# Daffodil international University

Faculty of Engineering

Department of Textile Engineering

Project (Thesis) Report on

**Studies on the Effect of Pre-treatment on the Physical Characteristics of Cotton Knit Fabric**

**Course code:** TE4214 **Course title:** Project (Thesis)


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Department of Textile Engineering

Faculty of Engineering

Daffodil International University

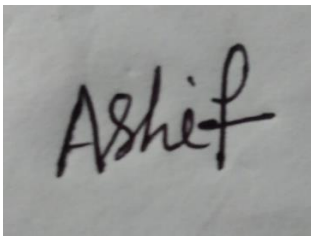

A Thesis report submitted in partial fulfillment of the requirements for the degree of

**Bachelor of Science in Textile Engineering**

Advance in Wet Processing Technology

# DECLARATION

By signing this statement, we at Daffodil International University certify that this study was completed under the guidance of **Mr. Tanvir Ahmed Chowdhury**, Assistant Professor in the Department of Textile Engineering in the Faculty of Engineering. Additionally, we hereby swear that neither this project nor any of its components have ever been submitted elsewhere for the purpose of receiving a degree or diploma.



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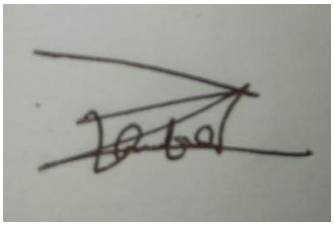

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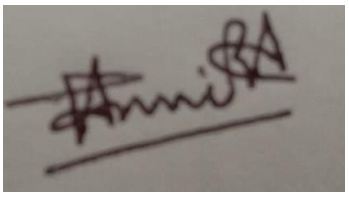
# LETTER OF APPROVAL

This project report from Md. Ashif Nur Rakib and Iqbal Hassan (ID 191-23-608 and 191-23-591) has been authorized in part fulfillment of the requirement for the degree of BACHELOR OF SCIENCE IN TEXTILE ENGINEERING. Under my direction, the aforementioned pupils have finished their project work. Throughout the study process, I discovered them to be sincere, diligent, and eager.

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# ACKNOWLEDGEMENT

First and foremost, we want to thank the Almighty Allah for giving us the ability to execute this project effectively through his divine grace. We are appreciative to Mr. Tanvir Ahmed Chowdhury, an assistant professor in the department of textile engineering at the Daffodil International University faculty of engineering. Our supervisor's extensive experience and deep interest in the subject of textile dyeing and finishing motivated us to complete the job. This endeavor was made possible by his never-ending tolerance, academic leadership, constant encouragement, active oversight, constructive criticism, insightful counsel, reading numerous subpar drafts and rectifying these at all levels. In order to complete our project report, we would like to thank Ass. Prof. Mr. Md. Mominur Rahman, Head, Department of Textile Engineering, Faculty of Engineering, Daffodil International University.

We would like to express our gratitude to all of our classmates at Daffodil International University who participated in the conversation while doing their course work. Finally, we would like to thank our parents, friends, and other loved ones for their encouragement, strength, and support as we wrote the project report.

# DEDICATION

**This Thesis (Project) is dedicated to our beloved parents and honorable teachers.**

# Abstract

Typically, contaminants and natural color are removed through scouring and bleaching. We utilize caustic soda, detergent, sequestering agent, wetting agent, and hot water for scouring. Detergent and caustic soda are the fundamental chemicals here. Sequestering agent, hydrogen peroxide, and peroxide stabilizer are used in bleaching. Hydrogen peroxide and a peroxide stabilizer are the fundamental chemicals here.

In this study, we examine the physical properties of knit fabric both before and after the procedure of treatment. In order to complete this task, we collected a sample and calculated the WPI, CPI, stitch length, pilling test, and bursting strength test. And we keep an eye on how those processes alter over time. We also watch as those processes alter.

