Faculty of Engineering

Department of Textile Engineering

Report on

# STUDY ON THE EFFECT OF BIO-POLISHING ON KNIT FABRIC PEOPERTIES

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

**Submitted by:**


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

Advance in Wet Processing Technology

Spring-2021

# DECLARATION

We hereby declare that, this project has been done by us under the supervision of **Tanvir Ahmed Chowdhury, Assistant Professor**, Department of Textile Engineering, Faculty of Engineering, Daffodil international University. We also declare that, neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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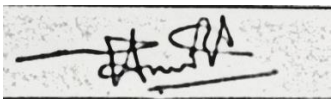
# LETTER OF APPROVAL

This project report prepared by **Md. Rakib Rayhan** (ID:171-23-4980) and **Sudipta Ghosh** (ID:172-23-5124), is approved in Partial Fulfillment of the Requirement for the Degree of BACHELOR OF SCIENCE IN TEXTILE ENGINEERING. The said students have completed their project work under my supervision. During the research period I found them sincere, hardworking and enthusiastic.



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

## DEDICATION

**We dedicated this project to our parents**

# ABSTRACT

The term Bio-polishing is a process which normally formed before or after dyeing and which can improve the fabric handling and superiority. Mainly it reduces the hairiness of fabric. This project was done to check the physical property of fabric before and after bio-polishing. So in this case we took 100% cotton s/j, 1x1 rib and interlock fabric to evaluate the change of physical property by using different types of chemical and by maintaining proper time and temperature. After the experiment we realized that after bio-polishing the CPI, WPI, GSM decreased and yarn count and SL increased before than scouring and bleaching. It also increase handle properties and decrease hairiness of the surface of the fabric before than the scouring and bleaching process. It removes pills and also improves the luster that is very important for a proper fabric surface to make standard garments.

# Table of Contents

**Contents** **Page Number**

# List of Figures

# List of Tables

# Chapter-1
# Introduction

# Chapter-1
# Introduction

Bio-polishing is a process that is normally carried out to remove protruding fibers from the surface of the fabric. It's normally occurred before, during or after dyeing. This tremendous process is completed by the hydrolysis action of enzyme. Here normally for single jersey, interlock fabric bio-polishing is done after bleaching and for rib (collar, cuff, hem) it's done after dyeing. There is also a process called singeing. And by this process we can also remove hairiness of the fabric by using heat. But it's a temporary and toxic treatment that's why fabric lost their anti pilling properties after a number of wash. That's why for the permanently removing of hairiness from the surface of the fabric, Bio-polishing or enzymatic treatment is the most standard process and for also customer satisfaction. Unfortunately this process decreases the strength of the fabric. Chemical cost will be increased also for high concentrated $H_2O_2$ or enzyme is pre-treatment process. If the weight loss% is too lower than the standard mentioned one, then the hairiness, fuzziness and other impurities will remain on the surface of the fabric and that will create absorbency problem in further. [1]

Figure 1.1: Bio-polished fabric

# Objectives:

Main objective of this project is to evaluate the physical property of knit fabric before and after Bio-polishing. Also besides-

- To check the difference of WPI, CPI, SL of the fabric before and after bio-polishing.
- To check the weight loss/gain of the fabric before and after bio- polishing.
- To differentiate the yarn count of the fabric before and after bio- polishing.
- To check the enzymatic effect on fabric surface.
- To check the protruding fibers on the surface of the fabric before and after bio-polishing. [2]

# Chapter-2
# Literature Review

# Chapter-2
# Literature Review

## 2.1 Definition of Bio-polishing

The term Bio-polishing is a process which normally formed before or after dyeing and which can improve the fabric handling and superiority. Mainly it reduces the hairiness of fabric. This tremendous process is completed by the hydrolysis action of enzyme. [3]

## 2.2 Objectives

- To remove pilling formation.
- To remove the hairiness of the fabric surface.
- To improve luster, softness of the fabric.
- To prevent material sticking property.
- To increase fast to washing and sewing ability of the fabric.

