Faculty of Engineering

Department of Textile Engineering

Report on

# STUDY OF THE EFFECTS OF TIME ON BIO-POLISHING OF COTTON KNIT FABRICS

Course code: TE-4214 Course title: Thesis (project)

**Submitted by**:
S.M Reyad
ID: 142-23-3903
Md.Moniruzzaman
ID: 142-23-3955

**Supervised by:**
Mr. Sumon mozumder
Assistant Professor
Department of Textile Engineering
Daffodil International University

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

Advance in Wet Processing Technology

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# DECLARATION

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

S M Reyad
ID:142 -23-3903
Department of TE
Daffodil International University

**Md. Moniruzzaman**
ID: 142-23-3955
Department of TE
Daffodil International University

# LETTER OF APPROVAL

This project report prepared by **S M Reyad** (ID:142-23-3903) and **Md. Moniruzzaman** (ID:142-23-3955), 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.

**SUMON MOZUMDER**
ASSISTANT PROFESSOR
DEPARTMENT OF TEXTILE ENGINEERING
FACULTY OF ENGINEERING
DAFFODIL INTERNATIONAL UNIVERSITY

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We would like to deliver thanks to our entire course mates in Daffodil International University, who took part in the discussion while completing the course work.

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.

*We dedicate this project report to our beloved parents*

# ABSTRACT

Bio-polishing is a common pretreatment for knitted fabric in textile wet processing industry. This study was done to evalute the study to evalute the Bio-polishing performance on knit fabric on the basis of time factor after the scouring and bleaching and bio-polishing. We done this research on 100% cotton single jersey,(1x1) rib and interlock. This project was mainly focused of the different time (10minutes,20minutes; 30minutes) on bio-polishing of cotton knit fabrics and piling rating. The aim of the work was to measure the WPI, CPI, Stitch length ,GSM, Yarn count, Weight loss, Pilling rating of the cotton knitted fabric after the scouring, bleaching and bio-polishing process. After completing the research we found that the single jersey, (1x1) rib; interlock fabric was showing the change in WPI, CPI, GSM, Stitch length, Yarn count, Weight loss and pilling rating with the different time during the bio-polishing. After scouring-bleaching WPI,CPI, GSM are increase and stitch length, yarn count are decrease in single jersey, (1x1)rib, interlock fabrics. Otherwise after bio-polishing WPI,CPI,GSM are decrease and stitch length, yarn count are increase. Removal of the surface hairiness of fabric by Bio- polishing technique results the less energy consumption, assures improved fabric handle, leads to minimal fabric pilling tendency. Removal of hairiness of textile fiber textile materials loses weight. These weights vary in fabric to fabric. Thus after scouring-bleaching and bio-polishing single jersey, (1x1) rib, interlock fabrics loses weight. And after bio-polishing pilling rating are good.

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# Introduction

# Chapter-1
# Introduction

Bio-finishing is a relatively new concept of treating the fabrics with enzymes. Recent advances in bio-finishing of cellulosic fabrics have led to multiple improvements of surface properties. The main objective of bio-finishing is to upgrade the fabric by removing the protruding fibers. The conventional methods of removing the protruding fibers employ a burning-off process (singeing) or a chemical treatment. The conventional methods are temporary, potentially toxic, and fibers return to the surface after a few washings and form fuzz. The fuzz on the surface of the fabrics constitutes the major reason for customer dissatisfaction. However, by using enzymes in the finishing process, the protruding fibers can be permanently removed from the fabric thus eliminating the fuzz. The enzyme treatment not only keeps the fabric looking new after repeated washings, but enhances feel, color, softness and drape ability which translates into a higher quality textile or apparel product. Bio-polishing of cotton fabrics carried out, either before or after the dyeing process, has an influential role on dye ability of the fabrics. Bulky dye molecules used in cotton fabrics react only in the accessible regions of fibers, which are, also major parts of the substrates for enzyme hydrolysis during bio-polishing. Cellulose pretreatment enhances penetration of alkali during scouring and increases the alkaline degradation of seed fragments in the subsequent process. Disaggregating cellulose molecules and development of newer regions leads to improvement in dye ability though in some cases dye ability decreases with hydrolysis initially, due to decrease in already available accessible regions by the end of component. Presence of various components in the total celluloses plays a dominating role in altering surface morphology of the fibers. Combination of bio polishing with shearing, singeing, considerably reduces the surfaced effects. [1]

In case of high concentration of $H_2O_2$ or enzyme in the pretreatment processes, chemical cost will be increased. Again, if the weight loss is less than the standard mentioned, then impurities will remain in the substrate which will create absorbency problem during the combined process. Light bio-polishing may not be effective enough to remove fuzz and the presence of fuzz leads to fabric problems in wear, notably pilling and a frosted appearance, which causes an apparent loss of color.

## 1.1 Objectives:

The broad objective of the project work is the study the effects of time on bio-polishing of cotton knit fabric. The main objective of this thesis report is to know the weight loss of different knit products during bio-polishing/enzyme wash process. Beside this -

- To know about the bio-polishing process of different knit fabrics.
- To know about the weight loss of different types of fabrics after bio-polishing process.
- To compare the weight loss % of different fabrics.
- To know about the effect of enzymatic treatment on fabric
- To know about change in WPI & CPI the bio-polishing process of different knit fabrics
- To know about change in S.L after bio-polishing process.
- To know about change in yarn count after bio-polishing process.

# Chapter-2
# Literature Review

# Chapter-2
# Literature Review

### 2.1 What is Bio-polishing

Bio-polishing is a finishing process that enhances fabric quality by decreasing the pilling tendency and fuzziness of (cellulose) knitted fabrics. This finishing process applied to cellulose textiles that produces permanent effects by the use of enzymes. This process removes protruding fiber & slubs from knitted fabrics, significantly reduces pilling, softens fabric hand and provides a smooth fabric appearance.[3]

### 2.3 Objects of Bio-polishing

- To removes protruding fiber &slubs.
- To removes Hairiness, and pills .
- To Prevented material sticking.
- To softens fabric hand & improved quality .
- To achievement of surface smoothness and a clear structural appearance& improved luster

## 2.4 Process of Bio-polishing:

There are two process of Bio-polishing

1. Dyeing followed by bio-polishing.
2. Bio-polishing before Dyeing.

### 2.4.1 Process sequence of Dyeing followed by bio-polishing

Scoured &bleaching sample

↓

Dye addition

↓

Salt addition

↓

Soda ash addition

↓

Dyeing

↓

Hot wash

↓

Soaping (at boil temperature )

↓

Hot Wash

↓

Cold wash

↓

Enzyme treatment

↓

Cold wash

↓

Drying

### 2.4.2 Process sequence of Bio-polishing before Dyeing :

Scoured & bleaching sample

↓

Bio-polishing

↓

Cold wash

↓

Drying

↓

Dye addition

↓

Salt addition

↓

Soda ash addition

↓

Hot wash

↓

Soaping (at boil temperature )

↓

Hot Wash

↓

Cold wash

↓

Drying

**Advantages & Disadvantages of Bio-polishing**

1. Depth of shade increases when enzyme treatment is given before dyeing but the depth decreases when enzyme treatment is given after dyeing.
2. Wash fastness of the enzyme treated sample after dyeing is good but Wash fastness of the enzyme treated sample before dyeing is very poor.
3. One bath application saves energy, time & cost but the bio-polishing effect is not as the two bath meth Decreases the Pilling tendency

4. Loss in weight.
5. Loss in strength.

## 2.5 What is Enzyme?

The term Enzyme came from the Greek word Enzymes means In the cells or Ferments'. These are naturally available, high molecular weight proteins, capable of catalyzing chemical reaction of biological process and therefore popular as Biocatalyst'. Enzymes are soluble organic substance, produced by living organisms whose different amino acids form long poly peptide chains (-HN-R-CONH-R-CO-)n by condensation polymerization. Enzymes has unique three dimensional shape and presence of ionic groups, make the structure more complex. During the last twenty years, the industrial use of enzymes has been expanded rapidly. Their application has been well established in various industries like detergent, textiles, food stuffs, medicines, animal feeds and others. The important significant of this bio reaction can be summarized as.[4]

- Enzymes are biodegradable and substitute the harmful chemicals and thus reduce the effluent load.
- Enzymatic actions are specific and hence subtract quality will not be effected.
- Enzymatic processes are economical as they utilize less steam energy and avoid use of costly chemical and auxiliaries.
- Enzymes are catalyst and after reaction it will obtain as it is and reused again.

**The history of enzymes in Textile:**

- Amylase Desizing (1952).
- Protease Wool (1984).
- Cellulose Bio-stoning (1987).
- Catalase Bleach cleanup (1993).