## TABLE OF CONTENTS

# CHAPTER 01

# INTRODUCTION

Before being colored or printed, cotton yarn or fabric goes through a number of different textile manufacturing steps. The primary wet technique used on textile materials prior to dying or printing is washing and bleaching. primarily whitening and cleaning This procedure removes natural colors and non-cellulose components entirely or in part. Scouring removes natural contaminants from the dough and gives it a high, uniform wettability. The bleaching procedure gives the fabric a gloss while eradicating its natural color. Cotton gets absorbent after contaminants are eliminated. More specifically, natural and accidental colors, undesired oils, fats, and waxes, soluble contaminants, and particle or solid soils on the cloth are removed or destroyed through washing and bleaching. increase. We also offer techniques for finishing, printing, and special needs dyeing. The process essentially entails using soap or detergent, hydrogen peroxide treatment, and alkali addition.

More specifically, washing and bleaching remove or destroy the natural and accidental colors, unwanted oils, fats, and waxes, soluble pollutants, and particle or solid soils on the fabric. increase. We also provide methods for printing, specific needs dyeing, and finishing. In essence, the procedure comprises adding alkali, treating with hydrogen peroxide, and applying soap or detergent.

# CHAPTER 2

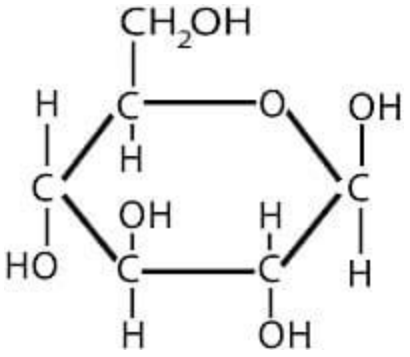
# LITERATURE REVIEW

## 2.1 Cotton fiber

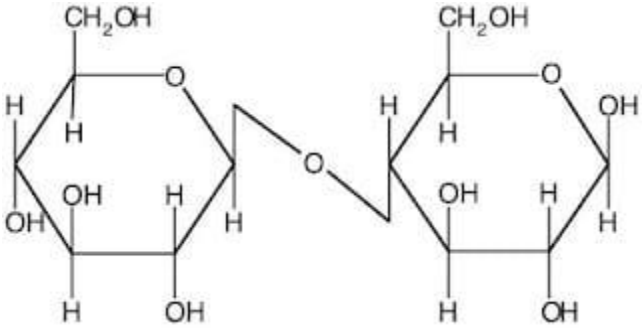
Cotton is a soft, staple fiber that develops around the cotton plant's seeds in a protective capsule called a boll. The most popular type of textile for apparel is created from the fiber when it is spun into yarn to create a soft, breathable fabric. About 50% of the textile fiber used in the world comes from cotton. Around 900 million metric tons of cotton are produced annually in 35 different countries. India, China, the United States, Pakistan, and Brazil are currently the top cotton-producing countries.