## 2.3 Method or process of bio-polishing

There are mainly two process of Bio-polishing

- Bio-polishing after dyeing
- Bio-polishing before dyeing

## 2.4 Process sequence of bio-polishing after dyeing

Add bleached sample

↓

Add sequestering, anti creasing, leveling and anti foaming agent

↓

Add dye solution

↓

Add salt solution

↓

Add alkali (Soda Ash/Caustic Soda)

↓

Dyeing

↓

Hot wash

↓

Add soaping agent and anti creasing agent

↓

Soaping

↓

Cold wash

↓

Add acid

↓

Add enzyme and anti creasing agent

↓

Enzyme treatment

↓

Cold wash

↓

Drying

## 2.5 Process sequence of Bio-polishing before Dyeing

Add bleached sample

↓

Add peroxide killer

↓

Add acid

↓

Add Enzyme and anti creasing agent

↓

Enzyme treatment

↓

Cold wash

↓

Add sequestering, anti creasing, leveling and anti foaming agent

↓

Add dye solution

↓

Add salt solution

↓

Add alkali (Soda Ash/Caustic Soda)

↓

Dyeing

↓

Hot wash

↓

Add soaping agent and anti creasing agent

↓

Soaping

↓

Cold wash [4]

## 2.6 Advantages & Disadvantages of Bio-polishing

- It removes protruding fibers from the surface of the fabric.
- It decreases the piling tendency of the fabric.
- It makes the fabric surface more smooth, luster and shiny.
- It reduce the strength of the fabric
- It increases the fabric weight loss %.
- It reduces the wet rub fastness properties of dark colored fabric. [5]

## 2.7 What is Enzyme?

The term enzyme is a substance which acts as a biological catalyst for bio chemical reaction. It comes from the Greek word enzymes which mean "cells". Actually they have some specific function that's why many of the reaction and process can't take place without them. Enzyme consist three unique dimensional shapes. It also consist an ionic group which make its structure more complicated. Enzymes are organic soluble substance. Normally it's produced by living organism and the amino acid of this organism form long poly peptide chains (-HN-R-CONH-R-CO-)n by condensation polymerization. Day by day the use of enzyme in textile industry has been increased. It is now also used in detergent, medicine, animal feeds, food and diary, paper and bio fuel industry. [6]

## 2.8 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) [7]

## 2.9 Types of Enzyme Used in Textile Wet Processing:

Cellulose enzyme: This type of enzyme normally used in textile bio-polishing sector to remove hairiness and pilling tendency of textile fabric. Cellulose enzymes also are natural and living micro-organism.

Amylase enzyme: This type of enzyme used in textile desizing process of cotton. It also removes size material from woven fabric. This natural and living micro-organism increases the water absorbency of fabric.

Catalase Enzyme: Bleached fabric contains residual peroxide. Catalase enzyme are used to remove this type of residual peroxide from the fabric for better coloration.

Pectinase Enzyme: To remove oil, fat, wax, dust in the scouring process of textile, this type of enzyme is used. It makes fiber clean and hydrophilic. [8]

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

Every enzyme has its own active centre and where the substrate molecule can easily join. In below figure, we can see a particular substrate molecule fits into the active site of the enzyme. Then this substrate molecule will form a complex with the enzyme. After later the enzyme will be regenerated itself and the substrate molecule converted into product. [Fig: 2.1]

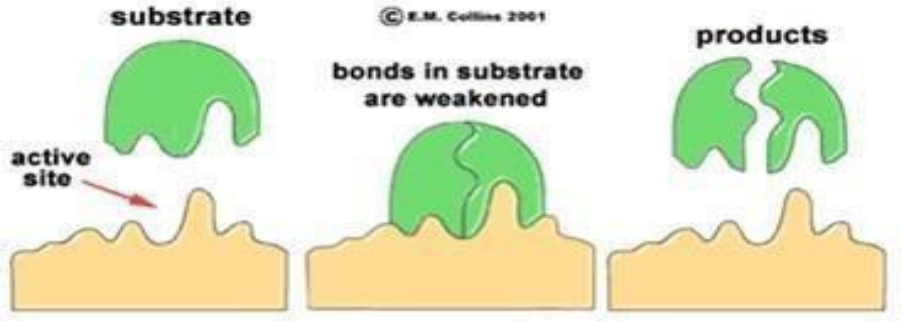



**Figure-2.1 Lock & Key model of enzyme specificity**

Before the inactivation of this enzyme by extreme temperature, $p^H$ or poisoned by a chemical bogie [Fig: 2.2], the process will be continued. [9]