- Laccase Denim Bleaching (1996).
- Peroxidase Enzymatic Rinse (1999)
- PectateLyase Bio-scouring(2003) [5]

## 2.6 Various Enzymes Used in Textile Processing:

**Amylases:** Which convert amylose or amylopectin polymers ,commonly referred to as starch in to water soluble shorter chain sugars (Starch desizing)

**Pectinases:** Which hydrolysepectins consisting of linear polymers of galacturonic acid (bio-scouring replacing caustic)

**Lipases:** Which hydrolyse fats and oils into alcohol and organic acids.

**Proteases:** Which catalyse splitting protein molecules, and in the extreme may break the protein into the component amino acids.

**Catalases or Peroxidases:** Which catalyse the decomposition of peroxide, also known as peroxide killer.

**Celluloses:** Which catalyse the hydrolysis of cellulosic materials (bio-singeing or bio-polishing). [7]

### 2.7 Mechanism of Enzyme Action: (Lock &Key theory)

Enzymes have active centers, which are the points where substrate molecule can join. Just as a particular key fits into a lock, a particular substrate molecule fits into the active site of the enzyme. The substrate forms a complex with the enzyme. Later the substrate molecule is converted into the product and the enzyme itself is regenerated(Fig.1).

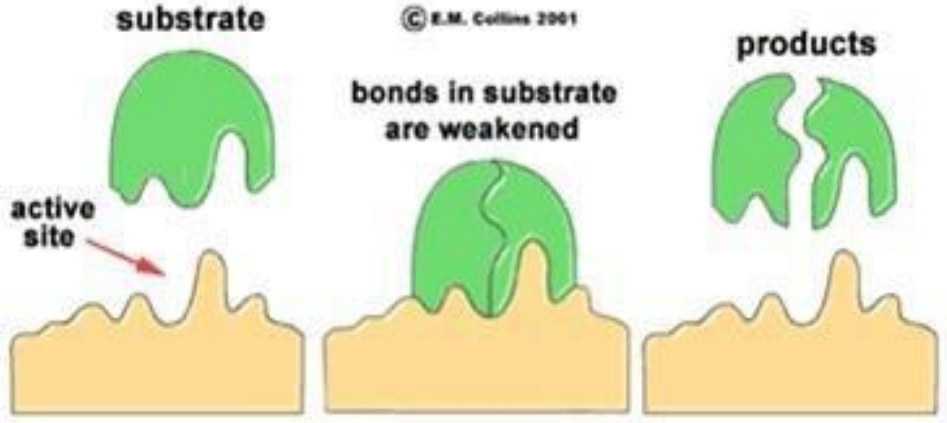



**Figure-2.1 Lock & Key model of enzyme specificity**

The process continues until the enzyme is poisoned by a chemical bogie (Fig.2) or inactivated by extremes of temperature, pH or by other negative conditions in the processing environment.[8]

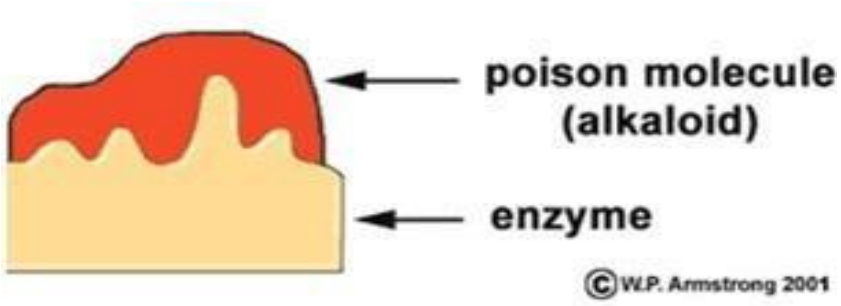



**Figure-2.2 Active site of enzyme blocked by poison molecule**

**Working of Enzyme:**

Enzymes are thought to have an area with a very particular shape. When a molecule of the right chemical for that enzyme comes along it will fit exactly into the shape. The area of particular shape is called the **active site** of the enzyme, as that is where the reaction takes place. The molecule that the enzyme works on is called the **substrate.** After the reaction has taken place and the products of the reaction leave the active site leaving it ready for another molecule of the chemical.

The active site of an enzyme has such a particular shape that only one kind of molecule will fit it, rather like a particular key fitting a lock. This is why enzymes are specific in their action.[9]

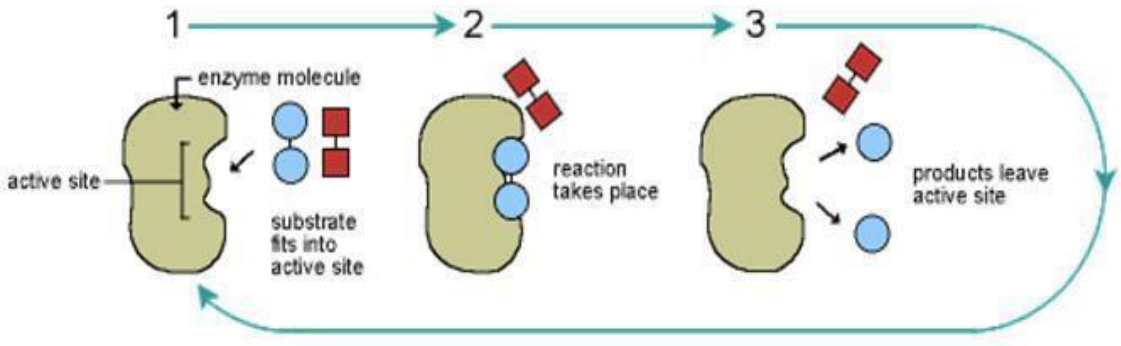
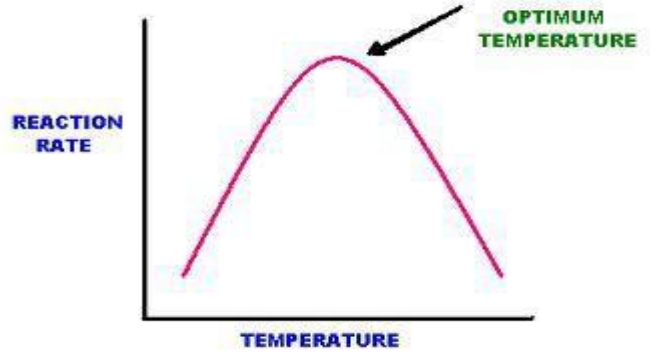



**Figure 2.3 -Working of enzyme**

**2.8 Factors affecting efficiency of enzymes:**

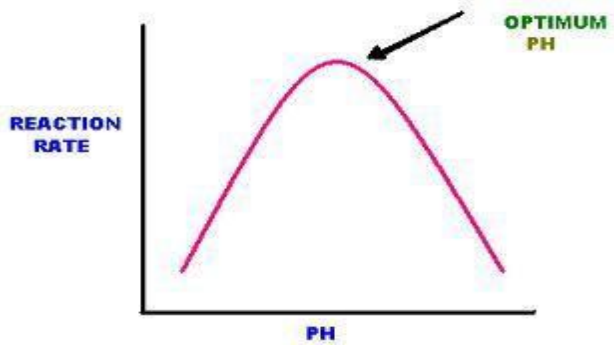
**Temperature:**

- Enzymes work at particular temperature. Change in temperature alters their efficiency. Most of enzymes work at40-600$^0$C.
- Above optimum temperature, heat alters the shape of enzyme molecule, changing the shape of active site. This leads to reduction in their activity.




**PH:**

- Some enzymes work best in alkaline medium, while some work best in acidic medium for every enzyme there is optimum pH where its activity is highest.



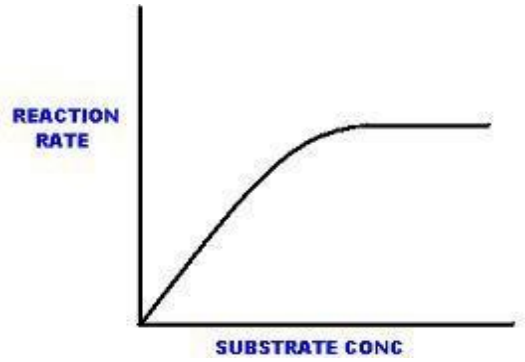

**Concentration of Enzymes:**

- Increase in concentration of enzymes increases the reaction rate.

[10]

**Concentration of Substrate:**

- Increase in concentration of substrate increases the reaction rate till certain point**.**




**Concentration of Products:**

- Accumulation of products decreases the enzyme activity.

**Radiations:**

- Exposure to UV rays, X-rays reduces their reactivity.

