



**Daffodil**  
*International*  
**University**

Faculty of Engineering

Department of Textile Engineering

Thesis Report On

“Study on spirality and Shrinkage of knitted fabric”

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Submitted By

<b>Name</b>	<b>ID</b>
Md.Atikur Rahman	153-23-197
Nadim Ahmed	153-23-200

Kazi Rezwan Hossain

Lecturer

Dept. of Textile Engineering

This Report Submitted in partial fulfillment of the requirements for the degree of Bachelor of Science in Textile Engineering.

Advance in Apparel Manufacturing Technology.

Duration: **August 2019**

## Declaration

We authenticate that this report is absolutely our own work, aside from where we have given completely archived references to crafted by others and that the materials contained in this report have not recently been submitted for appraisal in any formal course of study. On the off chance that we do anything, which is going to break the primary statement, the inspector/director has the privilege to drop my report anytime of time.

.....

Name: Md.Atikur Rahman

ID: 153-23-197

.....

Name: Nadim Ahmed

ID: 153-23-200

# Letter of Approval

27 May 2019

To

The Head

Department of Textile Engineering

Dattapara, Ashulia, Savar, Dhaka .

Subject: Approval of thesis report B. Sc in TE Program.

Dear Sir,

I am just writing to let you know that this thesis topics “Study on spirality and Shrinkage of knitted fabric” has been prepared by the student bearing ID: 153-23-197 and ID: 153-23-200 is completed for final evaluation. The whole report is prepared based on the proper investigation and information in Mawna Fashion The student were directly involved in their industrial attachment report activities.

Therefore, it will highly be appreciated if you kindly accept this industrial attachment report and consider it for final evaluation

Yours Sincerely

.....

Kazi Rezwan Hossain

Lectuer

Department of Textile Engineering

Daffodil International University.

## Acknowledgement

At the beginning, we would like to thank the Almighty **ALLAH** for giving us the ability to complete this report. Then we would like to take the opportunity to express our gratitude to our honorable supervisor **Kazi Rezwan Hossain, Lecturer, Department of Textile, Daffodil International University** for providing us with guidelines and suggestions to complete this Project. His thoughtful advice assistance logical direction & efforts have made it possible to implement the project faithfully.

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## Dedication

**Dedicated to the garments worker, who works morning to night, contribute running the wheel of country economy by hard work. Thank you so much, go forward, we are with you.**

## **Abstract**

The most common problems for knitted fabric are shrinkage and spirality due to their loop formation. In circular knitted fabrics spirality has an influence on the aesthetic and functional performance. The process in which a fabric becomes smaller than its original size due to washing and dyeing is known as shrinkage. This study determined the causes and remedies of shrinkage and spirality. And the main difference between tumble and line drying. The more responsible for shrinkage was the tumble drying contrary to line drying. The best result in shrinkage and spirality was shown by the full feeder lycra single jersey but on the other hand the worst result was shown by the double pique due to more tuck loop in its structure. So the line drying was the best for using the garments with assured quality and dimensional stability. Shrinkage is 6%. Ordinarily shrinkage is worthy under 5%. In any case, it tends to be change if there should arise an occurrence of purchaser necessity.

For measuring the shrinkage and spirality firstly we did the ISO-6330 washing after that used ISO-5077 for shrinkage and then ISO-16322-2 for spirality. And these are the international standard of these measuring system.

From our project work we can conclude that, in case of higher count, combed yarn, lower GSM, 100% cotton yarn used, single jersey structure cause the higher spirality in the weft knitted fabrics.

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# **CHAPTER – I**

## **INTRODUCTION**

## **1.1 Background of the study:**

The readymade garment is completely incomplete without Fabric. Because it is the main part to have cloth or clothing ourselves. But sometimes there are different difficulties to make finished garment to the desired & necessary out fit and the end result is fabric defects. It is causes because of the yarn swelling and the resulting crimp. Due to these obscurities fault occurred and effects quality, productivity, price and also efficiency. So Quality standards are part of a company standard operating procedure, product development and manufacturing planning. Standards reflect the standard intrinsic excellent level the company seeks to achieve. The vital cause of using quality standard is to supply consistency between products and products line. Because of maintaining standard or quality of product it is mandatory to notice the fault and find out the satisfactory solution to reduce the error.