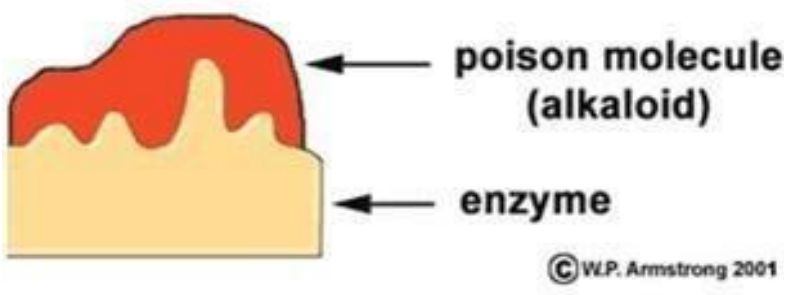
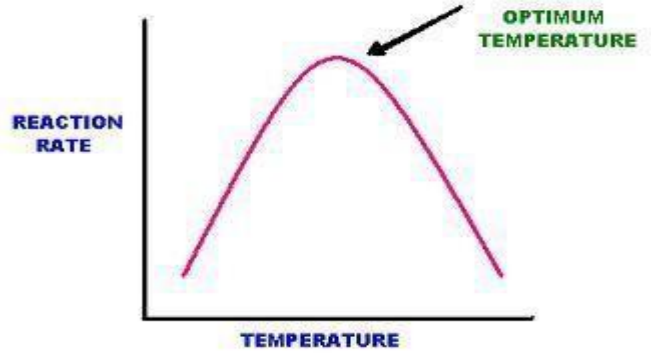



**Figure-2.2 Active site of enzyme blocked by poison molecule**

## 2.11 Factors affecting efficiency of enzymes

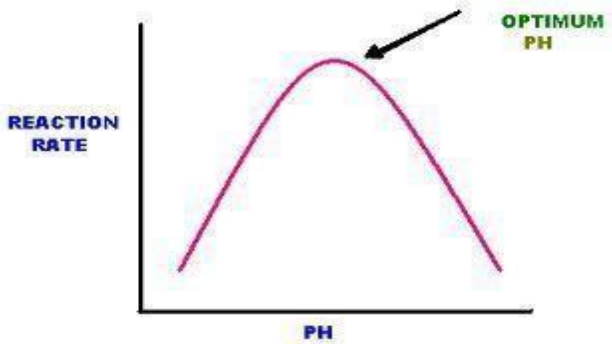
**Temperature:**

- Every enzyme work at particular temperature. Efficiency will be increased or decreased by the change of temperature. It normally works at 40-60$^0$ C.
- The shape of the enzyme molecule will be changed due to the alteration of heat at the optimum temperature. It also reduce their activity.




**PH:**

- Enzyme can perform their best both in alkaline and acidic media. The point where activity of enzyme is highest , there will be the optimum p$^H$

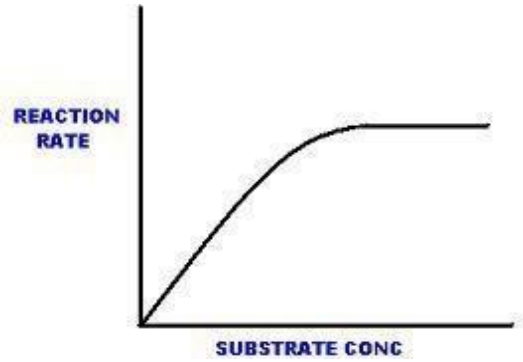



**Enzymes concentration:**

- Increase in concentration of enzymes increases the reaction rate.

**Substrate Concentration:**

- The reaction rate will be increase at certain point if the concentration of substrate increases.




**Products Concentration:**

- The activity of enzyme will reduce due to the accumulation of products.

**Radiations:**

- Exposure to UV rays, X-rays reduces their reactivity. [10]

## 2.12 Advantages and disadvantages of enzymes in bio-polishing

- It removes protruding fibers from the surface of the fabric.
- It decreases the piling tendency of the fabric.
- It makes the fabric surface more smooth, luster and shiny.
- It reduce the strength of the fabric
- It increases the fabric weight loss %.
- It reduces the wet rub fastness properties of dark colored fabric. [11]

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# Chapter-3

# Experimental Details

# Chapter-3
# Experimental Details

## 3.1 Materials

To fulfill our project work, we have taken 3 types of cotton knitted fabric. We have taken 100% Cotton S/J, 1x1 Rib and Interlock bleached fabric after the scouring and bleaching treatment. We have completed our project work by following every type of wet related rules. The specification of the scoured & bleached fabrics are given below-