### 2.9 Cellulose Enzyme for Textile Bio-polishing

Enzyme DL Ultra is high concentrated acid cellulose preparation. It is specially developed for fabric and garment bio-polishing. It can improve the hand feel and appearance of fabrics and permanently reduces the tendency of pilling. It is especially suitable for the finishing processes of cellulosic fabrics made of cotton, linen, viscose or lyocell.

**Specification:**

| | |
|---|---|
| **Appearance** | Liquid |
| **Color** | Brown |
| **Odor** | Slight fermentation odor |
| **Enzymatic Activity** | CMC: ≥15,000u/mL (*) ; |
| **Solubility** | Soluble in water |

| | |
|---|---|
| **CAS NO.** | 9012-54-8 |
| **IUB NO.** | EC 3.2.1.4 |

**Benefit:**

1. Excellent bio-polishing effect
2. Clean and even fabric surface
3. Softer hand feel
4. Brighter colors
5. Environmental-friendly &bio-degradation

**2.9 Processing condition:**

| | |
|---|---|
| **Temperature** | 45-60℃, optimum55℃ |
| **pH** | 4.5-5.0, optimum4.8 |
| **Liquor ratio** | 5:1-20:1 |
| **Dosage** | Fabric:0.1-0.2% owf<br>Denim:0.05-0.3% owf |
| **Time** | 30-60 minutes |
| **Inactivation** | Raising temperature above 80℃ for 10 minutes, or raising the pH above 8.0 for 10 minutes can inactivate Enzyme DL Ultra completely. |

**Storage:**

Should be stored in a dry place with temperature between 5-25℃

**Packaging:**

25kgs/drum; 30kgs/drum

**Shelf life:**

6-9 months, subject to storage condition.

**Safety:**

Enzyme preparations belong to protein, which may induce sensitization and cause anaphylaxis in sensitized individuals. Long-term exposure may cause minor irritation for skin, eyes or nasal mucosa, so any direct contiguity with human body should be avoided. If irritation or allergic response for skin or eyes develops, consult a doctor.[11]

**Advantages of Using Enzymes for Bio-polishing**

1. Hairiness, fluffs and pills are removed.
2. Material sticking (the burr effect) is prevented.
3. Improved handle.
4. Achievement of surface smoothness and a clear structural appearance.
5. Improved lustre
6. Material texture relaxation.
7. Increased flexibility and therefore a soft handle even with over end-products and mercerized fabric.
8. Improved sew ability.
9. Fast to washing, low pilling tendency, no napping in use, or during care operation.
10. Stone wash effect without pumice stone and dye stuff destroying chemicals.
11. Poor quality, uneven, napped, knoppy material surface typical second quality goods are converted into elegant, lustrous, soft, top quality with a fine, high quality surface appearance.

**Disadvantages of this Finishing Technique**

1. Loss in weight
2. Loss in strength

Celluloses have been used on a large scale for years in medicine analysis, food chemistry and other industries.

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# Chapter-3

# Experimental Details

# Chapter-3
# Experimental Details

## 3.1 Materials:

In our project work, we have taken cellulosic fabric (knit) for observing the effect of enzyme treatment. We have taken three piece of knit fabric (single jersey, rib and interlock fabric) as our materials for accomplishing our project work. At first we taka grey sample, then we scouring and bleaching, and finally we apply bio-polishing into the fabric. The name of the sample and their construction & specification are given below

**Table 3.1**: Sample Specification.

| Sample No. | Fabric type | WPI | CPI | GSM | Yarn count | Stitch length(mm) |
|---|---|---|---|---|---|---|
| 01 | Single jersey | 32 | 54 | 150 | 34 | 2.89mm |
| 02 | (1x1) rib | 53 | 72 | 235 | 36 | 2.76mm |
| 03 | Interlock | 48 | 66 | 226 | 32 | 1.67mm |

## Chemical used

- Detergent
- Sequestering agent
- Sodium hydroxide(NaOH)
- Hydrogen peroxide(H2O2)
- Peroxide Stabilizer
- Cellulose Enzyme
- Acetic Acid

This chemicals have been used in our research. The details of the chemicals used are mentioned in table 3.2

**Table 3.2:** Types of chemicals used in the research**.**

| **Chemical names** | **Function** |
|---|---|
| Detergent | Detergents are one kind of surfactants, it lower the surface tension of liquids. Detergent increase the wetting ability of water & it removes impurities. |
| Sequestering agent | It removes hardness of water |
| Sodium hydroxide(NaOH) | Sodium hydroxide create covalent bond & fixing the color of fabric. It also increase absorbency & control ph. |
| Hydrogen peroxide(H2O2) | It removed natural grey color & produced a white effect. |
| Peroxide Stabilizer | Keep active hydrogen peroxide during bleaching. |
| Cellulose Enzyme | To reduce hairiness from fabric. |
| Acetic Acid | To control ph |

## 3.2 Methods:

## Method of scouring and bleaching

At first we taka grey sample, then we scouring and bleaching, and finally we apply bio-polishing into the fabric

At first we take the weight of 30gm fabric from three samples (total sample weight contain 90gm) have been taken for scouring and bleaching treatment by using the following recipe in table 3.3

Table 3.3: scouring and bleaching recipe

| **Particulars** | **Recipe** |
|---|---|
| Detergent | 1g/L |

| | |
|---|---|
| Sequestering agent | o.7 g/L |
| Sodium hydroxide(NaOH) | 1 g/L |
| Hydrogen peroxide(H2O2) | 2 g/L |
| Peroxide Stabilizer | 1g/L |
| PH | 9.30 |
| Temperature | 100 |
| Time | 60min |
| M:L | 1:40 |
| Sample Weight | 90g/L |

**Table 3.4**: Apparatus Used

| Name | Function |
|---|---|
| Electric Balance | Used to measured weight |
| Scissors | Use to cut the fabric |
| Scale | Use to measure the length |
| Glass rod | Use to stirring the chemicals |
| GSM Cutter | Use to cut the fabric |
| PH Meter | Use to check ph |
| Biker | Use to mixing ,stirring and heating the chemical |
| Pipette | Use to measure the liquid |
| Thermometer | Use to check temperature |
| Gas Burner | Use to generate the flame |
| Dye Pot | Use to dying fabric |

## Calculation:

Total Liquor = (90 x 40) ml

= 3600 ml

a. Detergent required = (1 x 3600 x 100) /(1000 x 10)

= 360 ml

b. Sequestering agent required = (0.7 x3600 x100)/ (1000 x 1)

= 252 ml

c. Sodium hydroxide (NaOH) = (1 x3600 x 100)/(1000 x 1)

= 360 ml

d. Hydrogen peroxide (H2O2) = (2x 3600 x 100/(1000 x2 )

= 360 ml

e. Peroxide Stabilizer = (1x 3600 x 100)/( 1000 x 1)

= 360 ml

Total water required = 3600-(360+252+360+360+360) ml

= 1908 ml

**Process sequence**

Collect sample

⇩

Sample preparation

⇩

Recipe calculation

⇩

Preparing chemical

⇩

Preparing dye bath

⇩

Scouring and bleaching

⇩

Cold wash

## Working Procedure:

1. Firstly, 30 gm of fabric from each sample has been taken for scouring and bleaching.
2. Set the bath with detergent, sequestering agent, soda, H2O2, peroxide stabilizer
3. After some time we check ph
4. Then raise the temperature up to 100
5. When temperature raise up to 100 then this situation are keep 1 hour.
6. After 1 hour we drain the bath.