### 2.1.2 Chemical structure

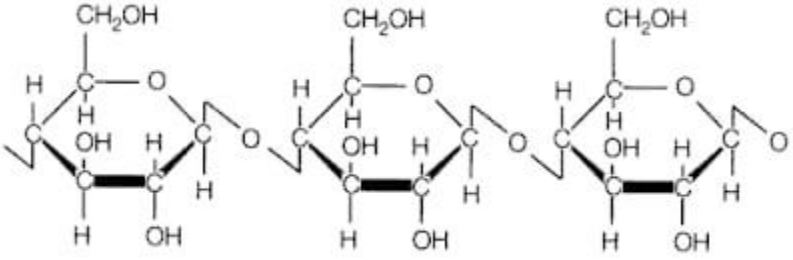
Chemical structure of cotton fiber



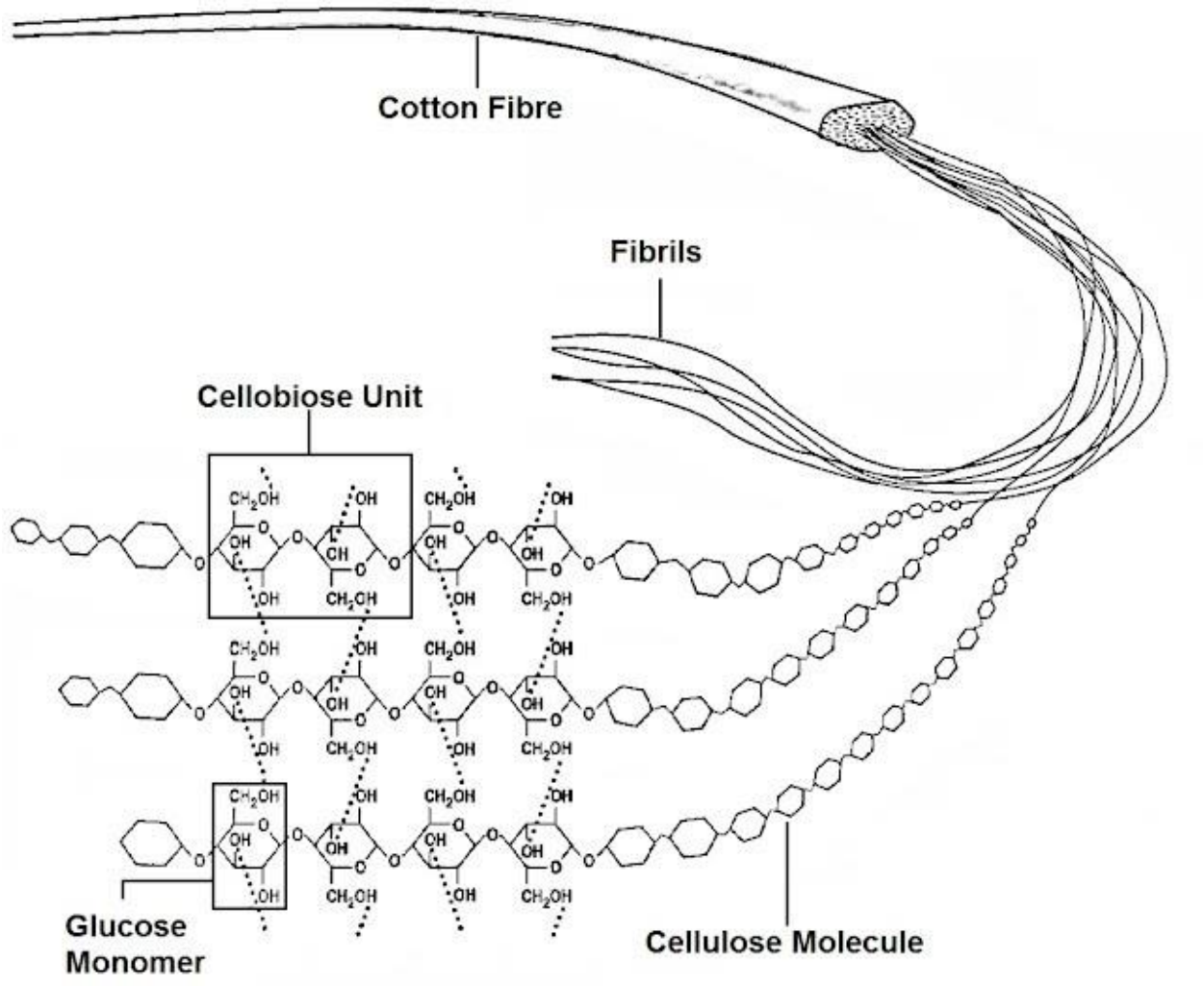
Glucose



Cellobiose



Cellulose




## Chemical structure of cotton fiber

One of the primary components of cotton fiber is cellulose. In the natural world, plants use CO2 that is present in the air, water, and soil to build up compounds that contain C, H, and O when sunshine is present. Photosynthesis is the name of this process. One of the products produced in this manner is glucose. Cellobiose is created when two glucose molecules interact, while large cellulose molecules are created when many cellobiose molecules combine. These cellubiose molecules were consequently joined longitudinally by a strong oxygen bridge. Additionally, via relatively lesser sideways forces, crystalline regions are generated where these forces are active, and amorphous regions are formed where they are not.

