Faculty of engineering

Department of Textile Engineering

Thesis Report on

Effect of bio-polishing on cotton knitted fabric

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Submitted by:

Md. Abul Farah

Id: 151-23-4149

Muhtasim Fuad

Id: 141-23-137

Supervised by:

Mr. Tanvir Ahmed Chowdhury

Assistant Professor

Department of Textile Engineering

Daffodil International University

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

Advance in Textile Wet Processing

4 Years courses

Declaration

We hereby announce that this project has been done by us under the observation of Mr. Tanvir Ahmed Chowdhury, Assistant Professor, Department of Textile Engineering, Daffodil International University. We also announce that neither this project nor any part of this project has been submitted elsewhere for the award of any degree.

Md. Abul Farah

ID: 151-23-4149

Department of Textile Engineering

Daffodil International University

Muhtasim Fuad

ID: 141-23-137

Department of Textile Engineering

Daffodil International University

Letter of Approval

This project report is prepared by Md. Abul Farah (ID: 151-23-4149) and Muhtasim Fuad (ID: 141-23-137), is accepted and Fulfill 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 passionate.

Mr. Tanvir Ahmed Chowdhury

Assistant Professor

Department of Textile Engineering

Daffodil International University

Acknowledgment

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We also thanks to our friends of the daffodil international university, who helps us in the discussion during our work.

Abstract

Bio-polishing is the most common and popular process applied to fabrics during wet processing to reduce hairiness and make the fabric surface smoother. As bio-polishing removing hairiness of fabrics the forming of pilling tendency is reduced but fabrics losses some strength and weight. We select this topic as our project because this process has great importance in the textile sectors. In the bio-polishing process, we use cellulase enzyme which is biodegradable, non-toxic. In this project, we use six types of cotton knitted fabric like –single jersey, rib, interlock, pique etc. Bio-polishing process is environmental friendly and economical.

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Chapter: 1

Introduction

1.1 Background of the Study: Bio-polishing means enzyme washing of cellulosic fabric to remove hairiness or fuzziness of the fabrics. Bio-polishing has become one of the most commonly wet-processing in textile industries. Bio-polishing is environment-friendly and biodegradable. After bio-polishing fabric surface is smoother, more lustrous, less hairiness and handle properties are improved. Due to bio-polishing hairiness of yarn in the fabric are removed so rubbing fastness is very good because the tendency of pilling formation is less. Bio-polishing effect on cellulose like cotton fabric is a permanent effect which is done by the application of enzyme. After bio-polishing the quality of the fabric is improved. Bio-polishing may be done before or after the dyeing process, mainly done before dying.

During bio-polishing, if the concentration of enzyme is higher then the process cost will be higher. Again if did not maintain temperature and time properly and continue more time then fiber loss will be higher and the strength of fabric will be lower.

1.2 Objectives: This thesis report is about the bio-polishing effect on 100%cotton knitted fabric.

i. To know about bio-polishing process and effect of cotton knitted fabric
ii. To know about changes of GSM, CPI, WPI and stitch length of fabric
iii. To compare changes percentages %.

Chapter: 2

Literature Review

2.1 What is Bio-polishing: Bio-polishing is a permanent finishing procedure in textile wet-processing with the application of enzyme to develop fabric quality by reducing the pilling tendency and fuzziness of (cellulose) cotton fabric. This is the permanent effect on cotton fabric.

2.2 Advantages of Bio-polishing:

i. To develop fabric handle properties
ii. To make the fabric surface smoother and flexible
iii. To reduce hairiness, fuzziness and pilling tendency
iv. To increase the fabric quality

2.3 Disadvantages of Bio-polishing:

i. Decrease strength of the fabric
ii. Loss in weight

2.4 What is Enzyme: The term enzyme comes from the Greek word "Enzymos "means from or in the cell. Eduard Buchner named the enzyme that brought about the fermentation of sucrose "zymase".The enzyme is naturally available, capable of catalyzing action, high molecular weight and most of them are proteins made up to more than 250 amino acid groups. An enzyme activity reduced outside its optimum temperature and pH. So we can say that the enzyme is a substance that acts as a catalyst in the living organism. In recent year's application of enzyme in textile industries are increased rapidly but first application of enzyme on fabric in Japan in 1989.

