followed during GSM calculation method without using GSM cutter. Here, I have follow the below steps:

- Firstly, I have cut 5pcs swatches by sing GSM cutter from the different parts of fabric.
- Then, measured the weight of each cutting swatches with the help of electric balance in one by one method.
- Calculate the average weight of cutting swatches.
- Finally, by multiplying “average cutting swatch weight” with 100, then I easily get the actual fabric GSM.

### Measurement of GSM with GSM Cutter:

= (Cutter dia constant X weight of sample)

Here

Diameter of cutter,( d ) = 11.28 cm

So, dia constant, (d.c ) =100.07 cm

**Note:** Area of round GSM cutter is (1/100) m<sup>2</sup>.

#### **Equipment's used:**

- GSM Cutter
- Electric Balance

### **Investigation of GSM (Grey + Finished):**

Table No: 04 Measurement of GSM (Grey + Finished)

<b>Fabric Type</b>	<b>Grey Fabric GSM</b>	<b>Finished Fabric GSM</b>
Single Jersey	140	160
Jacquard Interlock	172	200
Double Jacquard	166	200
F/T	241	260
Slub Jersey	121	140

## **3.5 Measurement of Color Fastness**

### **A. Color Fastness to Rubbing (Dry+ Wet):**

Quality should be characterized as far as a specific structure of cost. The national administrative quality affirmation and universal quality program like ISO 9000 arrangement set out the expansive quality parameters in view of which organizations keep up the fare quality in the article of clothing and apparel industry. Here we I examine Variation in come about the color fastness to rubbing test.

This test is intended to decide the measure of shading exchanged from the surface of hued material to different surfaces by rubbing.

### **Measurement of Colorfastness to Rubbing**

#### **Apparatus and materials**

- Crockmeter
- Sample fabric for measurement
- Grey scale for staining.
- Color matching cabinet.
- Water



## Working Procedure Dry Rubbing

- Dry rubbing cloth is fixed flat in place of over the end of the finger of the device.
- Fix the test specimen to the rubbing device by means of clamps such that the long direction of the specimen follows the track of the device.
- Operate the apparatus and rub the test specimen in straight line along the track to 10 times with the downward force of 9 Newton's.
- Remove the test specimen out and compare it with the standard fabric for staining test. Assign the rating by using the grey scale for staining.
- Each test is conducted for warp and weft way directions of the fabric.



Crockmeter

## Wet Rubbing

- Fix the test specimen to the rubbing device by means of clamps such that the long direction of the specimen follows the track of the device.
- A standard cloth is wetted for 10 min. in a disc containing distilled water to take-up about 100%.
- Then it is fixed flat over the end of the finger of the testing device.
- Operate the apparatus and rub the test specimen to and fro in a straight line along the track to 10 times with the downward force of 9 Newton's.
- Remove the test specimen out and compare it with the standard fabric for staining test. Assign the rating by using the grey scale for staining.
- Each test is conducted for warp and weft way directions of the fabric.

## Assessment on Grey Scale

Different fabric results are different. The measuring results on grey scale are below:

Table No. 05: color fastness to rubbing

<b>Fabric Type</b>	<b>Dry Measurement</b>	<b>Wet Measurement</b>
S/J (100% cotton)	4/5	4
Jacquard Interlock	4/5	4
Double Jacquard Interlock	White Color	White Color
French Terry	5	4/5
Slub Jersey	4/5	4

### A. Color Fastness to Wash (Color change + Staining):

#### Principle:

A specimen/dyed fabric with specified adjacent fabric (MFF) are laundered rinsed and dried. The specimen/composite sample is treated under appropriate condition in a chemical bath for recommended time. The abrasive action is accomplished by the use of a liquor ratio and an appropriate number of steel balls. The change in color of the specimen (dyed sample) and the staining of the adjacent fabric (MFF) is assessed by recommended Grey scales (1-5).

