



**In the name of ALLAH, The COMPASSIONATE,
The MERCIFUL**

Different Washes Affecting the Shrinkage of Knitted Garments



By

Ezza Nasir

(I.D: 111789002)

Thesis submitted in partial fulfillment of requirements for the degree of

**Master of Science
In
Textile**

Institute of Textile and Industrial Sciences
University of Management and Technology
Lahore
2013

Acknowledgement

If oceans turn into ink and all the wood become pens, even then, the praises of **ALMIGHTY ALLAH** cannot be expressed. I set my unfeigned and meek thanks before HIM, Who created the universe and bestowed the mankind with knowledge and wisdom to search for its secret, favoured and invigorated me with the fortitude and capability to aptly complete my research work.

Trembling lips and wet eyes praise for Prophet **HAZRAT MUHAMMAD** (peace be upon him), who is for ever a torch of guidance for the entire humanity.

I deem it may utmost pleasure to avail myself this opportunity in recording my deep feelings of regards and sense of gratitude to Dr. Nabeel Amin Director, Institute of Textiles and Industrial Sciences (STD), who inspite of his busiest tiring routine work provided his guidance and valuable suggestions throughout these research efforts.

Thanks are extended to **Mr. Babar Ramzan**, for this sincere cooperation, co-supervision and invigorating encouragement. He also made check and balance in this whole study for data collection and data interpretation.

I do not have words at my command to express my heartiest thanks, gratitude and profound admiration to my affectionate and caring **father (Abdul Nasir)** and other **family members** for their encouragement, patience, spiritual and intellectual inspiration.

My gratitude will remain incomplete if I do not mention the contribution of my most sincere friends namely **Aqsa Imran, Naveed Akhtar, Tabinda Riaz, Musadiq Azeem** and **Qurbat Zahra** who selflessly assisted me in the data collection process and gave suggestions.

Dedication

This humble effort

The fruit of studies and thoughts

Only and only dedicated to my

Mother

Which I strongly believe that

Her prayers are with me and will always,

TABLE OF CONTENTS

ACKNOWLEDGEMENT	III
LIST OF FIGURES:	VII
LIST OF TABLES.....	VIII
ABSTRACT	IX
CHAPTER NO 1: INTRODUCTION.....	1
CHAPTER NO 2: LITERATURE REVIEW.....	6
2.1 IMPORTANCE OF DIMENSIONAL CHANGE.....	6
2.2 DIMENSIONAL CHANGES IN GARMENTS	7
2.3 QUALITY ISSUES IN GARMENT MANUFACTURING.....	8
2.3.1. <i>Fabric Stage Problem</i>	9
2.3.2. <i>Spreading and Cutting Stage Problem</i>	9
2.3.3. <i>Factors Affecting Fabric Shrinkage</i>	10
2.3.4. <i>Fabric material</i>	10
2.3.5. <i>The Structure of Fabric</i>	13
2.3.6. <i>Production Process of Fabric</i>	14
2.4 SHRINKAGE IN KNITTED FABRICS	15
2.5 SHRINKAGE AND ITS CAUSES	16
2.5.1. <i>Construction Shrinkage</i>	18
2.5.2 <i>Elastic Shrinkage</i>	20
2.5.3. <i>Drying Shrinkage</i>	21
2.5.4. <i>Garment finishing</i>	23
2.6 SHRINKAGE BEHAVIOR OF DIFFERENT KNITTED FABRICS	23
2.6.1. <i>Fleece</i>	23
2.6.2. <i>Rib</i>	24
2.6.3. <i>Single jersey</i>	25
2.6.4. <i>Pique</i>	28
2.7. SUGGESTIONS TO DECREASE SHRINKAGE	29
2.9. GARMENT WASHES AND FINISHES	30
CHAPTER 3: MATERIALS AND METHODS	43
3.1. PROPERTIES OF KNITTED FABRIC.....	44
3.1.1. <i>Single jersey</i> :.....	44
3.1.2 <i>Pique</i>	44
3.1.3. <i>Three thread Fleece</i>	45
3.1.4. <i>Rib</i>	45
3.2 GARMENT WASHES RECIPE	45
3.2.1. <i>Silk wash Recipe</i>	46