Rapid detection of fabric shrinkage & spirality defect is significant to optimization of the relationship between good quality and productivity. Defects discovered after washing, relaxing the lot fabric, Felting, Compressive , Residually negatively effect on costs & budget of the product also the quality issue occurs . There is different plus to identifying an imperfection before different operations avoid spirality and shrinkage. This commentary is primarily based upon the contemporary knit fabric spirality & shrinkage problem due to some aspects during manufacturing the readymade garments of the knit fabric .Then finally assessment process of defect was done and find out the satisfactory suggestion.

## **1.2 Objectives of the Study:**

This project paper defines frequently occurs the sewing defects and way to prevent breakage thread.

- To learn about proper quality management system.  To design new method of quality control.
- To learn about the defects of garments
- Applying technical solution for remove or reducing defect.
- To know the causes of thread defects and its remedies.
- To implement technical solution toward thread defects.

- To prepare a guideline which will assist the technical person in the relevant field.
- To show how technical knowledge's-how can increase production efficiency.

### **1.3 Important and Scope of the study:**

- To analyze the types of faults in Fabric inspection
- To play an ideal role in increase or decrease production capability
- To calculate per lot faults in a line easily.
- To minimize sewing fault during production.
- It provides knowledge why sewing fault increase or decrease.
- To avoid defects on garments and save time.

### **1.4 Limitations of the study:**

- Limitation of time to research this topic.
- Limitation of primary data sources ➤ Limitation of accurate data.
- Input and output problem.
- Respondent unwillingness.
- Changing the style and arrangement.

# **CHAPTER - II**

## **LITERATURE REVIEW**

## Introduction

### **2.1 Spirality:**

Spirality is a common problem in weft knitted fabric. It is the de-twisting tendency of yarn in the fabric. It appears in mostly in single jersey fabrics but in double jersey fabrics this level is about zero. The causes of formation of spirality in twistiness in the yarn and increase it by using more number of needles and multifeeders machine so on. It can reduce in different ways but not remove from the fabrics.

Weave wear industry is developing at a quicker rate over the globe and mechanical advancements contribute a great deal in the accomplishment of industry. Sewn cotton texture is viewed as perfect for next-to-skin wear. Sew wear textures are famous in view of their great properties of solace, delicate quality, sweat ingestion, strength and delicateness. The dimensional solidness is a significant issue with reference to quality. Nature of the texture is of prime worry in situation of new ties among purchasers and producers. Purchasers, presently days, are winding up progressively concerned and mindful of texture quality and acknowledge higher quality benchmarks than at any other time. Pakistan's sew wear industry is lingering behind the world weaving industry because of its less direction and command over quality mindfulness and execution of value principles. Different imperfections in sewed textures influence the quality however spirality is the most widely recognized shortcoming that influences the single shirt sew wear texture. Single pullover texture is for the most part utilized for T-Shirts, sports wears and under pieces of clothing, so position of crease is significant in the careful state of the item, more is spirality, more de formed is the final result.

According to reference book, spirality originated from the spirals which are "winding is a level bend or a progression of bends that always increment in size hovering around a point" .According to Lau et al., the meaning of spirality will be, Spirality is the edge between the grain line and a line opposite to the course line .Davis et al. talked about the spirality as, in hosiery textures which are weaved in plain line, the length insightful columns of join called needle lines or grains, ought to possess a genuinely vertical line in the texture and ought to consistently be opposite to the across courses of lines. This is the rule development and it demonstrates an alternate impact with regards to textures that are sewn with cotton or fleece which demonstrates a noticeable predisposition towards left or right side, its appearance looks like twilled surface. The depiction of this deformity is named as spirality as it happens all the more usually in roundabout textures.