2.5 Advantages of enzyme:

i. The enzyme is toxic free and biodegradable
ii. Improved fabric quality
iii. Reduce water, chemical, and energy expenses
iv. It is easy to control the enzyme

2.6 Disadvantages of enzyme:

i. Workers may be affected by allergies
ii. Enzymes can be harmed if the small increase of temperature
iii. It decreases fabric strength and sometimes destroys the fabric

2.7 List of Enzymes used in textile industries are:

Serial No.	Name of enzymes	Uses and effects in textile
1.	Cellulases	Bio-polishing, Anti finishing, Smoothness, Stonewash on Denim
2.	Proteases	Better remove protein contain oil or stain, mainly used in household washing
3.	catalases	It decomposes H2O2, known as per-oxide killer
4.	Amylases	De-sizing of starch from warp yarn
5.	Pectinases	Hydrolysis of pectin's, for examples, decomposes of flax and hemp
6.	Lipases	Hydrolysis of oils and fats in detergent
7.	Peroxidases	Used as an enzymatic rinse process after reactive dyeing, give better-wet fastness and decolorized wastewater, known as per-oxide killer
8.	Collagenases	Remove wools skin parts
9.	Nitrilases	Provide better coloration
10.	Ligninases	Separate other plant parts from wool

Table: 01

2.8 Mechanism of Enzyme:

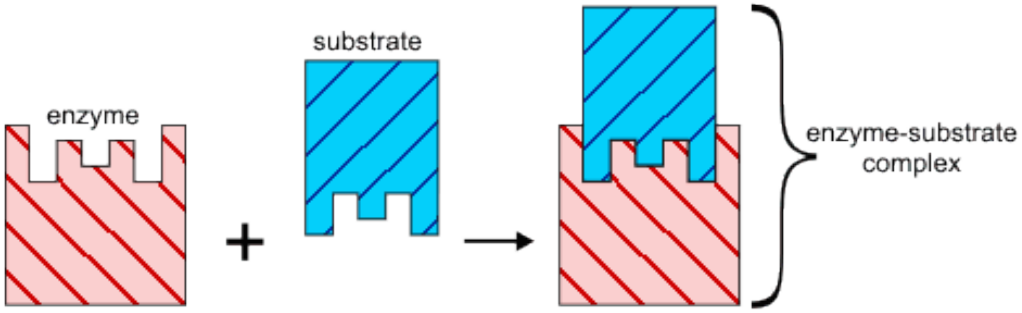

Figure 1: Enzyme Mechanism

The enzyme has an active site, in where substrate molecules are joining. During the reaction, the enzyme molecule changes its shape so that the substrate molecule can get closer to the enzyme molecule. The molecule that the enzyme works on is called substrate. Then an enzyme-substrate compound has been made. After complete reaction products leave the active side of the enzyme and the enzyme are regenerated.

2.9 Factors affecting enzyme activity:

1. **Temperature:** The optimum temperature of the enzyme is between 37˚-45˚c.In this region, enzyme activity is more but after 55˚c activity gradually lowers and at high temperature (80˚c) enzymes are dyed.

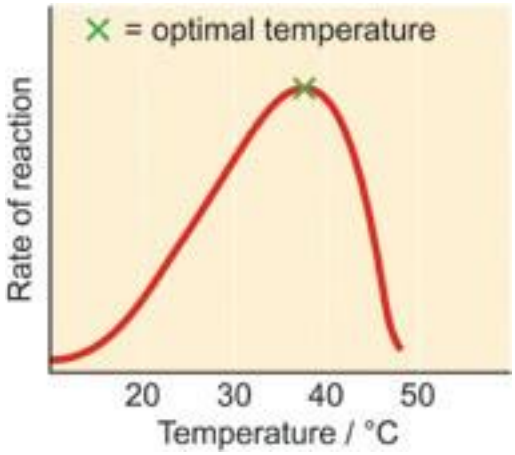

Figure 2: Effect of temperature

2. **pH:** Enzyme has optimum pH value, If pH value is less or more than optimum then enzyme activity will be reduced. For example, pepsin works at acidic condition but trypsin works at alkali condition.