3.2.2. <i>Simple garment Wash Recipe</i>	47
3.3.3. <i>Soda Stone Wash Recipe</i>	48
3.3.4. <i>Garment dye Recipe</i>	50
3.3 GARMENT WASHING MACHINE.....	67
3.4 STANDARD TEST USED:.....	69
3.4.1. <i>Dimensional Changes in Commercial Laundering of Woven and Knitted Fabrics Except Wool AATCC Test Method 96-2004 [54]</i>	70
3.4.2. <i>AATCC Test Method 179-2004 Skewness Change in Fabric and Garment Twist Resulting from Automatic Home Laundering [55]</i>	74
3.4.3. <i>ATCC Test Method 88C-2003:Retention of Creases in Fabrics after Repeated Home Laundering [56]</i>	77
3.5 ATMOSPHERIC CONDITIONS.....	79
3.6 STATISTICAL ANALYSIS.....	79
CHAPTER NO 4: RESULTS AND DISCUSSIONS	80
4.1. SHRINKAGE (LENGTH).....	83
4.2. SHRINKAGE (WIDTH).....	87
4.4. SKEWNESS	91
4.3. COMPARISON OF SHRINKAGE IN LENGTH, WIDTH AND SKEW.....	95
4.4. APPEARANCE.....	97
CHAPTER 5: SUMMARY	99
CONCLUSIONS.....	101

List of Figures:

Figure 1: Relaxed loop and Elongated loop.....	22
Figure 2: Stone washed sweat shirt.....	35
Figure 3: Pumice stone used for stone wash.....	35
Figure 4: Pumice stones in washing machine.....	36
Figure 5: Tonelle Washing Machine.....	67
Figure 6: Stone Dispenser.....	68
Figure 7: Mini Destoner.....	68
Figure 8: Automatic garment dyeing machine.....	69
Figure 9: Acrylic plate for marking before wash.....	73
Figure 10: Acrylic plate for marking and fabric with marks stenciled by the plate.....	74
Figure 11: Bench mark placement (woven and warp knit fabrics at least 60 cm wide).....	74
Figure 12: Marking on garment (test specimen for skewness).....	76
Figure 13: Diagonal lines for measurements.....	76
Figure 15: Lighting and viewing arrangement for crease retention.....	78
Figure 15:AATCC crease retention replicas.....	79
Figure 17: Interaction Plot for %age shrinkage in length.....	85
Figure 18: Main Effects Plot for %age shrinkage in length.....	86
Figure 19: Main Effect Plot %age shrinkage in length with respect to fabric.....	87
Figure 20: Interaction Plot for %age shrinkage in width.....	89
Figure 21: Main Effects Plot for %age shrinkage in width with respect to Washes.....	90
Figure 22:Main Effects Plot for %age shrinkage in width with respect to fabric.....	91
Figure 23: Interaction Plot for Skewness.....	93
Figure 24: Main Effects Plot for Skewness with respect to Washes.....	94
Figure 25: Main Effects Plot for Skewness with respect to Fabric.....	94
Figure 26: Dimensional change after Washes.....	96
Figure 27: Retention of Creases in Fabrics after Washes.....	97