Spirality can likewise be named as texture slant or texture torque. Spirality is the issue which happens when the rib isn't opposite to the course bearing. As the yarn is twisted to frame a circle, the external part expands and inward part packs. This is the conduct that outcomes in change in geometry of spirals with in the yarn, which at last outcomes in making it precarious. Rate spirality is considered as whole of the net spirality brought about by the yarn torque and the extra spirality brought about by every single other factor, these can be determined by two geometrical methodologies, we measure spirality in rate and edge of spirality.

## **2.2 Shrinkage**

Shrinkage (in texture) is a parameter of testing material textures to gauge changes long and width subsequent to washing. Shrinkage bombing materials are dimensionally flimsy and they can cause misshaping of the pieces of clothing or items made out of those materials. Shrinkage is tried at different stages, yet in particular before cutting the texture into further sewn items and in the wake of slicing and sewing preceding providing the items to purchasers and end clients. It is a required parameter of value control to guarantee the measures of the items to maintain a strategic distance from any objections with respect to disfigurement or change in measurements after residential clothing.



The tests are directed with gave determinations of purchasers emulating similar conditions like washing process duration, temperature and water proportion and texture burden and some of the time top stacking and front stacking clothes washers are picked to confirm the test and confirmation of the outcomes. This technique gives standard and interchange home washing conditions utilizing a programmed clothes washer. While the system incorporates a few alternatives, it is unimaginable to expect to incorporate each current blend of washing parameters. The test is material to all textures and final results reasonable for home washing. Shrinkage is the dimensional change in length and width wise in the fabric. It mainly occurs for swelling of yarn. So, it appears more in cotton fabrics than synthetic fabrics. It can reduce the shrinkage by using stenter machine after dyeing and drying the fabric. Also, if the higher GSM/lower stitches length/lower twist fabric contains lower shrinkage of fabric.

For measuring the spirality and shrinkage at first we have done ISO-6330 washing then use ISO: 16322-2 for spirality and ISO5077 for shrinkage. And these are international standard of these measuring systems.

## **2.3 Terminology & Definition**

**Shrinkage:** A dimensional change bringing about a reduction in the length or width of example exposed to determined condition is known shrinkage.

**Spirality:** If the Wales of the sewed texture are not opposite to the course and slant to one side or left Spirality happens in the texture. This makes significant issue, particularly in the clothing business.

**Yarn twist:** Twist is the proportions of the winding goes given to a yarn so as to hold the constituent filaments or strings together. Sum wind I. e. TPI enormously impacted the texture Spirality.

**Contort exuberance:** The inclination of a yarn is to curve or untwist unexpectedly. The heading of wind exuberance or torque S or Z contort change that happens

precipitously when an end or hanging circle is permitted to turn uninhibitedly. Higher measure of turn drives high enthusiasm and makes texture Spirality. Dry Relaxed State: The texture moves to this state with time. The dry loose is confined by texture structure and fiber type. No one but fleece can achieve this state.

**Loosened up State:** Static absorb water and dry level. This state tight structure doesn't generally arrive at a genuine loosened up state. Just fleece and silk can accomplish this state. Absorb water with tumult or unsettling steam or static splash at chosen temperature (beneath 900C) **Spirality**

Calculation for spirality percentage:

X =Average

deflection length from the seam line

Y= Sample length,

Spirality%  $= (X/Y) * 100$

Washing process:

ISO 6330

Determination of spirality after laundering knitted fabrics:

ISO 16322-2

## 2.4 Causes

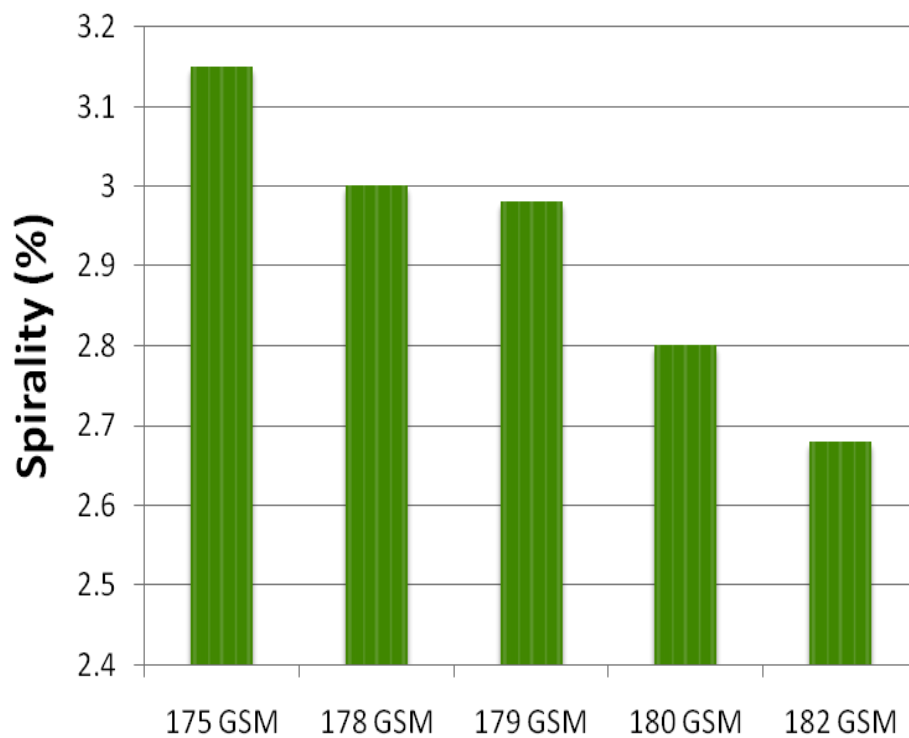
- The residual torque.
- Count of yarn,
- Fabric structure,
- GSM
- Fabric Relaxation,
- No. of feeder.
- Twist direction,
- Machine rotation,
- Spinning system,
- Fabric finishing. etc.

**Chapter-III**  
**MATERIALS AND METHODS**

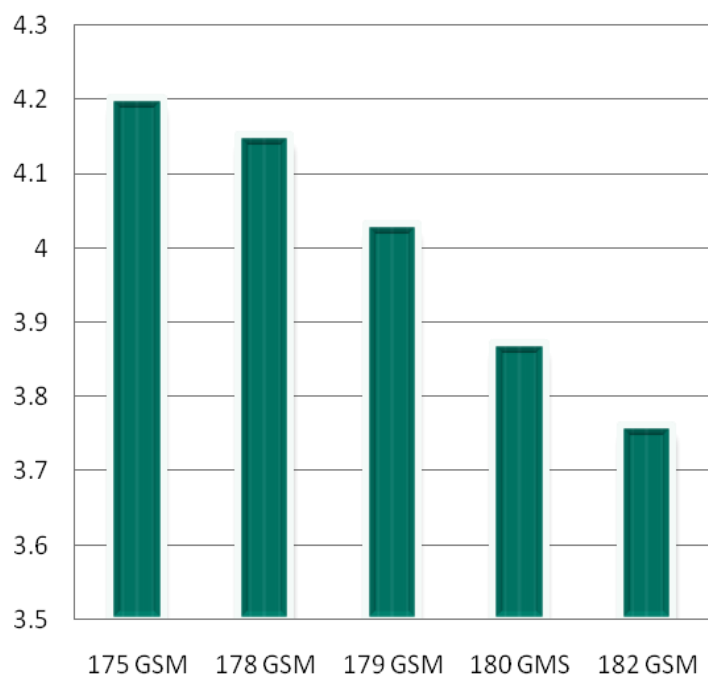
### 3.1 Considering the following parameters can control spirality

#### 3.1.1 Count:

The yarn is finer, the spirality will be more due to more twisting.