#### Apparatus & Materials:

Wash wheel with a thermostatically controlled water bath & rating speed of (40±2) rpm

- Wash wheel with a thermostatically controlled water bath.
- Multi-fiber
- Bleached fabric
- Thermometer
- Sewing machine
- Dryer
- Color matching cabinet

**Recipe:**

Chemicals	Amounts
Detergent:	1g/L
Sodium Per borate:	1g/L
M:L	1:20
Temp:	40°C
Time:	25 min

**Test Specimen and procedure:**

Cut a sample of dyed goods (10 × 4) cm and sew it with multi-fiber fabric, then maintain the color fastness measuring steps.



Dye bath for color fastness measurement

**Assessment Values:**

**The measuring results according to the grey scale.**

Table No. 06: color fastness to washing

<b>Fabric Type</b>	<b>Color Change Rate</b>	<b>Staining Rate</b>
Single Jersey	4/5	4
Jacquard Interlock	4/5	4
Double Jacquard	White Color	White Color
French Terry	4/5	5
Slub Jersey	4	5

### 3.6 Sample Attachment

#### Sample Grey and Finished fabrics:

Table No. 07: Sample Attachment

<b>Fabric Name</b>	<b>Grey Sample</b>	<b>Finished Sample</b>
S/J (100% cotton)		
Jacquard Interlock (100% cotton)		
Double Jacquard Interlock		
French Terry		
Slub Jersey (100% cotton)		

#### Wash Fastness measurement Sample (According to the grey scale):

Table No. 08: Sample Attachment

<b>Fabric Name</b>	<b>Color Change</b>	<b>Staining</b>
S/J (100% cotton)		
Jacquard Interlock		
Double Jacquard Interlock		
French Terry		
Slub Jersey (100% cotton)		

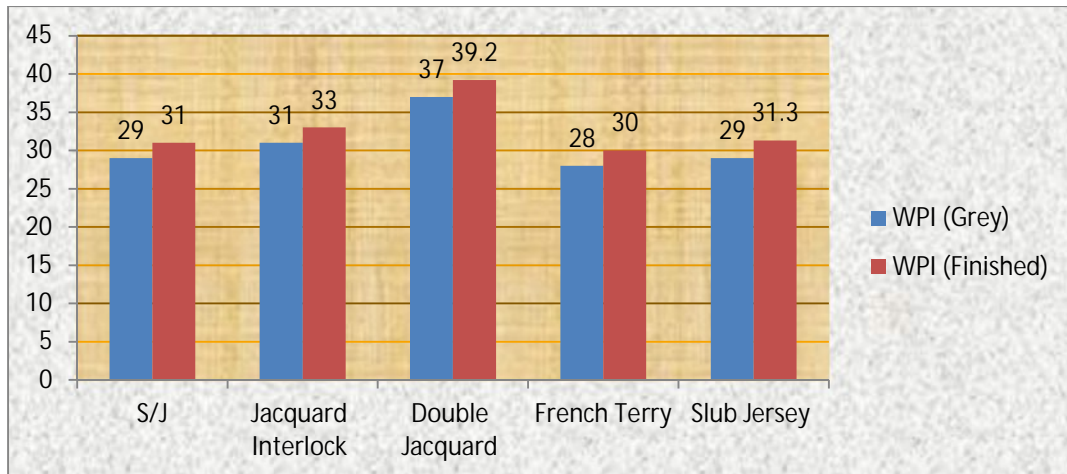
**CHAPTER-04**  
**DISCUSSION OF RESULTS**

## CHAPTER-04

### DISCUSSION OF RESULTS

The measurement results are discussed in this chapter. The changing rate and value are different for different fabric.

#### 4.1 Results of WPI:



WPI Value Changes (Graph)