## Process curve:

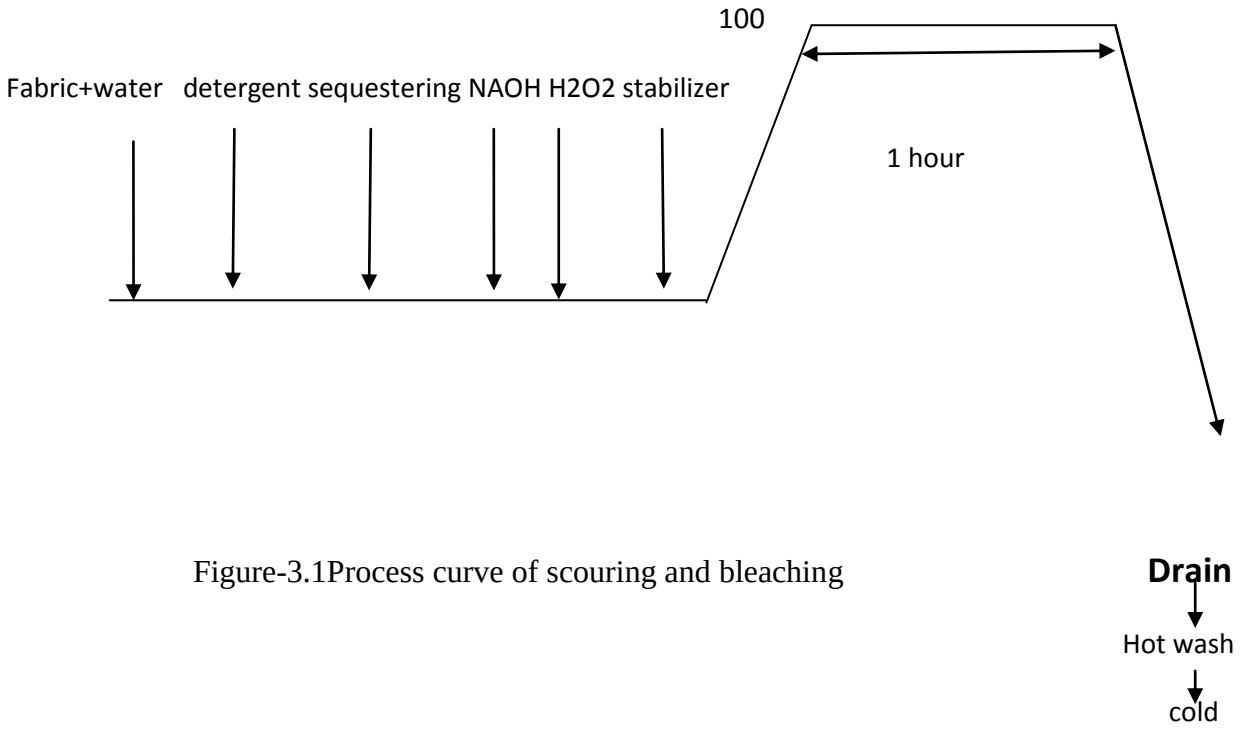


Figure-3.1Process curve of scouring and bleaching

## 3.3 Method of bio-polishing

Then we take the weight of 15gm fabric from three samples for three condition (total sample weight contain 45gm) have been taken for Bio-polishing treatment by using the following

**Table 3.5**: Bio-polishing recipe

| **Particulars** | **Recipe** |
|---|---|
| Cellulose Enzyme | 1% owf |
| Acetic Acid | 1 g/l |
| Temperature | $50^0$ c |
| M: L | 1:30 |
| pH | 4.8 |
| Time | 10 minutes, 20 minutes & 30 minutes |

## Calculation

### Enzyme% amount respect to owf (on the weight of the fabric)

In recipe, the enzyme% (on the weight of the fabric) amount respect to the materials is calculated with the following formula---

$$\text{Required amount Enzyme} = \frac{\text{(Material weight x Recipe amount \%)}}{\text{Stock solution\%}}$$

### Acetic Acid (gm/l) amount respect to liquor

In recipe, Acetic Acid (gm/l) amount respect to liquor is calculated with the following formula—

$$\text{Required amount Acetic Acid} = \frac{\text{(Total Liquor x Recipe amount)}}{\text{1000 x stock solution\%}}$$

Total water = (15x30)

=450 m/l

1. Cellulose required = (15x1%)/1%

= 15 m/l

2. Acetic acid required = (1x450x100)/( 1000x1)

=45 m/l

Total water required = 450- (15+45)

= 390 m/l

## Process sequence

Collect scouring and bleaching sample

⇩

Sample preparation

⇩

Recipe calculation

⇩

Preparing chemical

⇩

Preparing dye bath

⇩

Bio-polishing

⇩

Cold wash

## Working Procedure:

1. Firstly, 5 gm of fabric from each three sample has been taken(total 15 gm sample) one bath for enzyme treatment.

2. Thus we take three bath (every bath contain 15 gm sample) and Set the bath with substrate and acetic acid and check Ph.(pH=4.5.-5.5) in three conditions.

3. After checking pH of the dye bath, appropriate amount of cellulosic enzyme is added into the three dye bath.

4. Raise the temperature up to $50^0$c and hold the temperature for 10, 20 & 30 min for proper enzymatic action.

5. Then cool and rinse for removing fiber dust from the bath.

6. After rinsing the temperature is raised up to $80^0$c to kill enzyme. After completing the action the process is drained out.

## Process curve

**(1st bath)**

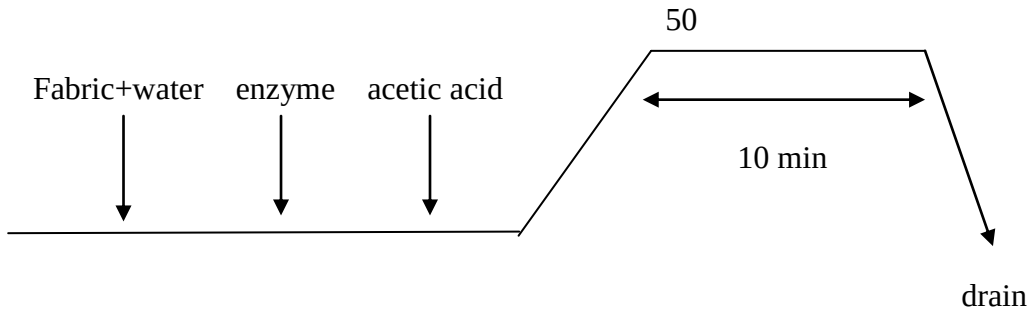


**Figure 3.2:** Process curve of bio-polishing (10 min)

**(2nd bath)**

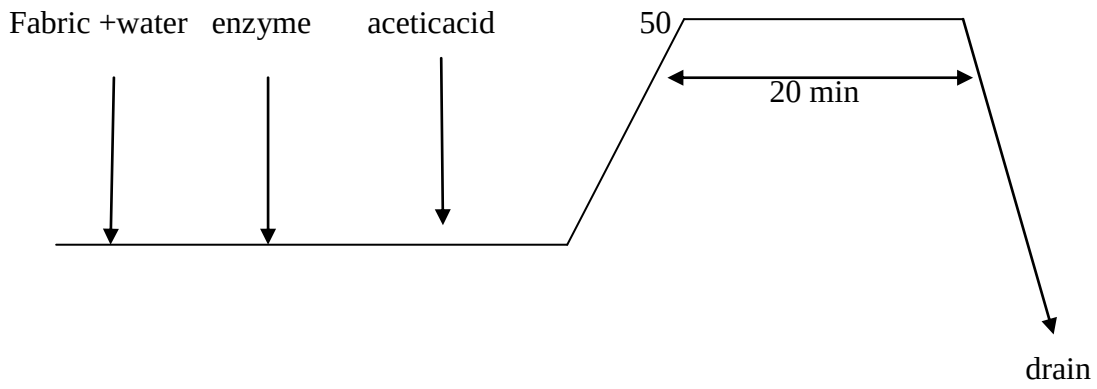


**Figure 3.2:** Process curve of bio-polishing (20 min)

**(3rd bath)**

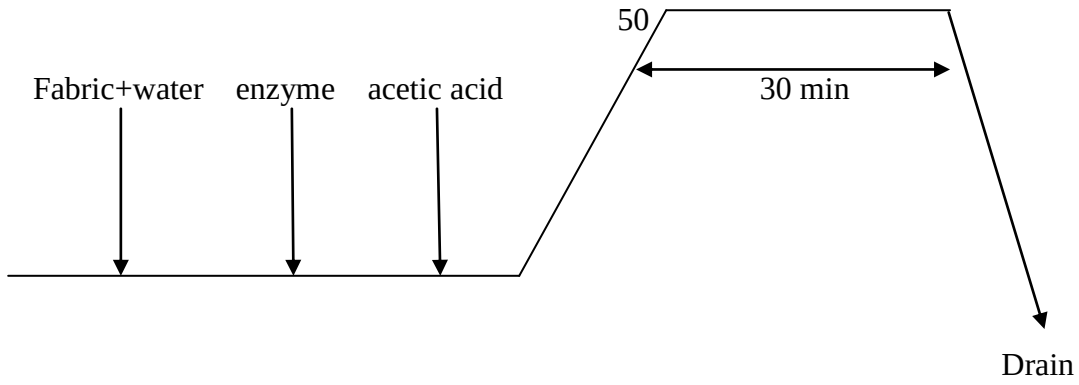


**Figure 3.2:** Process curve of bio-polishing (30 min)

# Sample attachment

# Samples before and after scouring-bleaching, bio-polishing

| Single jersey | | | | |
|---|---|---|---|---|
| **Before scouring and bleaching** | **After scouring and bleaching** | **After bio-polishing for 10 minutes** | **After bio-polishing for 20 minutes** | **After bio-polishing for 30 minutes** |
| | | | | |

| (1x1) Rib | | | | |
|---|---|---|---|---|
| **Before scouring and bleaching** | **After scouring and bleaching** | **After bio-polishing for 10 minutes** | **After bio-polishing for 20 minutes** | **After bio-polishing for 30 minutes** |
| | | | | |

| Interlock | | | | |
|---|---|---|---|---|
| **Before scouring and bleaching** | **After scouring and bleaching** | **After bio-polishing for 10 minutes** | **After bio-polishing for 20 minutes** | **After bio-polishing for 30 minutes** |
| | | | | |