**Fig: Effect of spirality on GSM (34Ne Combed yarn)**



**Fig: Effect of spirality on GSM (26Ne Carded yarn)**

## 3.2 Twist

### 3.2.1 Twist multiplier:

$$TM = TPI / \sqrt{\text{count}}$$

So when TM is increased, TPI also increased & the spirality of fabric also increased.

<u>TM</u>	<u>Twist liveness (cm)</u>	<u>Spirality (degree)</u>
3.2	19.69	4.2
3.5	25.99	6.5
3.8	28.96	7.3

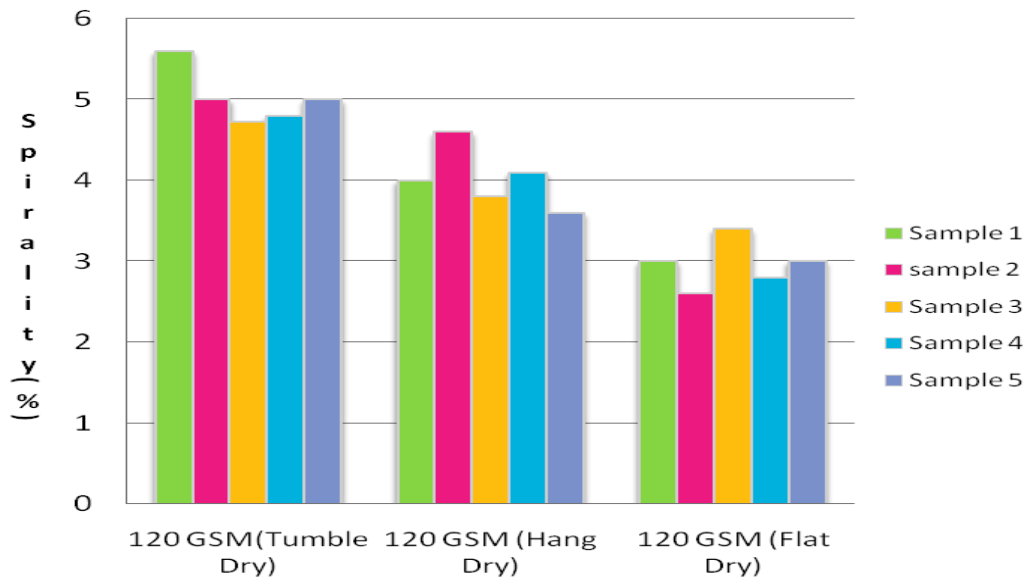
### 3.2.2 Twist factor:

$$TF = TPCm \times \sqrt{\text{tex}}$$

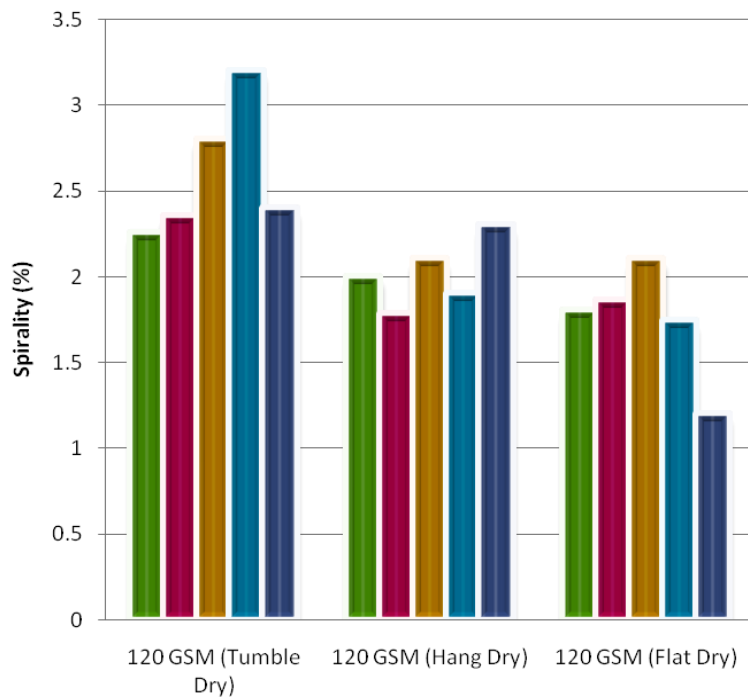
So, when TF is increased, TPCm also increased & spirality of fabric also increased

## 3.3 Blending of fibre

100% cotton yarn shows more spirality than polyester- cotton blend yarn on different procedure of dry.