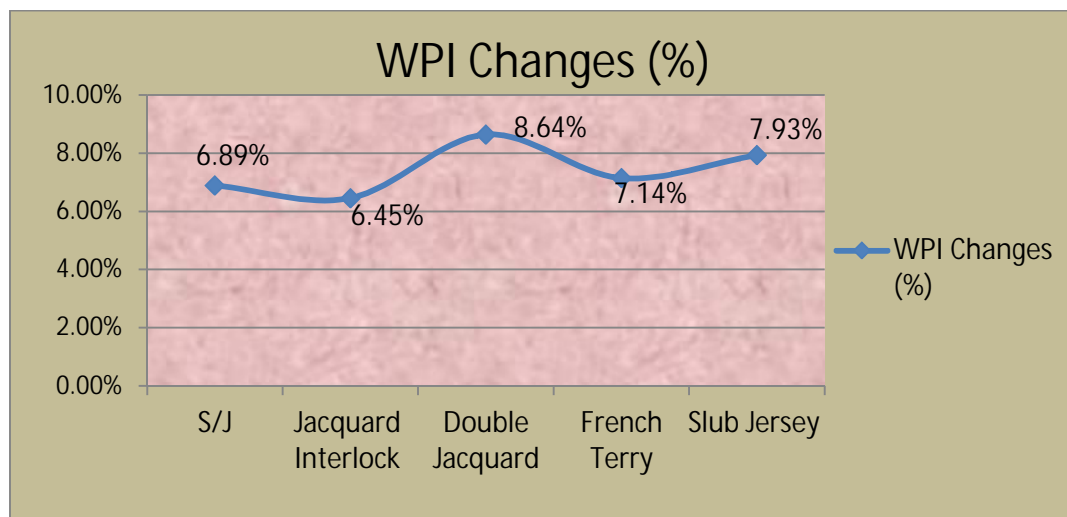
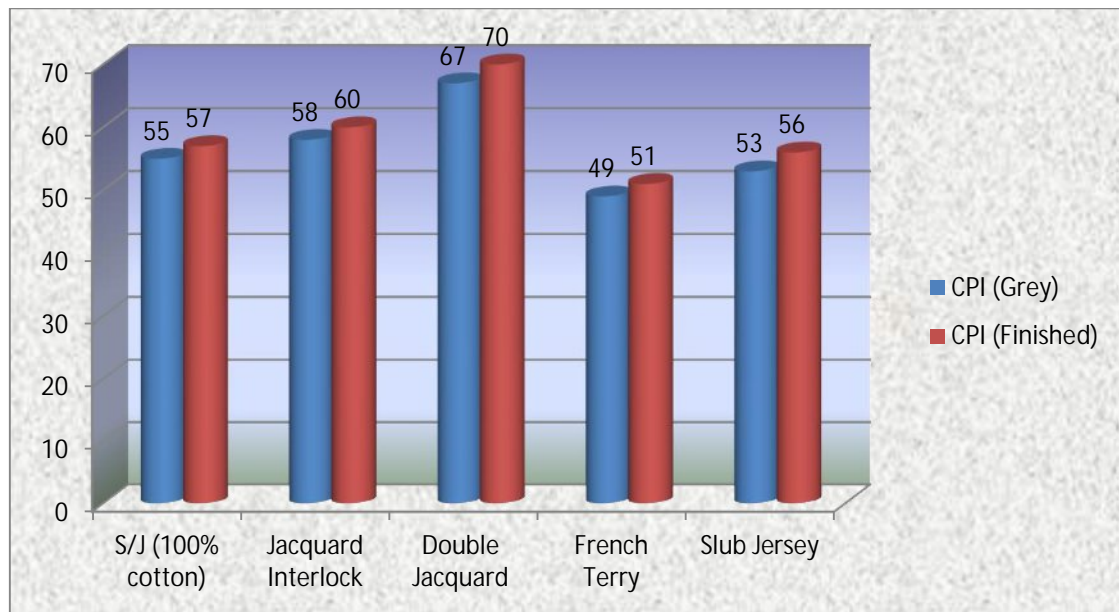


Figure 06. Graphical Representation of WPI changes

Here, the graph sign express that the increasing rate of WPI. The maximum increased rate is double jacquard interlock fabric (8.64%) and minimum increased rate is jacquard interlock (6.45%).

Single jersey increased (6.89%), Trench Terry (7.14%) Slub Jersey (7.93%). The value of WPI result is increased for every type of fabrics. We can say thatthe WPI of cotton knit fabric will increase after wet processing. This graph is expressed the changing.