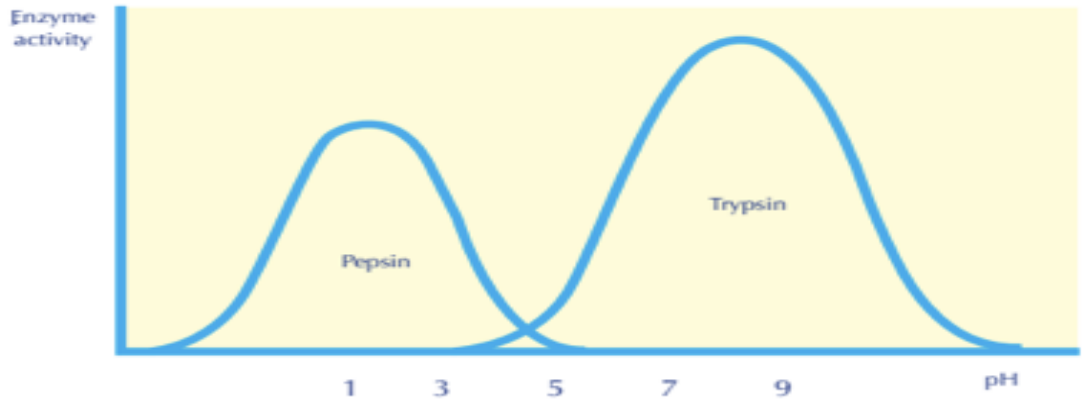

Figure 3: Effect of pH

3. **Enzyme Concentration:** If the concentration of enzyme increased the speed of reaction gradually increased.

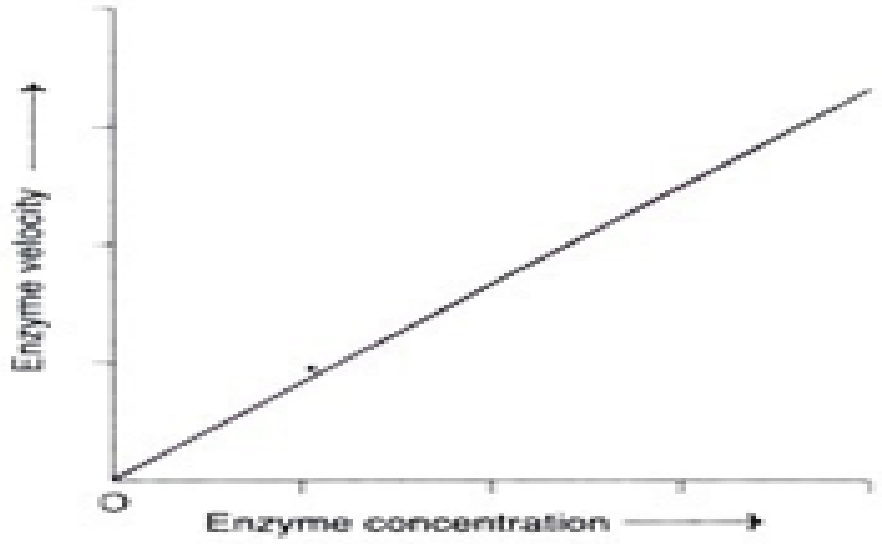

Figure 4: Effect of enzyme concentration

4. **Substrate concentration:** The reaction rate will be increased up to a certain limit of substrate concentration.