**FOR 100% COTTON OF SINGLE JERSEY**



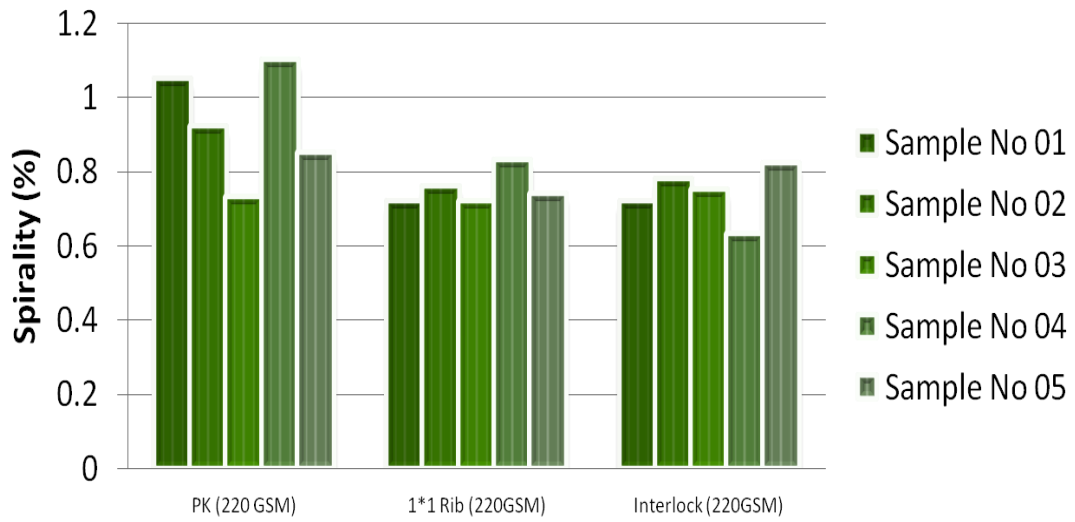
**FOR BLENDED (COTTON + POLYESTER) OF SINGLE JERSEY**

### 3.4 Fabric structure

- In single jersey fabric has more spirality than rib & interlock.
- No appreciable problem of spirality in rib & interlock fabric