## 4.2 Results of CPI:



CPI Value Changes (Graph)

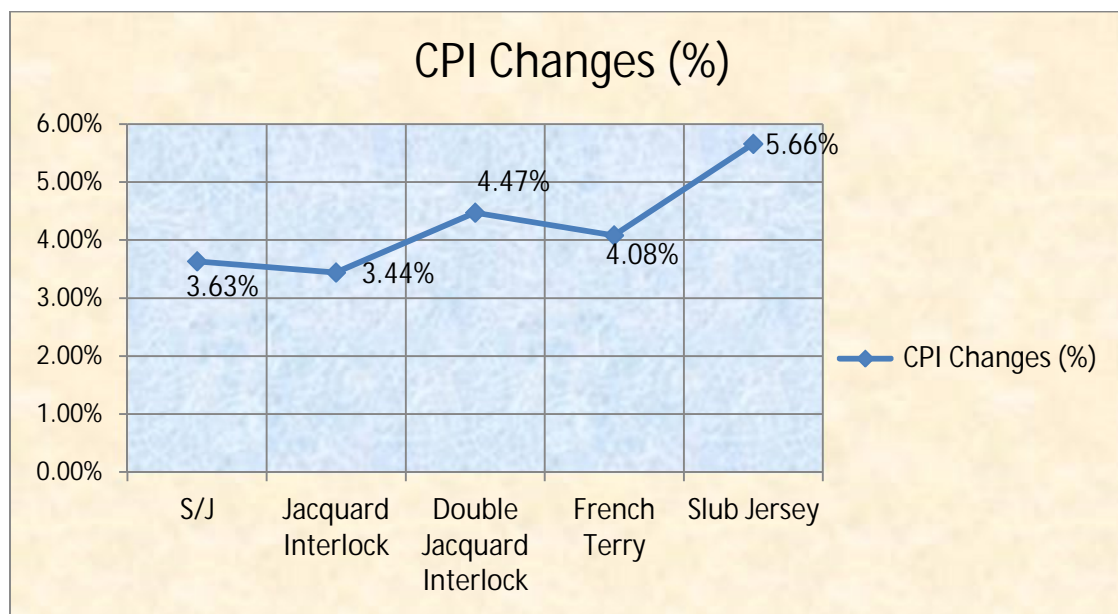


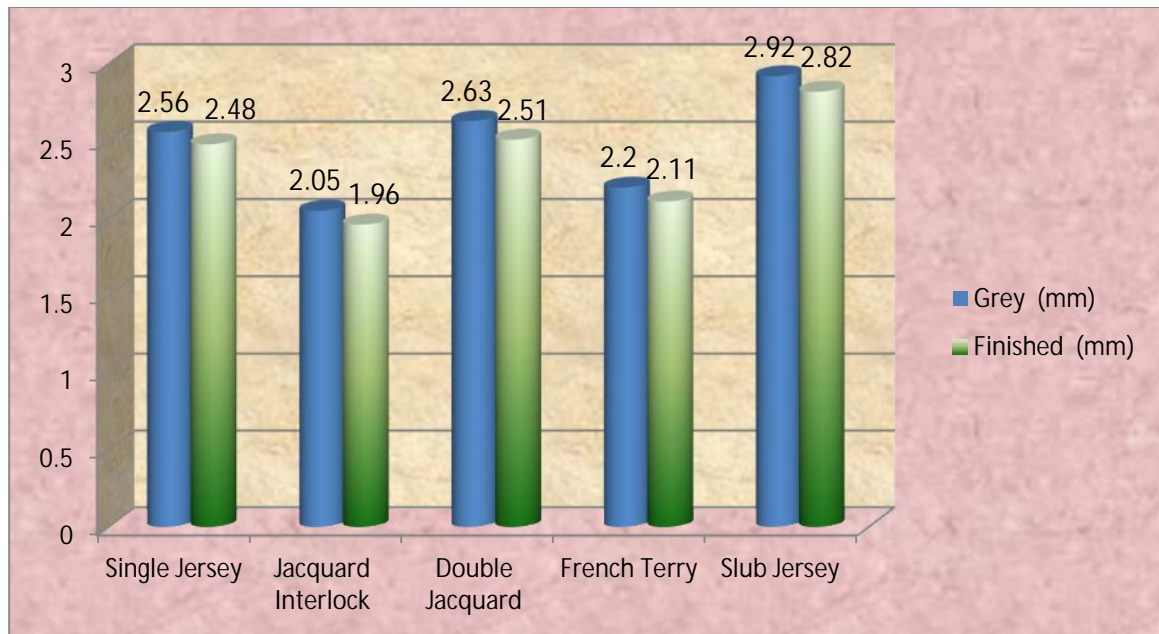
Figure 07. Graphical representation of CPI changes