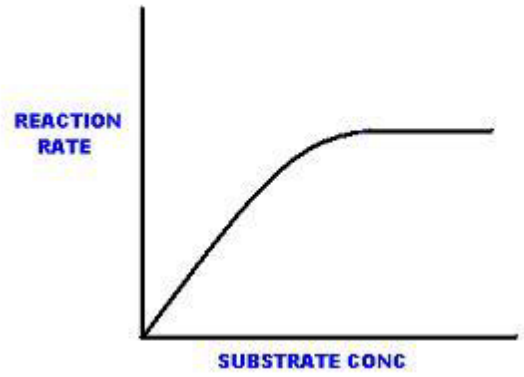

Figure 5: Effect of substrate concentration

2.10 Advantages of the enzyme using in bio-polishing:

i. Remove hairy, pills from fabric surface
ii. Make the fabric flexible and smooth
iii. Develop handle property of the fabric
iv. Developing the fabric quality

2.11 Disadvantages of the enzyme using in bio-polishing:

i. Weight loss
ii. Strength loss

Chapter: 3

Experimental Details

3.1 Process of bio-polishing:

We have done our thesis at" AKH Knitting and Dyeing Ltd" according to the recipe of bio-polishing followed in the industries.

3.2 Recipe of bio-polishing:

i. Enzyme = 1% (stock solution-1%)
ii. Acetic Acid = 0.8 g/l (stock solution-1%)
iii. Temperature = 45˚c-55˚c (for 15 minute)
iv. Temperature = 80˚c (for 5 minute)
v. pH = 4.5-5.5
vi. M:L = 1:30

3.3 Process description:

i. At first, we collected a scoured cotton knitted fabric
ii. Then we set the dye bath and make the solution according to the recipe
iii. Then we check the pH and put the sample on the dye bath
iv. Then we raise the temperature and maintain 45˚c-55˚c for 15 minute
v. After 15 minutes we raise the temperature up to 80˚c and maintain for 5 minute
vi. Then bath drained and Hot wash off the fabric
vii. Finally, we get bio-polished cotton knitted fabric.

3.4 Enzyme Deactivated: For deactive enzyme, we raise temperature 80˚c and continue for 5minute or increase pH value above 8 and maintain for 5 minutes.

3.5 Experimental Data: For our thesis experimentation we have collected 6 sample of cotton knitted fabric. We measure GSM, Stitch Length, CPI and WPI of the samples before and after bio-polishing and calculate the change percentage. The samples are –

Before Bio-polishing

Fabric Name	GSM	Stitch Length	CPI	WPI
S/ J Combed yarn	173.5	2.78	54	40
S/J Neps	196.4	2.58	54	34
S/J Carded yarn	170.3	2.54	54	39
1×1 Rib	292.5	2.74	33	54
Interlock	216	1.55	54	52
Pique	196.5	2.18	24	27

Table-02

3.6 Formula Used for Determine Change Percentage:

$$\text{Change Percentage} = \frac{\text{Measurement before bio-polishing} - \text{Measurement after bio-polishing}}{\text{Measurement before bio-polishing}} \times 100$$

CHAPTER 4

DATA ANALYSIS & FINDINGS

4.1 Data Analysis:

Sample -01 (Single Jersey Combed Yarns)

Test names	Before Bio-Polishing	After Bio-Polishing	Change Percentage%
GSM	173.5	173	0.3%
WPI (Wales per Inch)	40	37	7.5%
CPI (Course per Inch)	54	51	5.55%
Stitch Length	2.78	2.68	3.6%

Table: 03

For Sample-01,

GSM before bio-polishing is 173.5, after bio-polishing is 173 and change is 0.3%

WPI before bio-polishing is 40, after bio-polishing is 37 and change is 7.5%

CPI before bio-polishing is 54, after bio-polishing is 51 and change is 5.55%

Stitch length before bio-polishing is 2.78, after bio-polishing is 2.68 and change is 3.6%

Sample -02 (Neps)

Test names	Before Bio-Polishing	After Bio-Polishing	Change Percentage%
GSM	196.4	191.8	2.34%
WPI (Wales per Inch)	34	36	5.88%
CPI (Course per Inch)	54	51	5.55%
Stitch Length	2.58	2.86	10.85%