List of Tables

Table 1: Variables to evaluate the whole study	43
Table 2: Specification of Single Jersey Fabric	44
Table 3: Specification of Pique Fabric.....	44
Table 4: Specification of Flecce Fabric	45
Table 5: Specification of Rib Fabric	45
Table 6: Wash Type: Silk Wash	46
Table 7: Wash Type, Simple garment Wash	47
Table 8: Wash Type, Soda Stone Wash.....	49
Table 9: Wash Type, Garment dye	52
Table 10: Design of experiment.....	80
Table 11: Experimentation Data	82
Table 12: Analysis of Variance for %age shrinkage in length, using Adjusted SS for Tests.....	83
Table 13: Unusual Observations for %age shrinkage in length.....	84
Table 14: Analysis of Variance for %age shrinkage in width, using Adjusted SS for Tests.....	87
Table 15:Unusual Observations for %age shrinkage in width.....	88
Table 16: Analysis of Variance for Skewness, using Adjusted SS for Tests	91
Table 17:Unusual Observations for Skewness	92
Table 18: Least Squares Means	95
Table 19: Appearance of fabric after wash	97

ABSTRACT

Different washes on different knitted fabric will provide different shrinkage trends. The expectation on shrinkage for various apparel products will also be different. However, the effect of shrinkage in garment is still ambiguous. As a result, analysis of shrinkage after different washes can provide a more realistic study.

The purpose of this study was to analyze the shrinkage with commercial sewing threads in woven fabric.

This study focused on following major objectives:

- To study the effect of different washes on garment measurements;
- To study the effect of washes on fabric shrinkage and its appearance.

In this study, four different types of knitted fabric were sewn with same length and width measurements. To study the effect of different washes on shrinkage of garment. In this study, through subjective ranking, there were critical dimensions for measurements done on body length and width garment appearance and shrinkage.

Chapter no 1: Introduction

Textiles of subcontinent are one of ancient industry and have been showing a distinctive, and one of the richest part through out the history of world. Cotton and Silk were main fabrics produced, though silk industry flourished with encouragement given by different rulers in their reigns but cotton cultivators, weavers, dyers, printers and embroiders give a bold expression. Indus Valley is cultivating cotton since 1500BC.

After partition in 1947, Pakistan inherited only one textile mill and have to overcome many obstacles from to survive its textile industry. Pakistan is an agriculture country with best irrigation systems of the world and 97% of its population is related to the agriculture directly or indirectly.

Textile Industry of Pakistan is mainly dependent on the cotton industry, this is due to is fertile soil on the banks of Indus and long hot dry weather. Textile Sector is the backbone of Pakistan's economy. Pakistan Textile mainly consists of Cotton Yarn, Cotton Cloth, Knit wear, Bed wear, Towels, Tents, Canvas and Tarpaulin, Readymade Garments, Synthetic Textiles and Made up

Articles. Today textile sector of Pakistan shares only 700\$ billion export in total trade of \$91 trillion and is 8th largest exporter of textile products in Asia.

Pakistan Readymade Garments Manufacturers and Exporters Association (Prgmea), is playing a vital role in supporting garment industry of Pakistan. The knitwear industry in Pakistan has grown farly rapidly after the independence. Since the industry's development and growth has closely followed the footsteps of the textile industry. Starting with 2 or 3 units in 1950 today 670 finishing units both for the knit and woven fabrics There are approximately 4,000 garment units, with a diverse range of stitching capability including leather, knit and woven garments and made-ups with 160,000 industrial and 450,000 domestic sewing machines. Most of these garment manufacturers are small units having less than 30 stitching machines. There are 400 units with 30 – 50 machines and 600 units with 50 – 300 machines.

As the value is added in the raw material its manufacturing cost increases and selling cost becomes more profitable then selling one pound of raw cotton. The made ups and garments are used by the end-user customer so they have maximum value addition. Garments Manufacturers and Exporters Association (Prgmea), is playing a vital role in supporting garment industry of Pakistan. Pakistan textile industry is losing its competitiveness in international market. The ills faced by the sector and its contribution towards economic development. Knitwear exports suffered double jeopardy of gas and electricity rate hikes as well as supply shortage during recent years. As a result affect productivity cut and increases in cost of production rendering Pakistani knitwear uncompetitive in international markets. Pakistan Readymade Knitting industry is growing at a rate of 15 to 17 percent annually. The knitting sector has become a large consumer of domestic cotton yarns. The knitting sector, comprises of circular and flat knitted machines. Despite current economic conditions, the industry is expected to continue to grow at a stable rate

either through the expansion of existing units and /or through the establishment of new small and medium scale specialized knitting units.