Here, the graph sign showing that the result of CPI is increased for every fabric but the changing rate is different. The maximum increased rate is double slub jersey fabric (5.66%) and minimum increase rate is jacquard interlock fabric (3.44%).

Other changes rate is S/j (3.63%), Double Jacquard interlock (4.47%) and French Terry (4.08%). We can say from the graph that CPI will increase after wet processing and the variation depend on the fabric structure and processes that used for finishing treatment.



### 4.3 Result of Stitch Length:



Stitch Length Value Changes (Graph)

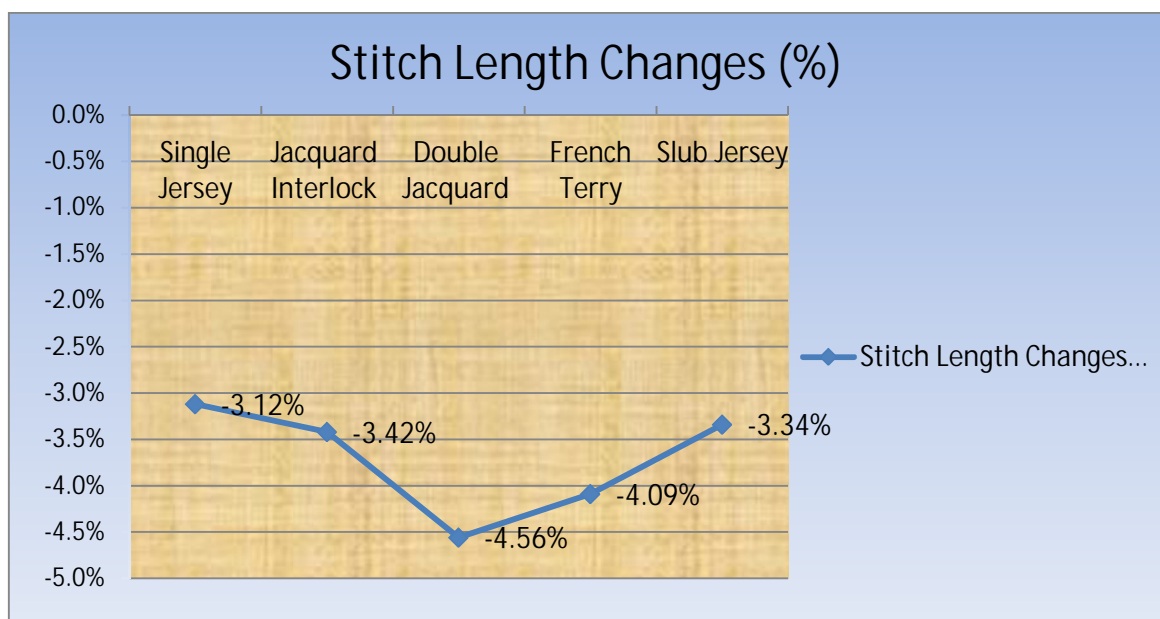
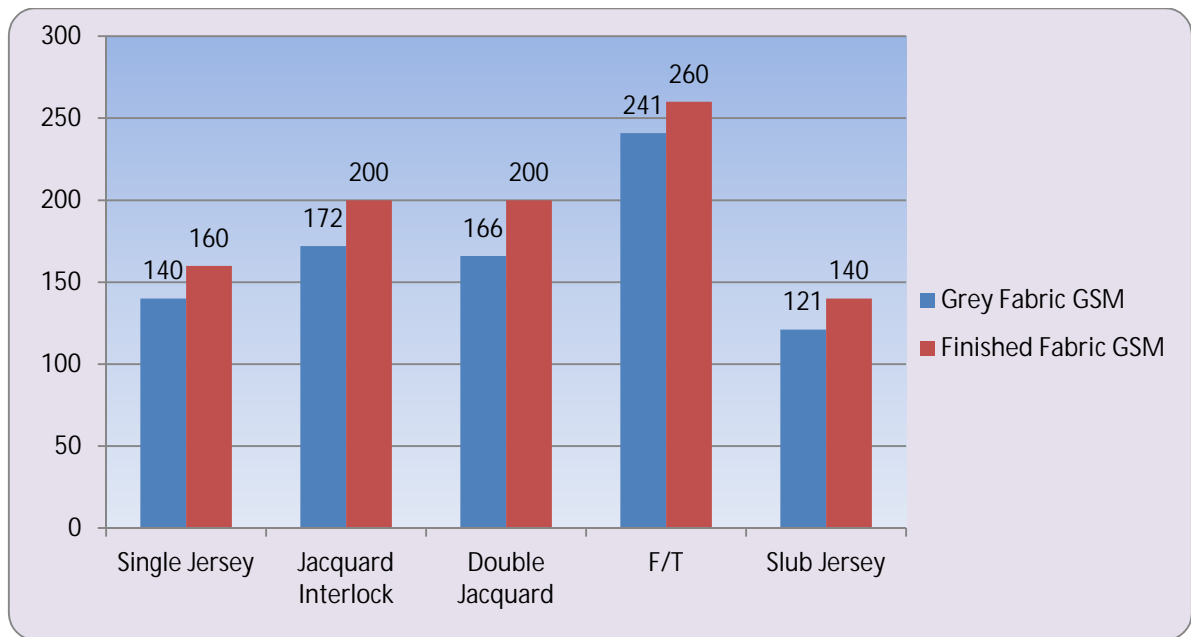