Table: 04

For Sample-02,

GSM before bio-polishing is 196.4, after bio-polishing is 191.8 and change is 2.34%

WPI before bio-polishing is 34, after bio-polishing is 36 and change is 5.88%

CPI before bio-polishing is 54, after bio-polishing is 51 and change is 5.55%

Stitch length before bio-polishing is 2.58, after bio-polishing is 2.86 and change is 10.85

Sample -03 (Single Jersey Carded Yarns)

Test names	Before Bio-Polishing	After Bio-Polishing	Change Percentage%
GSM	170.3	166.8	2.05%
WPI (Wales per Inch)	39	38	2.56%
CPI (Course per Inch)	54	51	5.55%
Stitch Length	2.54	2.60	2.36%

Table: 05

For Sample-03,

GSM before bio-polishing is 170.3, after bio-polishing is 166.8 and change is 2.05%

WPI before bio-polishing is 39, after bio-polishing is 38 and change is 2.56%

CPI before bio-polishing is 54, after bio-polishing is 51 and change is 5.55%

Stitch length before bio-polishing is 2.54, after bio-polishing is 2.60 and change is 2.36%

Sample -04 (1×1 Rib)

Test names	Before Bio-Polishing	After Bio-Polishing	Change Percentage%
GSM	292.5	291.9	0.205%
WPI (Wales per Inch)	54	56	3.7%
CPI (Course per Inch)	33	31	6.06%
Stitch Length	2.74	2.55	6.93%

Table: 06

For Sample-04,

GSM before bio-polishing is 292.5, after bio-polishing is 291.9 and change is 0.205%

WPI before bio-polishing is 54, after bio-polishing is 56 and change is 3.7%

CPI before bio-polishing is 33, after bio-polishing is 31 and change is 6.06%

Stitch length before bio-polishing is 2.74, after bio-polishing is 2.55 and change is 6.93%

Sample -05 (Interlock)

Test names	Before Bio-Polishing	After Bio-Polishing	Change Percentage%
GSM	216	215.2	0.370%
WPI (Wales per Inch)	52	52	0.00%
CPI (Course per Inch)	54	51	5.55%
Stitch Length	1.55	1.44	7.09%

Table: 07

For Sample-05,

GSM before bio-polishing is 216, after bio-polishing is 215.2 and change is 0.370%

WPI before bio-polishing is 52, after bio-polishing is 52 and change is 0.00%

CPI before bio-polishing is 54, after bio-polishing is 51 and change is 5.55%

Stitch length before bio-polishing is 1.55, after bio-polishing is 1.44 and change is 7.09%

Sample -06 (Pique)

Test names	Before Bio-Polishing	After Bio-Polishing	Change Percentage%
GSM	196.5	191	2.80%
WPI (Wales per Inch)	27	27	0.00%
CPI (Course per Inch)	24	25	4.2%
Stitch Length	2.18	2.40	10.09%

Table: 08

For Sample-06,

GSM before bio-polishing is 196.5, after bio-polishing is 191 and change is 2.80%

WPI before bio-polishing is 27, after bio-polishing is 27 and change is 0.00%

CPI before bio-polishing is 24, after bio-polishing is 25 and change is 4.2%

Stitch length before bio-polishing is 2.18, after bio-polishing is 2.40 and change is 10.09%