# Sample of pilling rating test

| Single jersey | | | | |
|---|---|---|---|---|
| **Before scouring and bleaching** | **After scouring and bleaching** | **After bio-polishing for 10 minutes** | **After bio-polishing for 20 minutes** | **After bio-polishing for 30 minutes** |
| | | | | |

| (1x1) Rib | | | | |
|---|---|---|---|---|
| **Before scouring and bleaching** | **After scouring and bleaching** | **After bio-polishing for 10 minutes** | **After bio-polishing for 20 minutes** | **After bio-polishing for 30 minutes** |
| | | | | |

| Interlock | | | | |
|---|---|---|---|---|
| **Before scouring and bleaching** | **After scouring and bleaching** | **After bio-polishing for 10 minutes** | **After bio-polishing for 20 minutes** | **After bio-polishing for 30 minutes** |
| | | | | |

# Chapter-04
# Discussion and result

# Chapter-04
# Discussion and result

## 4.1 Change in WPI (wales per inch) of fabric after scouring bleaching & bio-polishing Process

In grey, after scouring bleaching & bio-polishing process change in WPI of fabric in different sample type( time) value were recorded in the appendix-A1.The change in WPI of fabric in grey, after scouring bleaching & bio-polishing process in different time has been used to draw the following figure 4.1

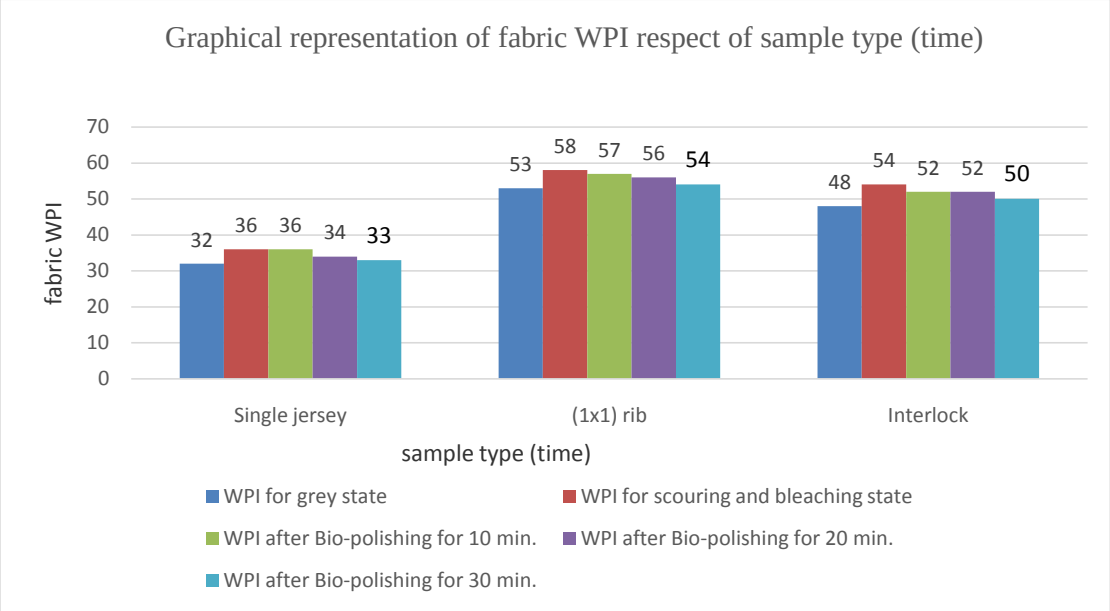


**Figure 4.1:** Column diagram of change in WPI of fabrics under different time

The column diagram has been drawn for the change in WPI of fabrics under different time. In this column diagram, different sample type (time) indicates along the X axis and change in WPI of fabrics value is indicates along the Y axis. We have been taken five sample in different state to understand that change in knit fabric WPI. At first scouring and bleaching stage knit fabric WPI are increase . Because in grey state fabric contain oil ,fats waxes, etc .In scouring and bleaching process oil ,fats and waxes etc are removed . Then knit fabrics loop fill up the gap where oils, fats and waxes are situated. So totally knit fabric compact and density will be increased. Thus WPI are increased .Otherwise bio-polishing stage,We are used cellulose enzyme .This enzyme are help to removed hairy fiber on the fabric upper surface .thus WPI are decreased.

In figure (4.1) we see that , scouring and bleaching stage WPI are increased but after bio-polishing WPI are decreased.

## 4.2 Change of CPI (coarse per inch) of fabric after scouring bleaching & bio-polishing process

In grey, after scouring bleaching & bio-polishing process change in CPI of fabric in differen tsample type ( time) value were recorded in the appendix-A2.The change in CPI of fabric in grey, after scouring bleaching & bio-polishing process in different time has been used to draw the following figure 4.2

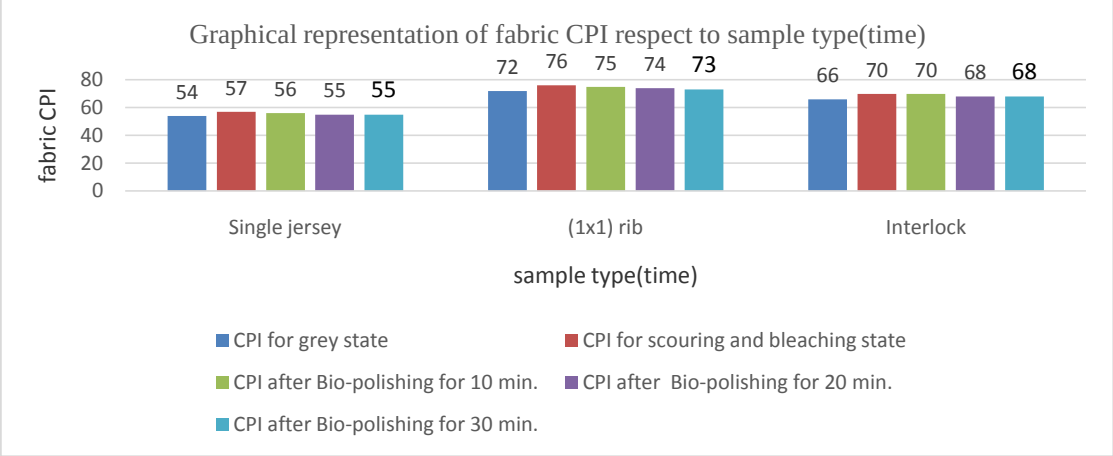


**Figure 4.2:** Column diagram of change in CPI of fabrics under different time

The column diagram has been drawn for the change in CPI of fabrics under different time. In this column diagram, different sample type ( time) indicates along the X axis and change in CPI of fabrics value is indicates along the Y axis. We have been taken five sample in different state to understand that change in knit fabric CPI.
At first scouring and bleaching stage knit fabric CPI are increase . Because in grey state fabric contain oil ,fats waxes, etc .In scouring and bleaching process oil ,fats and waxes etc are removed . Then knit fabrics loop fill up the gap where oils, fats and waxes are situated. So totally knit fabric compact and density will be increased. Thus CPI are increased .Otherwise bio-polishing stage,We are used cellulose enzyme .This enzyme are help to removed hairy fiber on the fabric upper surface .thus CPI are decreased.

In figure (4.2) we see that , scouring and bleaching stage CPI are increased but after bio-polishing CPI are decreased.