Figure 08. Graphical Representation of Stitch Length changes

Here, the graph shows that the Stitch Length is decreased for every type of knit fabric. The graph also shows that, the maximum decreasing rate is double jacquard fabric (4.56%) and minimum increase rate is jacquard interlock fabric (3.12%). I used the negative sign (-) for decrease value.

The other changes are S/J (3.12%), French Terry (4.09%) and slub jersey (3.34%). Here the question is why Stitch Length is decreased? The main reason that I observed, 'Shrinkage Problem' We can't avoid this problem but it is possible to minimize this by using proper twisted yarn.

#### 4.4 Result of GSM:



GSM value changes (Graph)

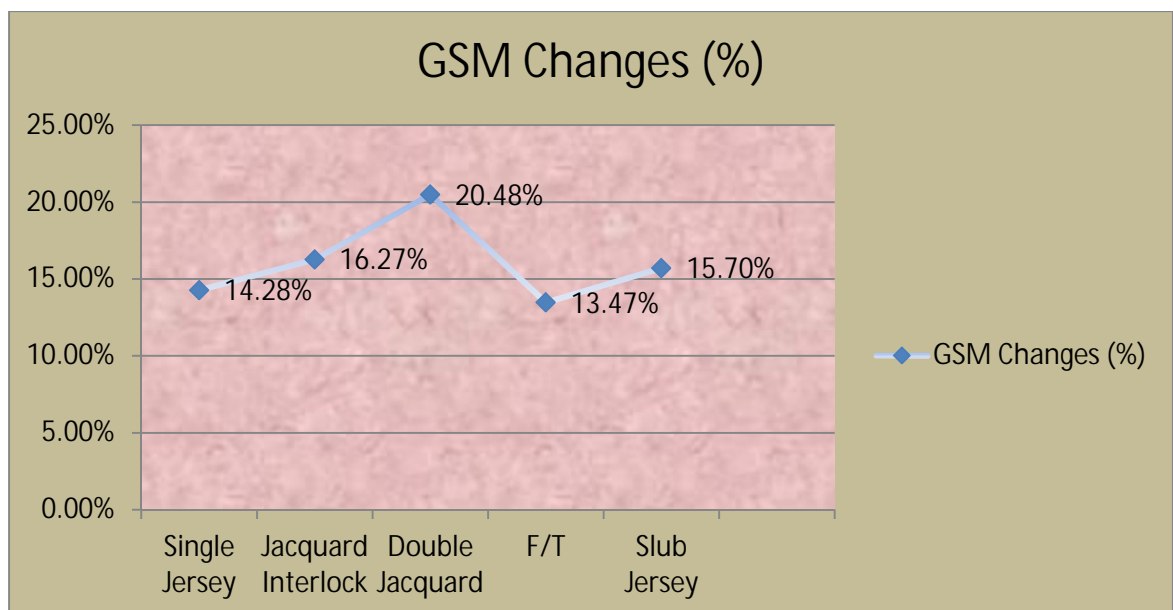


Figure 09. Graphical Representation of GSM changes