4.2 Findings:

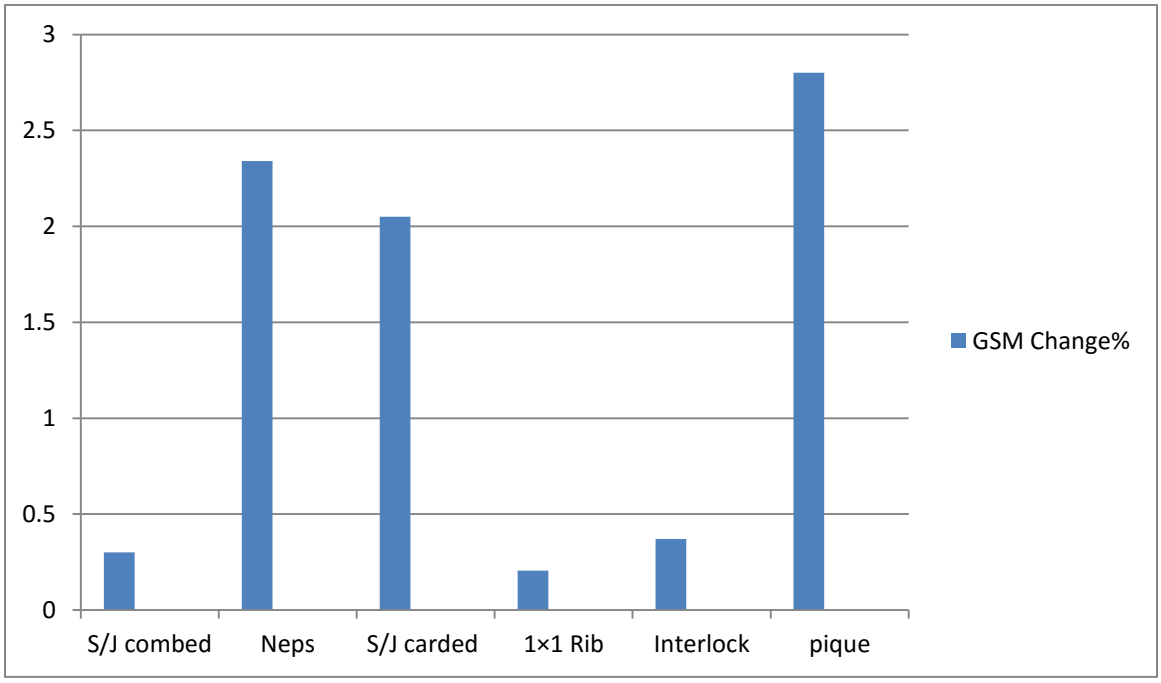

Chart 1: GSM Change percentage

Chart 1 indicates changes % of GSM after bio-polishing. Here we see that more changes of GSM is in pique fabric and fewer changes are in rib fabric. The values are S/J combed 0.3%, Neps 2.34%, S/J carded 2.05%, rib 0.205%, interlock 0.370% and pique 2.80%.