**Table 3.1:** Sample Specification.

| Sample No. | Types of fabric | WPI | CPI | GSM | Yarn count (Ne) | Stitch length (mm) |
|---|---|---|---|---|---|---|
| 01 | S/J | 33 | 47 | 170 | 24 | 2.85 mm |
| 02 | (1x1) rib | 44 | 57 | 240 | 26 | 2.8 mm |
| 03 | Interlock | 45 | 65 | 220 | 32 | 2.6 mm |

## 3.2 Chemical used for Bio-Polishing

- Peroxide killer
- Acetic Acid
- Neutralizing agent
- Enzyme
- Anti Creasing agent

Here is the chemical that we have been used for our project work. Details are given below:

**Table 3.2:** Chemicals & functions

| Chemical | Function |
|---|---|
| Peroxide killer | To remove the residual peroxide from the fabric, peroxide killer is used. |
| Acetic Acid | Acetic acid normally used to control the $p^h$ of the solution. |

| | |
|---|---|
| Neutralizing Agent | Neutralizing agents are used to control or return back the $p^h$ level to more natural level. |
| Enzyme | It's use for removing the hairiness from the surface of the fabric. |
| Ant creasing Agent | This type of chemical is used to resist the crease formation of fabric during process. |

## 3.3 What is scouring?

Scouring is the process of removing the natural impurities form the fabric like oil, fat, wax etc.

## 3.4 What is bleaching?

Bleaching is the process of removing the grey color of the fabric to give the white effect.

## 3.5 Method

At first we took 45 gm scoured and bleached fabric. Then we bio-polished the bleached fabric by using required amount of chemicals and fabric.

## 3.6 Recipe

**Table 3.3:** Bio-polishing recipe

| Particulars | Recipe |
|---|---|
| Peroxide killer | 0.5 g/L (Stock solution %.....1) |
| Acetic Acid | 1 g/L (Stock solution %.....1) |
| Neutralizing Agent | 0.4 g/L (Stock solution %.....1) |
| Enzyme | 1 g/L (Stock solution %.....1) |
| Ant creasing Agent | 1 g/L (Stock solution %.....1) |
| Material Weight | 45 gm. (15+15+15 ; s/j, rib, interlock) |
| M:L | 1:30 |
| Time | 20 min. (for peroxide killer and neutralization)<br>30 min. (for enzyme) |
| Temp. | $50^0$ C (for peroxide killer and neutralization)<br>$55^0$ C (for enzyme) |

**Table 3.4:** Apparatus Used

| Name | Function |
|---|---|
| Electric Balance | To measured weight |
| Scissors | To cut the fabric |
| Glass rod | To stirring the chemicals |
| GSM Cutter | To cut the fabric |
| PH Meter | Use to check ph |
| Biker | To mixing ,stirring and heating the chemical |
| Pipette | To measure the liquid |
| Thermometer | To check temperature |
| Gas Burner | To generate the flame |
| Pot | To make solution for bio-polishing the fabric |

## 3.7 Calculation:

Total Liquor = (45 x 30) ml
= 1350 ml

1. Peroxide Killer = (Total liquor * Required amount of chemical) / (Stock Sol$^n$ % * 1000)
= (1350 x 0.5 x 100) / (1 x 1000) ml
= 67.5 ml

2. Acetic Acid = (Total liquor * Required amount of chemical) / (Stock Sol$^n$ % * 1000)
= (1350 x 1 x 100) / (1 x 1000) ml
= 135 ml

3. Neutralizing Agent = (Total liquor * Required amount of chemical) / (Stock Sol$^n$ % * 1000)
= (1350 x 0.4 x 100) / (1 x 1000) ml
= 54 ml

4. Enzyme = (Total liquor * Required amount of chemical) / (Stock Sol$^n$ % * 1000)
= (1350 x 1 x 100) / (1x 1000) ml

= 135 ml

5. Ant Creasing Agent = (Total liquor * Required amount of chemical) / (Stock Sol$^{n}$ % * 1000)
   = (1350 x 1 x 100) / (1 x 1000) ml
   = 135 ml

6. Required water = Total Liquor – (Total dyes and chemicals)
   = {1350 – (67.5 + 135 + 54 + 135 + 135)} ml
   = 823.5 ml