### 4.3 Change of S.L(Stitch length) of fabric after scouring bleaching & bio-polishing process

In grey, after scouring bleaching & bio-polishing process change in S.L of fabric in different time value were recorded in the appendix-A3.The change in S.L of fabric in grey, after scouring bleaching & bio-polishing process in different time has been used to draw the following figure 4.3

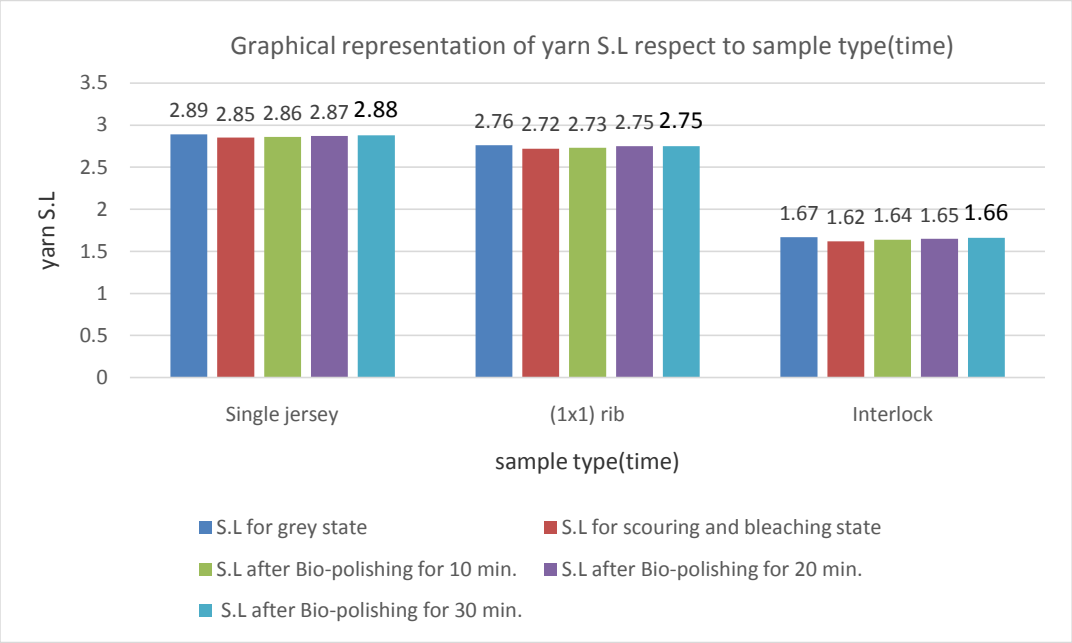


**Figure 4.3:** Column diagram of change in S.L of fabrics under different time

The column diagram has been drawn for the change in S.L of fabrics under different time. In this column diagram, different sample type (time) indicates along the X axis and change in S.L of fabrics value is indicates along the Y axis. We have been taken five sample in different state to understand that change in knit fabric S.L.
At first scouring and bleaching stage knit fabric S.L are decrease . Because in grey state fabric contain oil ,fats waxes, etc .In scouring and bleaching process oil ,fats and waxes etc are removed . Then knit fabrics loop fill up the gap where oils, fats and waxes are situated. So that this stage S.L are decreased .Otherwise bio-polishing stage .We are used cellulose enzyme .This enzyme are help to removed hairy fiber on the fabric upper surface .thus S.L are increased.

In figure (4.3) we see that, scouring and bleaching stage S.L are decreased but after bio-polishing S.L are increased.

### 4.4 Change of GSM (grams per square meter) of fabric after scouring bleaching & bi-polishing process

In grey, after scouring bleaching & bio-polishing process change in GSM of fabric in different sample type ( time) value were recorded in the appendix-A4.The change in GSM of fabric in grey, after scouring bleaching & bio-polishing process in different time has been used to draw the following figure 4.4

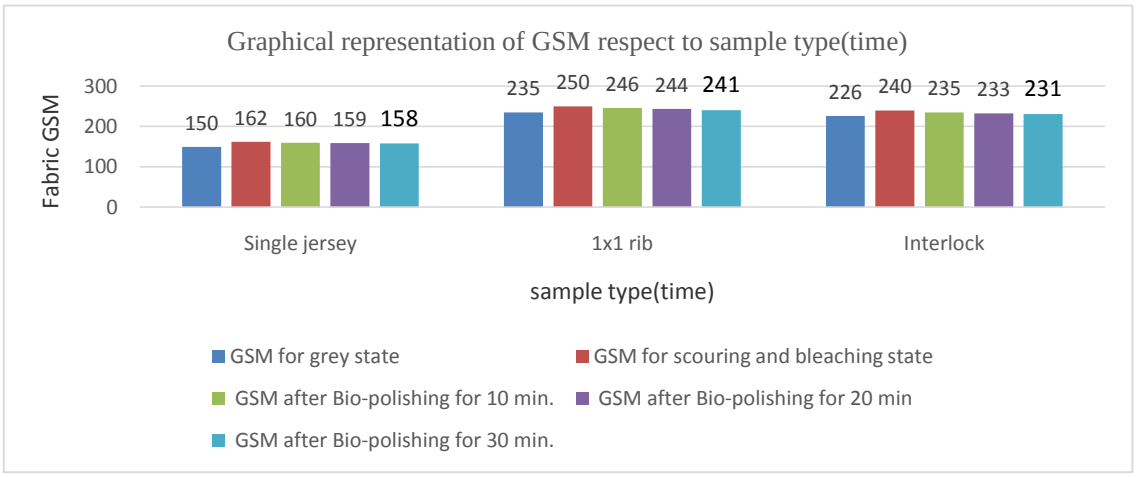


**Figure 4.4:** Column diagram of change in GSM of fabrics under different time

The column diagram has been drawn for the change in GSM of fabrics under different time. In this column diagram, different time indicates along the X axis and change in GSM of fabrics value is indicates along the Y axis.
We have been taken five sample in different state to understand that change in knit fabric GSM. At first scouring and bleaching stage knit fabric GSM are decrease . Because in grey state fabric contain oil ,fats waxes, etc .In scouring and bleaching process oil, fats and waxes etc are removed . Then knit fabrics loop fill up the gap where oils, fats and waxes are situated. So totally knit fabric compact and density will be increased. Thus GSM are increased .Otherwise bio-polishing stage ,We are used cellulose enzyme .This enzyme are help to removed hairy fiber on the fabric upper surface .thus GSM are decreased.

In figure (4.4) we see that ,scouring and bleaching stage GSM are increased but after bio-polishing GSM are decreased.

### 4.5 Change of yarn count of fabric after scouring bleaching & bio-polishing process

In grey, after scouring bleaching & bio-polishing process change in yarn count of fabric in different sample type (time) value were recorded in the appendix-A5.The change in yarn count of fabric in grey, after scouring bleaching & bio-polishing process in different time has been used to draw the following figure 4.5

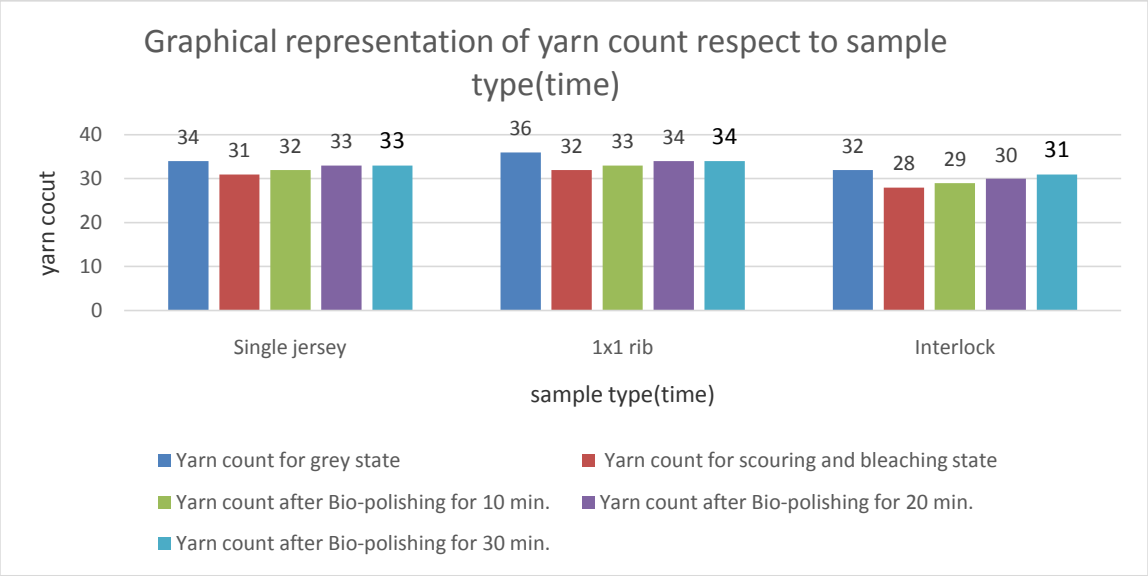


**Figure 4.5:** Column diagram of change in yarn count of fabrics under different time

The column diagram has been drawn for the change in yarn count of fabrics under different time. In this column diagram, different time indicates along the X axis and change in yarn count of fabrics value is indicates along the Y axis. We have been taken five sample in different state to understand that change in knit fabric yarn count.
At first scouring and bleaching stage knit fabric yarn count are decrease . Because in grey state fabric contain oil ,fats waxes, etc .In scouring and bleaching process oil ,fats and waxes etc are removed . Then knit fabrics loop fill up the gap where oils, fats and waxes are situated. So totally knit fabric compact. Thus yarn count are increased .Otherwise bio-polishing stage, We are used cellulose enzyme .This enzyme are help to removed hairy fiber on the fabric upper surface .thus yarn count are increased.
In figure (4.5) we see that, scouring and bleaching stage yarn count are decreased but after bio-polishing yarn count are increased.