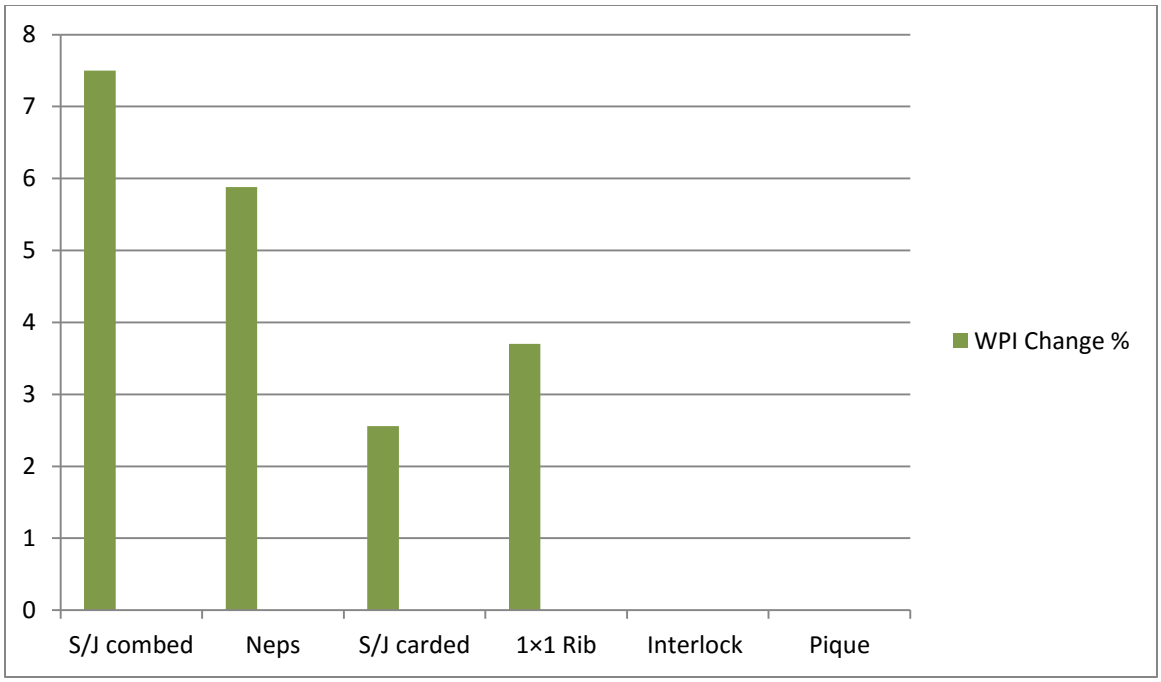

Chart 2: WPI Change Percentage

Chart 2 indicates changes % of WPI after bio-polishing. Here we see that more changes of GSM is in S/J combed fabric and No changes are in both interlock and pique fabric. The values are S/J combed 7.5%, Neps 5.88%, S/J carded 2.56%, rib 3.70%, interlock 0.00% and pique 0.00%.

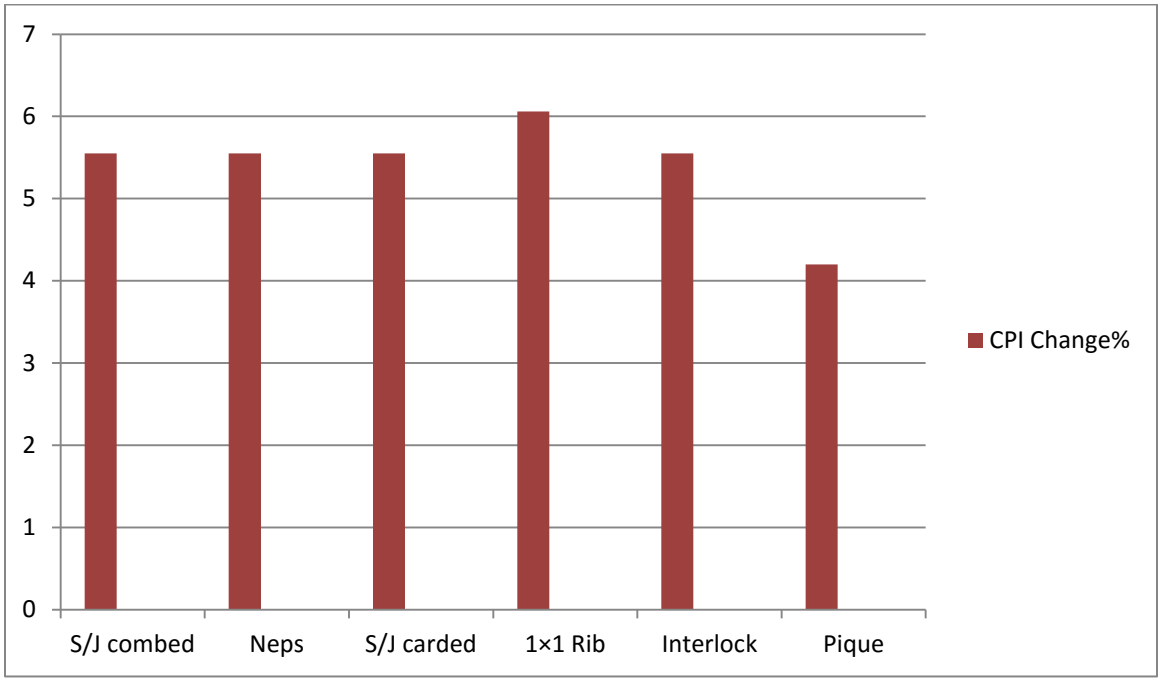

Chart 3: CPI Change Percentage

Chart 3 indicates changes % of CPI after bio-polishing. Here we see that more changes of GSM is in Rib fabric and fewer changes are in pique fabric. The values are single jersey(combed) 5.55%, Neps 5.55%, single jersey 5.55%, rib 6.06%, interlock 5.55% and pique 4.2%.