## 3.8 Process Sequence:

Collect Sample

↓

Sample Preparation

↓

Recipe Calculation

↓

Prepare Chemical

↓

Preparing Bath

↓

Bio-Polishing

↓

Cold Wash

## 3.9 Process curve

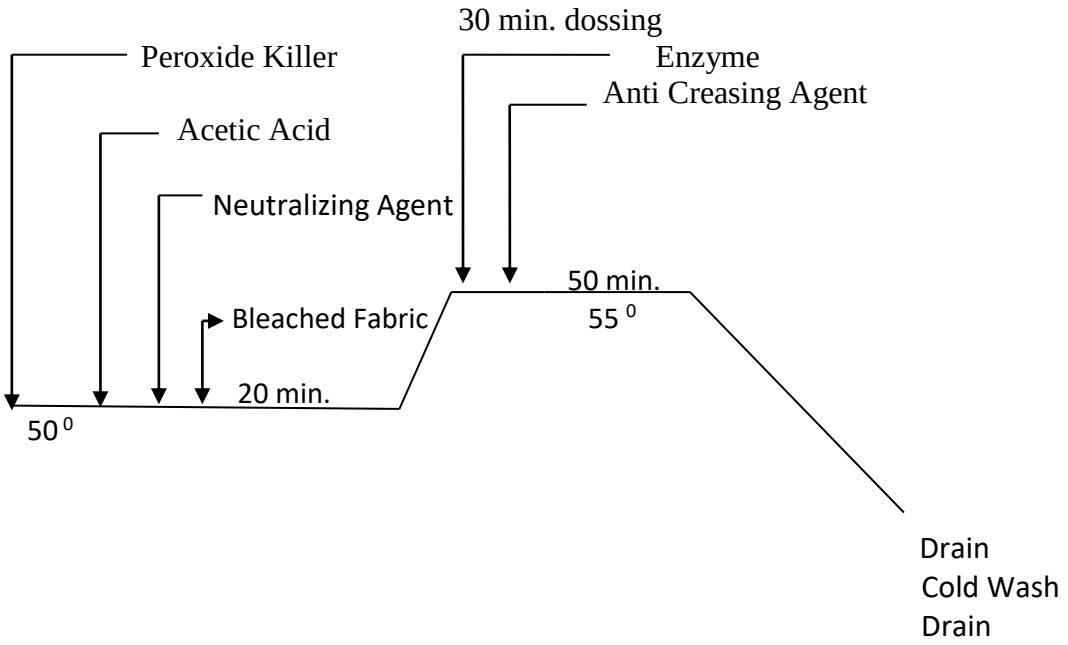


Figure-3.1: Process curve of bio-polishing

## 3.10 Working Procedure:

1. At first, we have taken total 45 gm bleached fabric (15 gm S/J, 15 gm Rib, 15 gm Interlock) for our Enzyme treatment.

2. Then we have taken 823.5 ml water into the pot and fixed the temperature at $50^0$ C. We added peroxide killer & acetic acid. Then we added 45 gm sample into the solution. After that we set the process time for 20 minutes.

3. We have added enzyme and ant creasing agent after 20 minutes to raise the temperature at $55^0$ c for 30 minutes.

4. We checked the $p^h$ continuously after a few minutes later and that was between 4.5 - 5.5

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

6. After that the temperature is raised up to $80^0$ c and rinse to kill enzyme. After completing the Action the process is drained out.

7. We have done the same process in 3 times.

# Chapter-04
# Discussion and result

# Chapter-04
# Discussion and result

### Change in WPI (Wales per inch) of fabric before & after bio-polishing Process

After bio-polishing, here we can see that the Wales per inch of s/j, 1x1 rib and interlock fabric has been decreased.

**Table 4.1:** Result of WPI after bio-polishing

| Fabric | After scouring & bleaching | After bio-polishing | | |
|---|---|---|---|---|
| | | 1st sample | 2nd sample | 3rd sample |
| Single Jersey | 33 | 29 | 30 | 28 |
| 1x1 Rib | 44 | 39 | 39 | 40 |
| Interlock | 45 | 40 | 42 | 41 |

### Change in CPI (Course per inch) of fabric before & after bio-polishing Process

After bio-polishing, here we can see that the course per inch of s/j, 1x1 rib and interlock fabric has been decreased.

**Table 4.2:** Result of CPI after bio-polishing

| Fabric | After scouring & bleaching | After bio-polishing | | |
|---|---|---|---|---|
| | | 1st sample | 2nd sample | 3rd sample |
| Single Jersey | 47 | 44 | 43 | 44 |
| 1x1 Rib | 57 | 53 | 53 | 52 |
| Interlock | 65 | 60 | 61 | 59 |

### Change in GSM of fabric before & after bio-polishing Process

After bio-polishing, here we can see that the GSM of s/j, 1x1 rib and interlock fabric has been decreased.