### 2.1.3 Chemical composition of cotton

| | |
|---|---|
| **Cellulose** | **88.0-97.0** |
| **Protein** | 1.0-2.0 |
| **Well and wax** | 0.4-1.5 |
| **Pectin** | 0.4-1.5 |
| **Minerals** | 0.7-1.6 |
| **Others** | 0.5-8.0) |
| | |

1. Cellulose (88.0-97.0)
2. Protein (1.0-2.0)
3. Wall and wax (0.4-1.5)
4. Pectin (0.4-1.5)
5. Minerals (0.7-1.6)
6. Others(0.5-8.0)

### 2.1.4 Properties of cotton:

- Technical
- Physical
- Chemical
- Miscellaneous

**Technical properties:**

1. Density (1.52gm/cm3)
2. Diameter (mic value2.0-7.0)

3. Elastic recovery
4. Breaking elongation
5. Tensile strength
6. Moisture regain(8.5)
7. Water absorbency(25-27%)
8. DP (9000-15000)
9. Color(90-100)

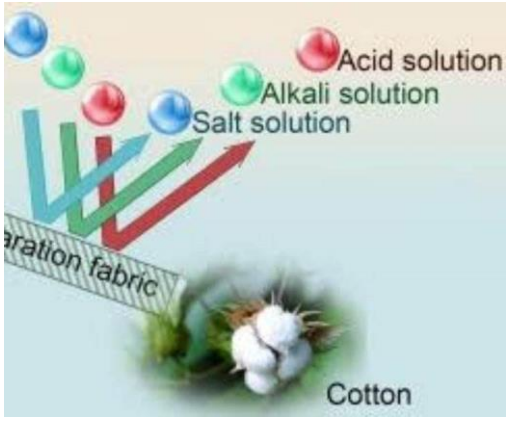
**Physical properties:**

1. **Tenacity:** Long polymers, numerous, consistent hydrogen bond formations between adjacent polymers, and spiraling fibrils in the primary and secondary cell walls all contribute to cotton's improved strength. One of the few fibers that gets stronger when wet, thanks to better arrangement in the amorphous part of the fiber.

2. **Elastic plastic:** Long polymers, numerous, consistent hydrogen bond formations between adjacent polymers, and spiraling fibrils in the primary and secondary cell walls all contribute to cotton's improved strength. One of the few fibers that gets stronger when wet, thanks to better arrangement in the amorphous part of the fiber

3. **Hygroscopic and thermal properties.**

**Chemical property:**



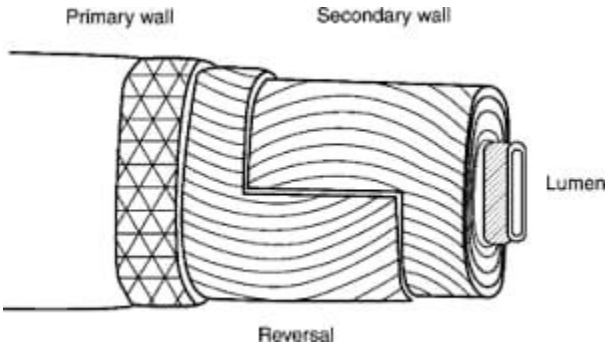

1. **Effect of acid** : cotton is attacked by hot dilute acid.
2. **Effect of Alkali:** cotton has excellent resistant to alkali.
3. **Effect of micro-organism:** cotton is attacked by fungi and bacteria.