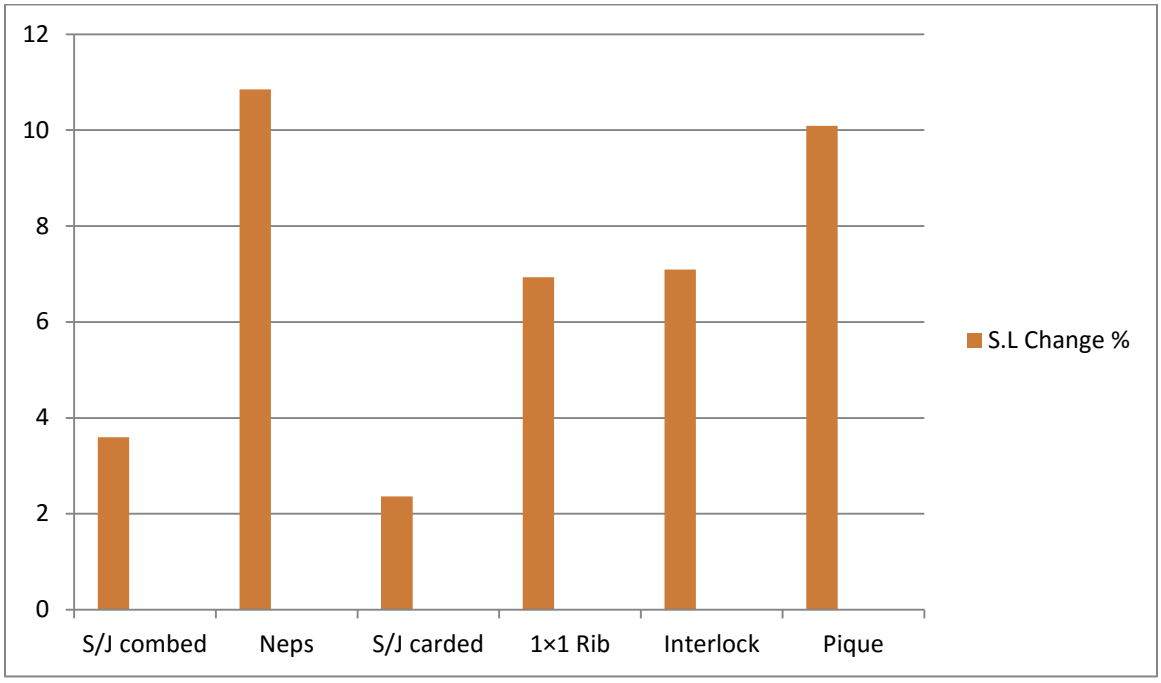

Chart 4: Stitch Length Change Percentage

Chart 4 indicates changes % of Stitch Length after bio-polishing. Here we see that more changes of GSM is in Neps fabric and fewer changes are in single jersey (carded) fabric. The values are single jersey(combed) 3.6%, Neps 10.85%, single jersey(carded) 2.36%, rib 6.93%, interlock 7.09% and pique 10.09%.

Chapter: 5

Conclusion

Conclusion: Bio-polishing is a long-lasting and broadly used effect on cellulosic textiles by using an enzyme. Nowadays bio-polishing is must be done during the dying process in all dying industries. After bio-polishing fabrics surface is smoother, less hairiness and develop the handle properties of the fabrics. But there is a limitation of bio-polishing is fabrics loss their some strength.

By doing this thesis we achieved basic knowledge about CPI, WPI, Stitch Length, and GSM and their changes due to bio-polishing. During our work, we have learned practically how to measure CPI, WPI, Stitch Length, and GSM.

After this thesis, our thoughts about bio-polishing process or treatment have become more clear and specific. I think this knowledge will be more helpful for ours and this report will be useful for others about bio-polishing.

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