Product specifications of textile and apparel products have always had a profound effect on the thinking and planning of managers in all areas of textile and apparel production.

China, India, Sri Lanka, Vietnam, Bangladesh, Korea, Bangladesh, Jordan and Kenya are among major competitors in the industry. Small units face more challenges, as they get no facilities with regards to electricity services and financing. On the other hand 14% high mark-up rate and 20% inflation is making textile business prohibitive, and the country's goods would be rendered uncompetitive in international markets.

Garment sector have to face many challenges for the survival in the increased competition from other countries like China, India, Bangladesh, Sri Lanka and other countries that have preferential trade arrangements with major importing countries. Beside this garment industry have to face the frequent shifting trends of fashion industry, to market product internationally with quality certifications. Anti dumping policies imposed by major importers. Non tariff barriers may increase such as standards relating to child labor, human rights, and working conditions, use of carcinogenic chemicals, inflammable materials, etc. Increasing energy cost and hours of load shedding and high capital costs for modernization and expansion.

Garments Sector is divided in to some sub-sectors:

- Men's Wear (Woven & Knit),
- Women's Wear (Woven & Knit)
- Babies wear
- Sports wear

- T-Shirts & Pullovers
- Hosiery.

Washing and finishing in Garment Industry is very important and essential process. This is basically done for enhancing the end product. Finishing is a process of adding extra effect to products. Washing process is for making our product smooth and feels good. Customers use to buy only smooth and soft products when they purchase. So, washing process is one of the most important process in Garment making. Every year is bringing many new finishes in industry.

These are the some of the washing available for knitted garments. Each washing has different look. CPL (Cut panel laundry) is done for arresting shrinkage of our knitted fabrics. Acid, Bio, enzyme and Silicone washing is used to give soft silky feel to garment and removing unevenness on fabric surface. Stone wash gives the faded effect to garment. Another wash is done to increase the GSM of the fabric to increase. Vintage wash will create old garments. Garment wash is the basic type of washing which helps us just an washed effect.

Beside these washes and finishes garments are also dyed after whole garment is manufactured.

These finishing / washing/ dying involve chemicals which have some side effects on the garment construction. Fabric, seams, attachments can be damaged by these chemical destroying the durability and efficiency of the garment.

This study is conducted to study after affects of the washes of garment, and how they become a factor of increasing or decreasing efficiency of the garment.

In today's competitive markets where quality is expected at a low price, apparel companies are demanding low shrinkage from their suppliers to meet the needs of the consumer. In addition to

low values, the shrinkage from garment to garment for the same style must be consistent. Traditionally, apparel manufacturers have set rigid specifications for their suppliers that in many cases allow little room for error in processing. In fact, some shrinkage specifications for apparel products may not be attainable at all by the suppliers of that product.

In addition, many testing methods have been devised to measure shrinkage. Acceptance, rejection, and discount penalties are dependant on this gathered data. Further, in depth analysis of this data can allow for a better understanding of the causes of inconsistent or high shrinkage.

A better understanding can then impact production techniques to make the shrinkage phenomena manageable. Indeed, more realistic specifications for a finished product can then be set for a fabric or garment based on the knowledge learned. This knowledge can also impact other product specifications such as weight and width as well as the determination of garment pattern layouts. Even with this knowledge, it is often overlooked as to how these specifications can limit a mill's ability to manufacture goods that yield good shrinkage characteristics on a consistent basis. Therefore, in order to be successful in controlling shrinkage, there must be an understanding by all parties involved in bringing a product to market as to what makes a fabric or garment shrink.

Background of the study

In apparel industry apparel products are seams are the most important thing which converts the two-dimensional fabric into three-dimensional wearable garment.

There are some other methods of apparel manufacturing but seams is the most used method for the assembling the fabric into the apparel. [1]