**Table 4.3:** Result of GSM after bio-polishing

| Fabric | After scouring & bleaching | After bio-polishing | | |
|---|---|---|---|---|
| | | 1st sample | 2nd sample | 3rd sample |
| Single Jersey | 170 | 163 | 162 | 162 |
| 1x1 Rib | 240 | 233 | 230 | 231 |
| Interlock | 220 | 205 | 205 | 204 |

**Change in yarn count of fabric before & after bio-polishing Process**

After bio-polishing, here we can see that the yarn count of s/j, 1x1 rib and interlock fabric has been increased.

**Table 4.4:** Result of yarn count ($N_e$) after bio-polishing

| Fabric | After scouring & bleaching | After bio-polishing | | |
|---|---|---|---|---|
| | | 1st sample | 2nd sample | 3rd sample |
| Single Jersey | 24 | 26 | 26 | 26 |
| 1x1 Rib | 24 | 26 | 26 | 26 |
| Interlock | 32 | 36 | 36 | 36 |

**Change in stitch length of fabric before & after bio-polishing Process**

After bio-polishing, here we can see that the stitch length of s/j, 1x1 rib and interlock fabric has been increased.

**Table 4.5:** Result of Stitch length after bio-polishing

| Fabric | After scouring & bleaching | After bio-polishing | | |
|---|---|---|---|---|
| | | 1st sample | 2nd sample | 3rd sample |
| Single Jersey | 2.85 | 2.91 | 2.90 | 2.92 |
| 1x1 Rib | 2.8 | 2.84 | 2.84 | 2.86 |
| Interlock | 2.6 | 2.73 | 2.72 | 2.74 |

So after scouring and bleaching the WPI, CPI, GSM, has been increased. Because the grey fabric contains a lot of oil, fat, waxes. Also the loop of yarn are filled up by them has been removed from the fabric. On the other hand stitch length and yarn count are increased due to shrinkage property of the fabric due to removing of oil, fat and waxes. In bio-polishing stage we have used cellulose enzyme that reduces the hairiness from the fabric surface that's help to reduce WPI, CPI, GSM and shrinkage property of fabric. That's why the stitch length and yarn counts are increased.

# Chapter-05
# Conclusion

# Chapter-05

# Conclusion

Bio-polishing is one of the important process of textile wet processing to remove the hairiness and reduce the pilling tendency of fabric. Before doing the experiment we haven't so much idea about this and also haven't any idea how the hairy fibers are removed from the surface of the fabric. After doing that, we have come to an excellent idea about bio-polishing process, time and temperature, recipe calculation, change of WPI, CPI, GSM, SL & yarn count after bio-polishing. We have also gain some knowledge about types of enzyme, bio-polishing, chemical required for bio-polishing and also their function. Here-

- We see that after scouring and bleaching the WPI of knit fabric has been increased due to the removal of oil, fat and wax from the grey fabric. And after bio-polishing the WPI was decreased due to the removal of hairy fibers from the surface of the knit fabric.

- We see that after scouring and bleaching the CPI of knit fabric has been increased due to the removal of oil, fat and wax from the grey fabric. And after bio-polishing the CPI was decreased due to the removal of hairy fibers from the surface of the knit fabric.

- We see that after scouring and bleaching the GSM of knit fabric has been increased due to the removal of oil, fat and wax from the grey fabric. And after bio-polishing the GSM was decreased due to the removal of hairy fibers from the surface of the knit fabric.

- We see that after scouring and bleaching the stitch length of knit fabric has been decreased due to the removal of oil, fat and wax from the grey fabric. And after bio-polishing the stitch length was increased.

- We see that after scouring and bleaching the yarn count of knit fabric has been decreased due to the removal of oil, fat and wax from the grey fabric. And after bio-polishing the yarn count was increased.

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Faculty of Engineering Department of Textile Engineering Report on STUDY ON THE EFFECT OF BIO-POLISHING ON KNIT FABRIC PEOPERTIES Course code: TE-4214 Course title: Project (Thesis) Submitted by: Student's Name Student's ID Md. Rakib Rayhan 171-23-4980 Sudipta Ghosh 172-23-5124 Supervised by: Tanvir Ahmed Chowdhury Assistant Professor Department of Textile Engineering Daffodil International University A project submitted in partial fulfillment of the requirements for the degree of Bachelor of Science in Textile Engineering Advance in Wet Processing Technology Spring-2021 "©Daffodil International University" i DECLARATION We hereby declare that,