We can see from the graph that, the rate changing rate of GSM also increased. The maximum increasing rate of GSM is double jacquard fabric (20.48%) and minimum increased rate of GSM is French terry (13.47%).

We know that, some weight is loss by scouring and bleaching but it is recovered by finishing treatments. GSM result also depends on the requirement of buyer. We can control GSM by Stenter.

## 4.5 Graphical Representation of Color Fastness:

### Color Fastness to Rubbing (Dry & Wet):

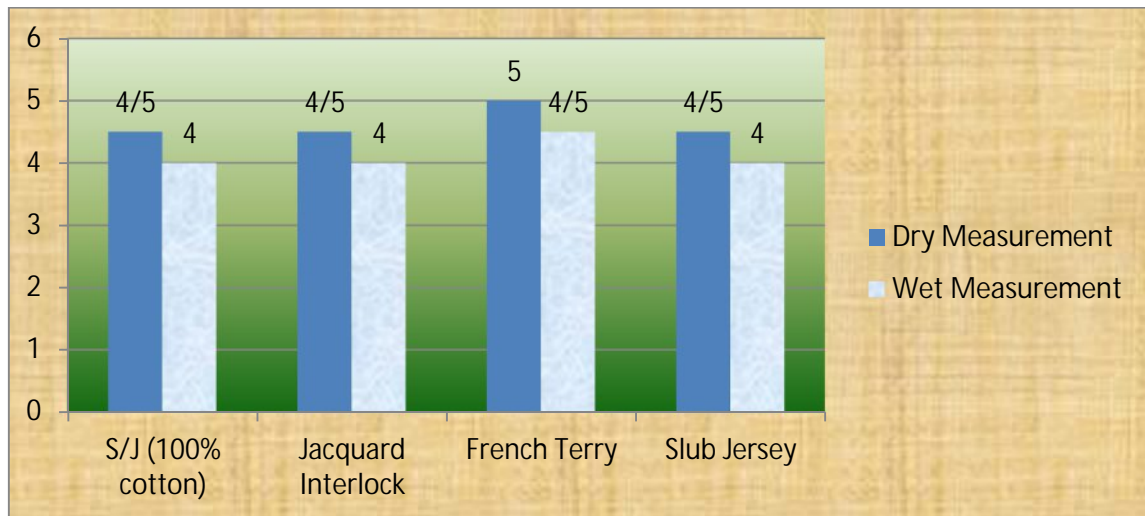


Figure 10. Graphical Representation of Rubbing Fastness

Here, we can see from the graph, color fastness of rubbing is very good for cotton knit fabrics. Dry and wet measurement result is given on the graph. S/J fabric dry and wet measurement is respectively 4/5 and 4, for jacquard Interlock 4/5 and 4, for French Terry 5 and 4/5 the last one is Slub jersey 4/5 and 4.