### 4.6 Change of weight of fabric after scouring- bleaching & Bio-polishing process

In grey, after scouring bleaching & bio-polishing process change in weight of fabric in different sample type(time)value were recorded in the appendix-A6.The change in weight of fabric in grey, after scouring bleaching & bio-polishing process in different time has been used to draw the following figure 4.6

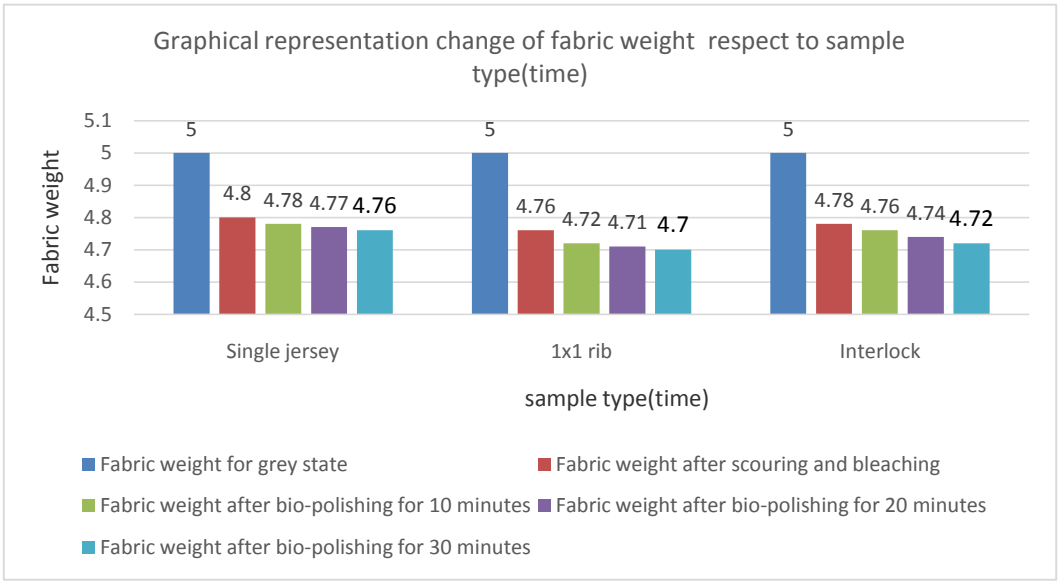


**Figure 4.6:** Column diagram of change in weight of fabrics under different time

The column diagram has been drawn for the change in weight of fabrics under different time. In this column diagram, different time indicates along the X axis and change in weight of fabrics value is indicates along the Y axis.
We have been taken five sample in different state to understand that change in knit fabric weight. At first scouring and bleaching stage knit fabric weight are decrease . Because in grey state fabric contain oil ,fats waxes, etc .In scouring and bleaching process oil ,fats and waxes etc are removed . Then knit fabrics loop fill up the gap where oils, fats and waxes are situated. So total knit fabric compact. Thus fabric weight are decreased .Otherwise bio-polishing stage, We are used cellulose enzyme .This enzyme are help to removed hairy fiber on the fabric upper surface .thus fabric weight are decreased.

In figure (4.6) we see that , scouring and bleaching stage fabric weight are decreased and after bio-polishing fabric weight are also decreased.

## 4.7 Change of pilling rating of fabric after scouring- bleaching & Bio-polishing process

In grey, after scouring bleaching & bio-polishing process change in pilling rating of fabric in different time value were recorded in the appendix-A7.The change in pilling rating of fabric in grey, after scouring bleaching & bio-polishing process in different time has been used to draw the following figure 4.7

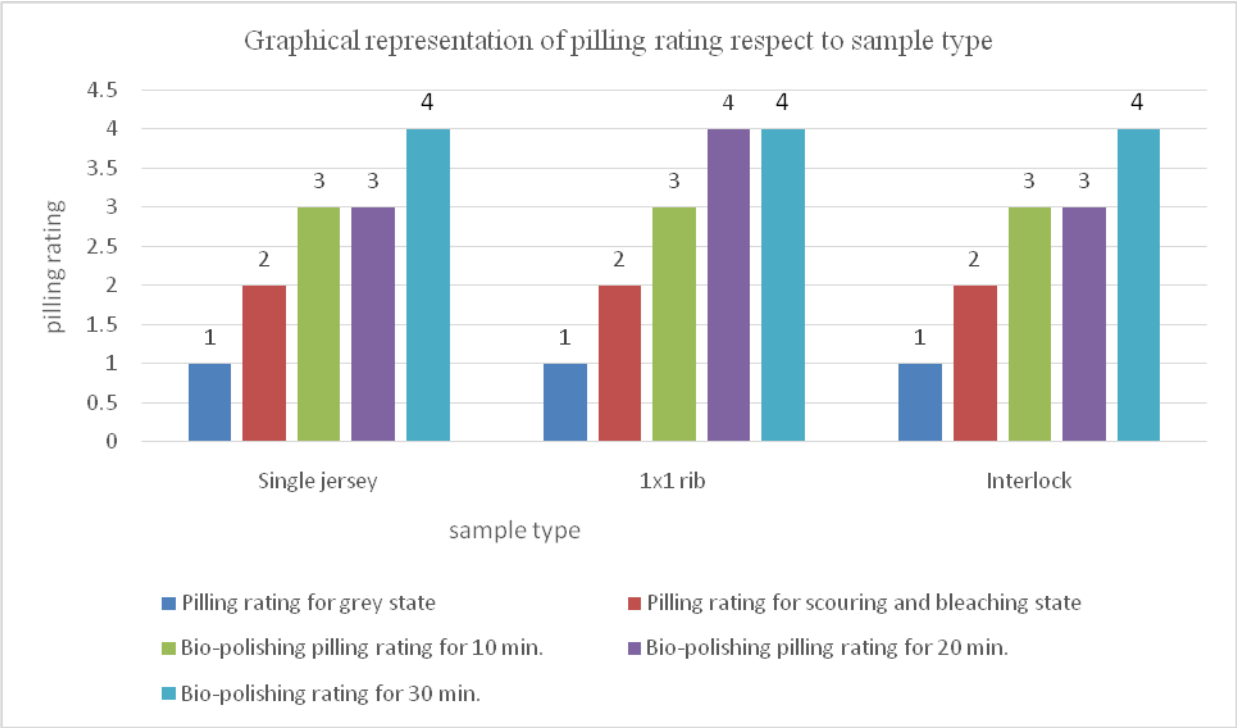


**Figure 4.7:** Column diagram of change in pilling rating of fabrics under different time

The column diagram has been drawn for the change in pilling rating of fabrics under different time. In this column diagram, different time indicates along the X axis and change in pilling rating of fabrics value is indicates along the Y axis.We have been taken five sample in different state to understand that change in knit fabric pilling rating.
At first scouring and bleaching stage knit fabric pilling rating are increase . Because in grey state fabric contain oil ,fats waxes, etc .In scouring and bleaching process oil ,fats and waxesetc are removed . Then knit fabrics loop fill up the gap where oils, fats and waxes are situated. So totally knit fabric compact and density will be increased. Thus pilling rating are increased .Otherwise bio-polishing stage,We are used cellulose enzyme .This enzyme are help to removed hairy fiber on the fabric upper surface .thus pilling rating are increased.

In figure (4.7) we see that , scouring and bleaching stage pilling rating are increased and after bio-polishing stage pilling rating are increased

# Chapter05
# Conclusion

# Chapter-05

# Conclusion

After finishing the project work, we have come to know the effect of time on bio-polishing of cotton knit fabric. Before doing this project we did not know about the actual information about the effect of time on bio-polishing of cotton knit fabric. Now we can say that after scouring and bleaching stage WPI, CPI, GSM, Pilling rating are increased. Otherwise yarn count, stitch length, change of fabric weight are decreased. Then after bio-polishing stage WPI, CPI, GSM, Pilling rating are decreased. Otherwise yarn count, stitch length, change of fabric weight are increased. We have tried out best to conduct the project work. We reached at the end with following outcomes-