**Miscellaneous property:**

1. Absorbency.
2. Shrinkage.
3. Wrinkling
4. Breath ability.

### Mechanism of cotton:

**Primary wall:** It is a outer protective wall. It contain protein wax , pectin as well as cellulose.




**Secondary wall:** It is almost full of pure cellulose(94%)

**Lumen:** It is liquid and gummy substance. A matured cotton fiber has some little lumen at the center.

### 2.2 Scouring & Bleaching

## Scouring

Scouring is the removal of natural components (oil, wax, fats, gum, etc.) as well as additional impurities (during the fabrication process) to create hydrophilic and pure textile materials.

## Bleaching

Bleaching is a process by which removing natural color from the fabric.

# Combined scouring and bleaching

Due to color bodies found in the fiber, (cotton) has a yellowish or off-white color and contains impurities that prevent dyeing and finishing, such as oils, fats, waxes, minerals, leafy matter, and motes. Scouring is the removal of impurities and improvement of absorbency, while Bleaching is the destruction of yellowish or off-white colored bodies.

**Facilities of this process:**

- Reduce strength loss
- Reduce weight loss
- Uniform scouring and bleaching

## 2.2.1 Chemicals in the scouring & bleaching process

1. **Caustic soda (NaOH):** Solubilizes silicates, saponifies glycerides (oils and waxes), and neutralizes acidic compounds.

2. **Wetting agent:** Lower interfacial tensions and surface tension.

**3. Detergents:** Remove oil-borne stains, suspend materials after they have been eliminated, emulsify fats, oils, and waxes.

**5. Sequestering agents:** Metal ion deactivation

**6. Hydrogen peroxide :** Destroy the natural color and make the fiber white

**7. Peroxide stabilizer :** Control the decomposition rate of hydrogen peroxide

### 2.2.2 Biopolishing

Biopolishing is a process, which apply enzyme (cellulase) to develop the fabric quality by reduce the pilling tendency and fuzziness of cotton fabric.

Advantages:

To make the fabric surface smoother and flexible.

Reduce fuzziness, hairiness and piling tendency .

Increase fabric quality

# Chapter 3

# Experimental details

## 3.1 Sample collection

All the sample are collected from bulk section of the production of the dyeing section (100% cotton knit fabric)

### 3.1.2 Apparatus on WPI & CPI

WPI= wales per inch

CPI= Coarse per inch

### Apparatus:

- Scale
- Pen
- Magnifying glass

### 3.1.3 Working procedure

*At first we take the fabric and according to it's course and Wales direction marking with pen

*Then set the point and counting the wpi and CPI through 1 inch by the help of magnifying glass

And counted the yarn

Finally determined the wpi and cpi

## 3.2 Apparatus on stitch length

When we will straight a total loop then which length we will get this

length is called stitch length. Its unit is mm.

**Apparatus:**

- Sample
- Scale
- Scissor

## 3.2.1 Working procedure

- At first we take a sample of fabric.
- Then we had to count 100 wales thread and mark the ends point with pen.
- Open the thread form on end of the sample and marking ends point measure by scale in cm. now the value is converted into mm.

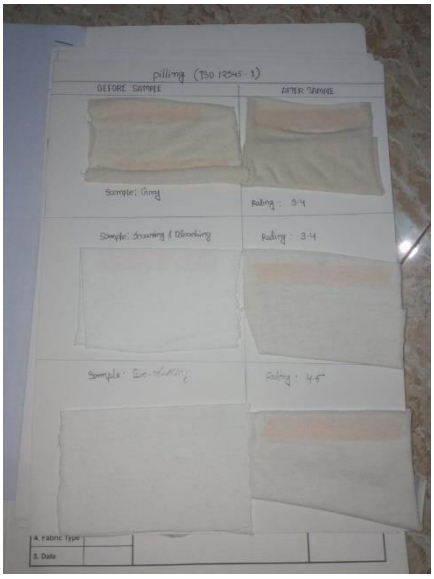
## 3.3 Apparatus on pilling test

- Pilling box
- Pen
- Scissor
- Needle lock stitch machine

We have to test by the help of this machine below the picture:

### 3.3.1 Working procedure

- All specimen cut with template (125mm*125mm)
- Stitch all specimen by folding 12mm using needle lock stitch machine.
- Prepare sample mounted on tube and applied tap cover
- Prepare pilling specimen on tube wear kept into pilling box 3 hours 10800 revolution.
- After completing test stitch remove and inspected by bleach grading table.