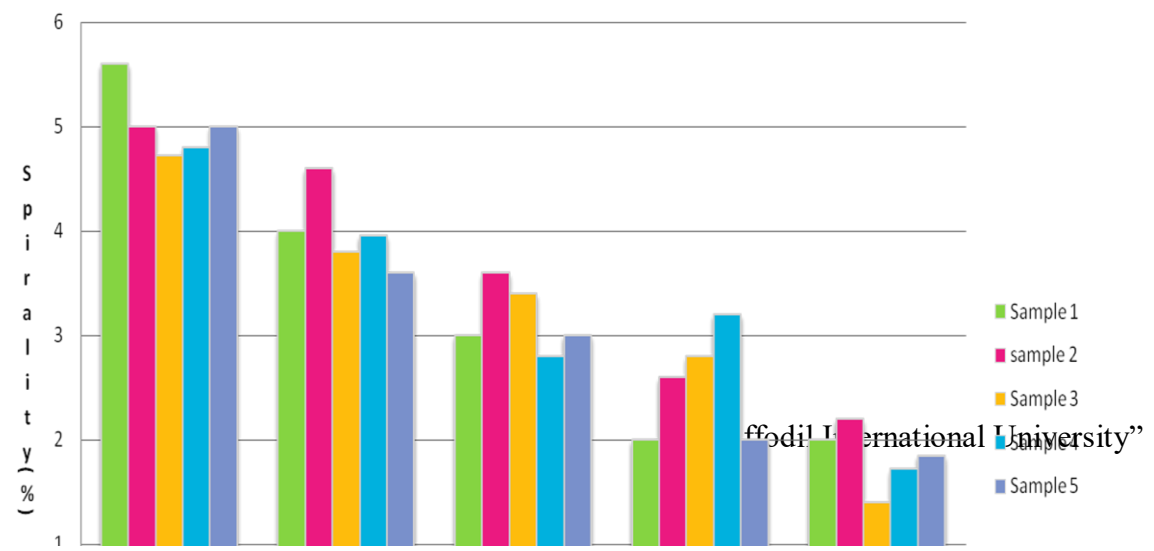


### 3.5 Effect of fabric structure with Tumble dry on spirality



### 3.6 GSM

- In plain single jersey fabric GSM increases, spirality decreases.



### 3.7 Direction of m/c rotation:

Z-contort yarn gives z slant, s-turn gives s-slant to the texture. With multifeed m/cs , the texture is made in helix, which offers ascend to course tendency and thus grain Spirality . Bearing relies upon the rotational heading of the weaving m/c. Prior research work uncovered that, for a clockwise turning m/c, the grain would be slanted towards the left. In this way creating the spirality.

### 3.8 Effect of stenter m/c

#### 3.8.1 Stenter Machine:

A machine or mechanical assembly for extending or stentering textures. The motivation behind the stenter machine is to carrying the length and width to pre decide measurements and furthermore for warmth setting and it is utilized for applying completing synthetic compounds and furthermore conceal variety is balanced.

If the fabric is delivered to the dryer without sending through the stenter m/c and completed garments that show lower spirality, higher shrinkage. On the contrary, it shows tolerate Limit according to buyer requirements by going through the stenter m/c.

**Table3.2: Before stenter (For Plain Single Jersey Fabric):**

Serial	Fabric GSM	Spirality (%)
01	180	0.5
02	180	0.4
03	180	0
04	180	0
05	180	0

**Table3.3:After stenter (For Plain Single Jersey Fabric)**

Serial	Fabric GSM	Spirality (%)
01	175	3.3
02	175	3
03	175	3.7
04	175	3.5
05	175	3.8

### 3.9 Shrinkage

#### 3.9.1 Types of shrinkage:

Shrinkage is an adjustment in measurements over the length and width of the texture in the wake of washing, use and when presented to unwinding of textures. Essentially shrinkage is of two sorts one is less shrinkage and other is in addition to shrinkage. Slant (turning of the vertical grains) is additionally seen alongside shrinkage. Anomalous curving is likewise considered as a non-congruity.

1. Contraction: Any observable decline in measurements is known as Contraction (less) shrinkage.
2. Expansion: Any perceptible increment or development in measurement is known as Expansion (in addition to) shrinkage.

**On the other condition shrinkage causes ,those are-**

- Relaxation shrinkage,
- Felting shrinkage,
- Compressive shrinkage,
- Residual shrinkage.

### **3.9.2 Causes:**

Shrinkage is mainly due to yarn swelling and the resulting crimp increase during washing in case of cotton fabrics. Yarn swelling percentage is more in polyester cotton blending yarn.

### **3.9.3 Composition and properties of the fibres**

Organization and substance decide the sort and level of strands. Regular filaments contract more than manufactured strands. Manufactured strands are increasingly steady due to their crystalline and thermoplastic nature. They don't shrivel, though regular filaments are increasingly inclined to contract in view of progressively formless area in their fiber structure which permits more retention of water, swelling of strands and expanded lubricity builds the contracting propensity. Mixed textures ordinarily engineered and normal are additionally viewed as increasingly steady.