- We see that scouring and bleaching stage knit fabric WPI are increase . Because in grey state fabric contain oil ,fats waxes, etc .Otherwise bio-polishing stage, We are used cellulose enzyme .This enzyme are help to removed hairy fiber on the fabric upper surface .thus WPI are decreased.
- We see that scouring and bleaching stage knit fabric CPI are increase . Because in scouring and bleaching process oil ,fats and waxes etc are removed .Otherwise bio-polishing stage,We are used cellulose enzyme .This enzyme are help to removed hairy fiber on the fabric upper surface .thus CPI are decreased.
- We see that scouring and bleaching stage knit fabric S.L are decrease .Because in scouring and bleaching process oil ,fats and waxesetc are removed . So totally knit fabric compact and density will be increased .Otherwise bio-polishing stage.Cellulosic enzyme are help to removed hairy fiber on the fabric upper surface .thus S.L are decreased.
- We see that scouring and bleaching stage knit fabric GSM are decrease Because in scouring and bleaching process oil,fats and waxesetc are removed .So totally knit fabric compact and density will be increased. Thus GSM are increased .Otherwise bio-polishing stage. Cellulosic enzyme are help to removed hairy fiber on the fabric upper surface .thus GSM are decreased.
- We see that scouring and bleaching stage knit fabric yarn count are inecrease . Because in grey state fabric contain oil ,fats waxes, etc .In scouring and bleaching process oil ,fats and waxesetc are removed. Thus yarn count are increased .Otherwise bio-polishing stage. cellulosic enzyme are help to removed hairy fiber on the fabric upper surface
- We see that scouring and bleaching stage knit fabric weight are decrease . Because in scouring and bleaching process oil ,fats and waxes etc are removed. Thus fabric weight are decreased .Otherwise bio-polishing stage. Cellulosic enzyme are help to removed hairy fiber on the fabric upper surface .thus fabric weight are decreased.
- We see that scouring and bleaching stage knit fabric pilling rating grade are increase . Because in scouring and bleaching process oil ,fats and waxes etc are removed . Then knit fabrics loop fill up the gap where oils, fats and waxes are situated. Thus pilling rating are increased .Otherwise bio-polishing stage. Cellulosic enzyme are help to removed hairy fiber on the fabric upper surface .thus pilling rating are good.

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# Appendix

# Appendix

**Table A1.** Change of WPI (wales per inch) of fabric after scouring-bleaching & Bio-polishing

| SL No. | Sample name | WPI of gray fabric | WPI after scouring and bleaching | % of change in WPI after scouring and bleaching | WPI after Bio-polishing | Time (Minute) | % of change in WPI (for grey & bio-polishing state) |
|---|---|---|---|---|---|---|---|
| 1 | Single jersey | 32 | 36 | -12.5 | 36 | 10 | -12.5 |
| | | | | | 34 | 20 | -6.25 |
| | | | | | 33 | 30 | -3.25 |
| 2 | (1x1) rib | 53 | 58 | -9.433 | 57 | 10 | -7.92 |
| | | | | | 56 | 20 | -5.92 |
| | | | | | 54 | 30 | -1.92 |
| 3 | Interlock | 48 | 54 | -12.5 | 52 | 10 | -8.33 |
| | | | | | 52 | 20 | -8.33 |
| | | | | | 50 | 30 | -4.16 |

**Table A2.** Change of CPI (course per inch) of fabric after scouring-bleaching &Bio-polishing stage

| SL No | Sample name | CPI of grey state | CPI after scouring and bleaching | % of change in CPI after scouring and bleaching | CPI after Bio-polishing | Time (minute) | % of change in CPI(for grey & bio-polishing state) |
|---|---|---|---|---|---|---|---|
| 1 | Single jersey | 54 | 57 | -5.55 | 56 | 10 | -3.70 |
| | | | | | 55 | 20 | -1.85 |
| | | | | | 55 | 30 | -1.85 |
| 2 | (1x1) rib | 72 | 76 | -5.55 | 75 | 10 | -4.14 |
| | | | | | 74 | 20 | -2.77 |
| | | | | | 73 | 30 | -1.38 |
| 3 | Interlock | 66 | 70 | -6.06 | 70 | 10 | -6.06 |
| | | | | | 68 | 20 | -3.03 |
| | | | | | 68 | 30 | -3.03 |

**Table A3.** Change of S.L (Stitch length) of fabric after scouring-bleaching & Bio-polishing

| SL No | Sample name | Stitch length of grey state | Stitch length after scouring and bleaching | % of change in stitch length after scouring & bleaching state | Stitch length after Bio-polishing | Time (minute) | % of change in Stitch length (for grey & bio-polishing state) |
|---|---|---|---|---|---|---|---|
| 1 | Single jersey | 2.89 | 2.85 | 1.38 | 2.86 | 10 | 1.03 |
| | | | | | 2.87 | 20 | 0.69 |
| | | | | | 2.88 | 30 | 0.34 |
| 2 | (1x1) rib | 2.76 | 2.72 | 1.44 | 2.73 | 10 | 1.08 |
| | | | | | 2.75 | 20 | 0.36 |
| | | | | | 2.75 | 30 | 0.36 |
| 3 | Interlock | 1.67 | 1.62 | 2.99 | 1.64 | 10 | 1.79 |
| | | | | | 1.65 | 20 | 1.19 |
| | | | | | 1.66 | 30 | 0.59 |

**Table A4.** Change of GSM (gram per squre meter) of fabric after scouring-bleaching & Bio-polishing

| SL No | Sample name | GSM of grey state | GSM after scouring and bleaching | % of change in GSM (after scouring& bleaching) | GSM after Bio-polishing | Time (minute) | % of change in GSM (for grey & bio-polishing state) |
|---|---|---|---|---|---|---|---|
| 1 | Single jersey | 150 | 162 | -8.00 | 160 | 10 | -6.66 |
| | | | | | 159 | 20 | -6.00 |
| | | | | | 158 | 30 | -5.33 |
| 2 | (1x1) rib | 235 | 250 | -6.38 | 246 | 10 | -4.68 |
| | | | | | 244 | 20 | -3.82 |
| | | | | | 241 | 30 | -2.55 |
| 3 | Interlock | 226 | 240 | -6.19 | 235 | 10 | -3.98 |
| | | | | | 233 | 20 | -3.09 |
| | | | | | 231 | 30 | -2.21 |

**Table A5.** Change of yarn count of fabric after scouring-bleaching &Bio-polishing stage

| SL No | Sample name | Yarn count of grey state | Yarn count after scouring and bleaching | % of change in yarn count (after scouring and bleaching) | Yarn count after Bio-polishing | Time (minute) | % of change in yarn count (for grey & bio-polishing) |
|---|---|---|---|---|---|---|---|
| 1 | Single jersey | 34 | 31 | 8.82 | 32 | 10 | 5.88 |
| | | | | | 33 | 20 | 2.94 |
| | | | | | 33 | 30 | 2.94 |
| 2 | (1x1) rib | 36 | 32 | 11.11 | 33 | 10 | 8.33 |
| | | | | | 34 | 20 | 5.55 |
| | | | | | 34 | 30 | 5.55 |
| 3 | Interlock | 32 | 28 | 12.5 | 29 | 10 | 9.37 |
| | | | | | 30 | 20 | 6.25 |
| | | | | | 31 | 30 | 3.12 |

**Table A6.** Change of weight of fabric after scouring-bleaching & Bio-polishing

| SL No | Sample name | Fabric Weight of grey state | Fabric Weight of after scouring and bleaching | % of change in weight loss after scouring & bleaching state | Fabric Weight after Bio-polishing | Time (minute) | % of change in weight loss (for grey & bio-polishing state) |
|---|---|---|---|---|---|---|---|
| 1 | Single jersey | 5 | 4.80 | 4 | 4.78 | 10 | 4.4 |
| | | | | | 4.77 | 20 | 4.6 |
| | | | | | 4.76 | 30 | 4.8 |
| 2 | (1x1) rib | 5 | 4.76 | 4.8 | 4.72 | 10 | 5.6 |
| | | | | | 4.71 | 20 | 5.8 |
| | | | | | 4.70 | 30 | 6.0 |
| 3 | Interlock | 5 | 4.78 | 4.4 | 4.76 | 10 | 4.8 |
| | | | | | 4.74 | 20 | 5.2 |
| | | | | | 4.72 | 30 | 5.6 |

**Table A7.** Change of pilling rating of fabric after scouring- bleaching & Bio-polishing

| SL No | Sample name | pilling rating of grey state | pilling rating after scouring and bleaching | % of change in pilling rating after scouring & bleaching state | pilling rating after Bio-polishing | Time (minute) | % of change in pilling rating(for grey & bio-polishing state) |
|---|---|---|---|---|---|---|---|
| 1 | Single jersey | 1 | 2 | -100 | 3 | 10 | -200 |
| | | | | | 3 | 20 | -200 |
| | | | | | 4 | 30 | -300 |
| 2 | (1x1) rib | 1 | 2 | -100 | 3 | 10 | -200 |
| | | | | | 4 | 20 | -300 |
| | | | | | 4 | 30 | -300 |
| 3 | Interlock | 1 | 2 | -100 | 3 | 10 | -200 |
| | | | | | 3 | 20 | -200 |
| | | | | | 4 | 30 | -300 |