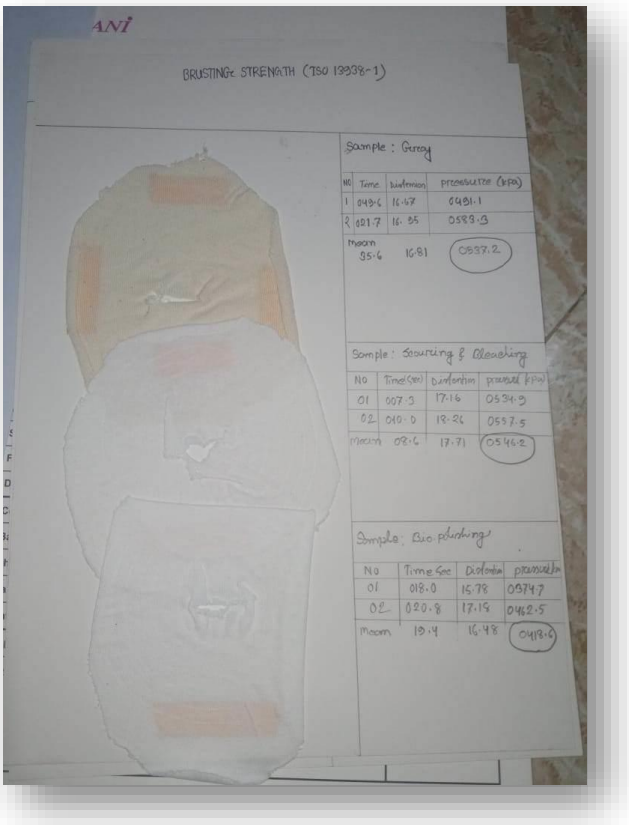



**Sample**

| Grade | description |
|---|---|
| 5 | No pilling |
| 4-5 | Small pilling |
| 4 | Bit pilling |
| 3-4 | Normally pilling |
| 3 | Lot of pilling |

| | |
|---|---|
| 2 | Highly pilling |
| 1-2 | Huge and hole area |
| 1 | Maximum pilling and hole |

### 3.4 Working procedure on Bursting strength test




**Sample**

- In this process.
- The tested area is 50cm2 .
- Place the test specimen over the diaphragm.
- Place the distension.

- recording device into the measuring position and adjust it to the zero position.
- Apply pressure to the specimens until the fabric brust.
- Then note the time ,strength from the monitor.

We have to test by the help of this machine below the picture:

# CHAPTER 4

# Result & Discussion

## 4.1 Changing WPI of fabric before and after scouring bleaching & biopolishing

# WPI

### Study on WPI during scouring & bleaching

| Sample name | NO Of obs | WPI before process | WPI After process | Change | Change% | Average% |
|---|---|---|---|---|---|---|
| Cotton S/J | 1 | 34 | 38 | 4 | 11.76 | 9.71 |
| | 2 | 34 | 37 | 3 | 8.82 | |
| | 3 | 35 | 38 | 3 | 8.57 | |

Here ,we calculate the WPI [During scouring] before process and after process.we also determine the change % and it's average %.

We read 3 times a sample,and determine WPI

In first read WPI before process 34 and after process 38

And their change 4 and change %11.76

For second row WPI before 34 after 37 and it's change 3 and change %8.82 and last one 35 and 37 their change 3 and change %8.57.