### Color Fastness to Washing:

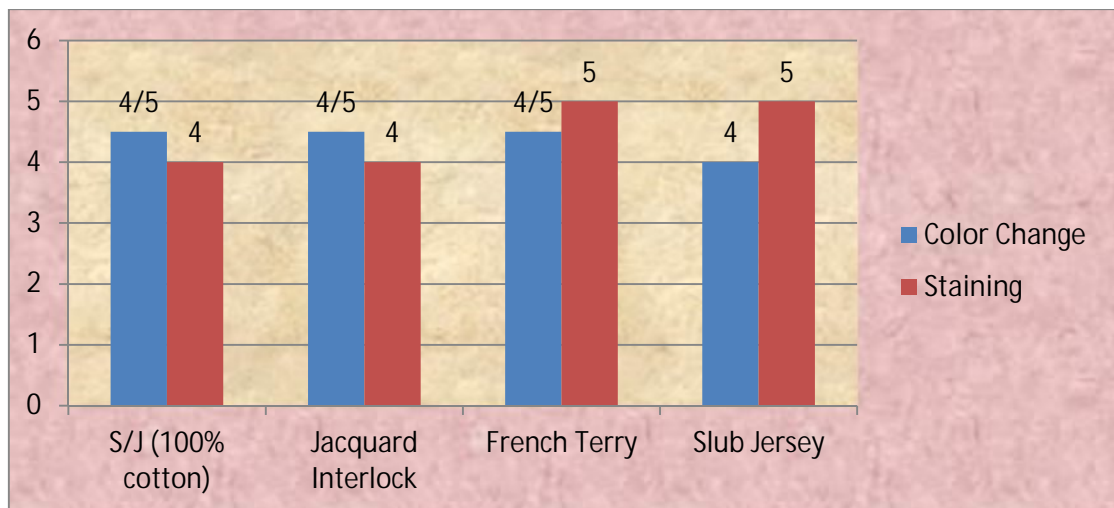


Figure 11. Graphical Representation of Wash Fastness

Here, the graph expressed the result of color fastness to washing. The color fastness to washing is also very good for cotton knit fabrics. Color change and staining measurement result is given on the graph. S/J fabric dry and wet measurement is respectively 4/5 and 4, for jacquard Interlock 4/5 and 4, for French Terry 4/5 and 5 the last one is Slub jersey 4 and 5.

We can see from graphs that the CPI, WPI and G.S.M. of knit fabric increased after wet-process. While the stitch length decreased after wet-process.

The main reason behind the decrease in stitch length after wet-process is yarn shrinkage. In the scouring-bleaching process cotton fiber swells. For this the diameter of fiber increases which causes length-wise shrinkage of yarn. This results in decrease in stitch lengths.

Though some weight is lost due to scouring-bleaching process but in course of other processes like, dyeing and finishing with softener, some weight is gained due to addition of dyes and softener. We can see that the final result of G.S.M has increased due to shrinkage, addition of dye and softener. Rubbing fastness and washing fastness of reactive dyes is very good on cotton knit fabric. It is the most important property of reactive dye. Finally we have to maintain the buyer requirement for color fastness.

**CHAPTER-05**  
**CONCLUSION**

## CHAPTER-05

### CONCLUSION

Most common and some special Properties of knit dyeing (CPI, WPI, Stitch, length GSM variation and Color fastness) are interpreted in my report. According to this report we can observe the changing properties with percentage(%). This report is able to give a deep concept about different types of cotton knit fabric (grey and finished) on changing value of WPI, CPI Stitch Length and GSM also the color fastness of finished fabric and its variation. If the changing value is more than the required result, it can be faults. Thus value depends on the buyer requirement. Finally I think the report will contribute significantly to develop and enrich our knowledge on cotton knit fabric dyeing with reactive dyes.

- It can be seen that the increases of WPI in the fabric structure, areal density is increased of each fabric. Maximum WPI increasing % is double jacquard interlock (8.65 %) and minimum jacquard interlock (6.45 %).
- This report shows that the CPI changing % of different knit fabric. Thus fabrics are increasing CPI % and the % are different. The maximum decreasing % is Slub Jersey (5.66 %) and minimum decrease is Jacquard Interlock (3.44 %).
- For the stitch length, it depends on the changing value of WPI. The maximum decreasing percentage is double jacquard interlock (4.56%) and minimum is single jersey (3.12%).
- GSM variation is very common of knit fabric. Sometime it plays an impotent role to maintain the quality of products. Double jacquard changing rate is maximum (20.48%) and F/T is minimum (13.47%).
- For color fastness it is depend on the chemicals, finishing treatment, fabric type and measuring method. The result can be various on different measurements.

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