Here,we noticed a change on WpI after scouring process that is 9.71

## Study on WPI during bio-polishing

| Sample name | NO Of obs | WPI before process | WPI After process | Change | Change% | Average% |
|---|---|---|---|---|---|---|
| Cotton S/J | 1 | 38 | 40 | 2 | 5.26 | 5.30 |
| | 2 | 37 | 39 | 2 | 5.405 | |
| | 3 | 38 | 40 | 2 | 5.26 | |

Here ,we calculate the WPI [During Biopolishing] before process and after process.we also determine the change % and it's average %.

We read 3 times a sample,and determine WPI

In first read WPI before process 38 and after process 40

And their change 2and change %5.26

For second row WPI before 37 after 39 and it's change 2 and change %5.405 and last one 38 and 40 their change 2 and change %5.26

Here,we noticed a change on WpI after bleaching process that is

5.30%

## Study on WPI Change % between two process

| Process | Change% |
|---|---|
| Scouring and bleaching | 9.71 |
| Bio-polishing | 5.30 |

Here ,we comparing the change% between process .In scouring bleaching process WPI change % is 9.71 And In biopolishing process WPI change % is 5.30So we see that, WPI change % is more in scouring bleaching process rather than biopolishing process.

# CPI

## 4.2 Changing CPI of fabric before and after scouring bleaching & biopolishing

### Study on CPI before & after scouring bleaching

| Sample name | NO Of obs | CPI before process | CPI After process | Change | Change% | Average% |
|---|---|---|---|---|---|---|
| Cotton S/J | 1 | 52 | 55 | 3 | 5.76 | 3.77 |
| | 2 | 54 | 55 | 1 | 1.85 | |
| | 3 | 54 | 56 | 2 | 3.703 | |

Here, we calculate the CPI [During scouring & bleaching] before process and after process.we also determine the change % and it's average %.

We read 3 times a sample,and determine WPI

In first read WPI before process 52 and after process 55

And their change 3 and change %5.76

For second row CPI before 54 after 55 and it's change 1 and change %1.85 and last one 53 and 56 their change 2 and change %3.70

Here,we noticed a change on CpI after scouring & bleaching process that is 3.77%

### Study on CPI before and after bio-polishing

| Sample name | NO Of obs | CPI before process | CPI After process | Change | Change% | Average% |
|---|---|---|---|---|---|---|
| Cotton S/J | 1 | 55 | 57 | 2 | 3.63 | 3.66 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 2 | 55 | 56 | 1 | 1.81 | |
| | 3 | 54 | 57 | 3 | 5.55 | |

Here ,we calculate the CPI [During Biopolishing] before process and after process.we also determine the change % and it's average %.

We read 3 times a sample,and determine WPI

In first read CPI before process 55 and after process 57

And their change 2and change %3.63

For second row WPI before 55 after 56 and it's change 1 and change %1.81 and last one 54 and 57 their change 3 and change %5.55

Here,we noticed a change on CPI after bleaching process that is 3.66%

## Study on CPI Change % between two process

| Process | Difference |
|---|---|
| Scouring and bleaching | 3.77 |
| Bio-polishing | 3.66 |

Here ,we comparing the change% between process.

In scouring bleaching process CPI change % is 3.77

And In biopolishing process CPI change % is 3.66

So we see that, WPI change % is more in scouring & bleaching process rather than biopolishing process

# stitch length

## 4.3 Changing SL of fabric before and after scouring bleaching & biopolishing

### Study on SL before & after scouring bleaching & biopolishing

| Sample name | No of obs | Before scouring& bleaching | After scouring& bleaching | Average | After bio-polishing | Average |
|---|---|---|---|---|---|---|
| Cotton S/J | 1 | 2.65 | 2.70 | 2.70 | 2.74 | 2.73 |
| | 2 | 2.68 | 2.71 | | 2.73 | |

Here ,we calculate the Stitch length [During scouring & bleaching and biopolishing] before process and after process.we also determine it's average.

We read 2 times a sample,and determine Stitch length

In first read Stitch length before process 2.65mm and after process 2.70mm

For second row stitch length before 2.68mm after 2.71 and their average 2.70.

In after Biopolishing process the determined values are 2.74&2.73 and their average 2.73.

## Study on change the stitch length on different process

| process | Difference |
|---|---|
| Scouring& bleaching | 2.70 |
| Bio-polishing | 2.73 |

Here, we comparing the change% between process.

In scouring bleaching process the Stitch length is 2.70 mm

And In biopolishing process the Stitch length is 2.73

So we see that stitch length is more in biopolishing process rather than scouring bleaching process

# pilling test

## 4.4 Changing Pilling test of fabric before and after scouring bleaching & biopolishing

| Sample | process | Rating |
|---|---|---|
| Cotton S/J | Before scouring& bleaching | 3-4 |
| | Scouring &bleaching | 3-4 |
| | Bio-polishing | 4-5 |

Pilling rating (ISO12945-1):

5- NO Change

4-slight change

3-moderate change

2-significant change

1-several change

# Bursting strength test

## 4.5 Changing Bursting strength of fabric before and after scouring bleaching & biopolishing

### Study on Bursting strength during bleaching & scouring

| Sample name | No of obs. | Before process | After process | Average |
|---|---|---|---|---|
| Cotton S/j | 1 | 0491.1kpa | 0534.9kpa | 0546.2 |
| | 2 | 0583.3kpa | 0557.5kpa | |

Here, we determined the Bursting strength [During scouring bleaching] before process and after process. we also determine it's average .

We read 2 times, and determine Bursting strength test and it's pressure

In first read by monitor pressure before process 0491.1 and after process 0534.9

For second row, before process 0583.3 after 0557.5 and it's average 0546.2and their average 0546.2

## Study on Bursting strength during bio-polishing

| Sample name | No of obs | Before process | After process | average |
|---|---|---|---|---|
| Cotton S/j | 1 | 0534.9kpa | 0374.2kpa | 0418.6 |
| | 2 | 0557.8kpa | 0462.5kpa | |

Here, we determined the Bursting strength [During Biopolishing] before process and after process. we also determine it's average .

We read 2 times, and determine Bursting strength test and it's pressure

In first read by monitor pressure before process 0534.9and after process 0374.2

For second row, before process 0557.8 after 0462.5and their average 0418.6

## Study on Bursting strength Change % between two process

| Process | Difference |
|---|---|
| Scouring and bleaching | 0546.2kpa |
| Bio-polishing | 0418.6 kpa |

Here ,we comparing the change% between process.

In scouring bleaching process the pressure is 0546.2kpa.

And In biopolishing process the pressure is 0418.6 kpa.

## CHAPTER 5

# Conclusion

This experiment carry out on 100% cotton fabric, and how much scouring, bleaching and biopolishing affect their physical characteristics. We performed several tests on each sample before scouring bleaching and after scouring bleaching & before and after Biopolishing.

We determined the WPI, CPI, Pilling test and absorbency test after scouring bleaching, the primary cell wall of cellulosic fiber is broken .and that result WPI ,CPI and Stitch Length is increased. and it also increase in biopolishing. Through the peeling test we realized that the peeling tendency of before and after scouring bleaching sample is very high. But after doing biopolishing that its pilling tendency has decreased a lot.

And, By biopolishing it was concluded that the strength of scouring & bleaching sample is very high but after biopolishing its strength is greatly reduced.

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http://dspace.daffodilvarsity.edu.bd:8080/bitstream/handle/123456789/8494/181-23-5270.pdf?isAllowed=y&sequence=1

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http://dspace.daffodilvarsity.edu.bd:8080/bitstream/handle/123456789/8493/181-23-5256.pdf?isAllowed=y&sequence=1

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http://dspace.daffodilvarsity.edu.bd:8080/bitstream/handle/20.500.11948/3108/Final_project_thesis.pdf isAllowed=y&sequence=2

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