### **3.9.4 Structure of the fabric/ knit or weave, loose and tight structure**

This factor additionally assumes an essential job in the contracting of the items. The items which are inexactly woven or weaved are inclined to shrivel more and firmly sewed and woven items are progressively steady. The fundamental reason is that weaved textures shrinkage is on the grounds that they are made by interloping the yarn which is similarly a free and adaptable structure though woven are viewed as progressively steady and less delicate to shrinkage.

### **3.9.5 Finishing applications and procedures**

Filaments to texture change suggests loads of mechanical pressures and powers during assembling, which incorporates following strides for fiber to yarn transformation with turning then texture with weaving, sewing. At the point when the items are submerged in water, the water goes about as a loosening up medium and all anxieties and strains get loose and attempt to return to its unique loosened up state. Indeed, even in the wake of completing with refined completing machines some leftover shrinkage remains, which is conveyed forward to the piece of clothing stage. This remaining shrinkage may cause disfigurement or de-forming of the items after residential clothing. There are sure acknowledgment breaking points of shrinkage levels for each item. Anomalous shrinkage levels are viewed as a non-adjustment to quality measures.

### 3.9.6 Calculation for shrinkage percentage:

- Shrinkage percentage =  $(L_0 - L_1) \times 100 / L_0$
- Where,  $L_0$  = the distance between the datum line before washing
- $L_1$  = the distance between datum lines after washing.

### 3.9.7 Washing process:

- ISO 6330

### 3.9.8 Test methods:

The different test methods are used as per the final destination of the product (Europe, U.S.A., etc) and the expected washing or laundry methods in practice. Mainly [I.S.O.](#) and [AATCC](#) standards are used for shrinkage testing. There are few brands which are customizing the test method as per their quality norms. Test Method.



### 3.10 Shrinkage measuring template, scale and marker

- AATCC Test Method 135
- AATCC Test Method 150
- ISO 6330
- CAN/CGSB 58

AATCC Test Method 135, Dimensional Change of Fabrics After Home Laundering Scope: Determines the dimensional changes of articles of clothing when exposed to home washing methodology utilized by buyers. The strategy is for texture not yet made into a piece of clothing. An example is set apart with benchmarks before home washing. At that point it is washed multiple times absolute, at that point the benchmarks are estimated once more. When washing benchmarks are looked at.

AATCC Test Method 150, Dimensional Change of Fabrics After Home Laundering Scope: Determines the dimensional changes of pieces of clothing when exposed to home washing systems utilized by purchasers.

### 3.11 Working Procedure:

The example which is done shrinkage test, spread on table. At that point a glass layout put on test texture which is square size. There are six imprint on glass layout and separation between two imprint is 35 cm. Denoting the example texture by unchangeable marker. At that point test is sewn by hand sewing machine. Test is prepared for washing. Straightforward wash the texture at 60°c temp for 90 min. in the wake of washing the texture is taken out. Dry the example according to any of the technique. It can either be Line Dry or Flat Dry or Tumble Dry. To locate the dimensional change read the Shrinkage/Stretch on 3 points on the Wrap side and 3 on Weft Side. Get the mean estimation of wrap-wise and weft savvy readings to get the Accurate Shrinkage or Stretch.

Shrinkage is resolved as;

Shrinkage % = (length of texture before wash)- (length of texture after wash)/(length of texture after wash) \*100

Model,

length of texture before wash = 35 cm length

of texture after wash = 33 cm Presently,

Shrinkage % = {(35-33)/33} \* 100

= 6%

Here, Shrinkage is 6%. Ordinarily shrinkage is worthy under 5%. In any case, it tends to be change if there should arise an occurrence of purchaser necessity.

Assurance of dimensional change in washing and drying:

Global Standard ISO 5077

### 3.12 Influencing factors:

- Twist factor: twist factor increases so that shrinkage will be increases.
- Stitch length: stitch length increases so that shrinkage will be increases.
- GSM: GSM increases so that shrinkage will be decreases.
- Elasticity of yarn.

### 3.13 Effect of GSM on Shrinkage (Tumble Dry):

In plain single jersey fabric lengthwise and widthwise decreases with increase in GSM.

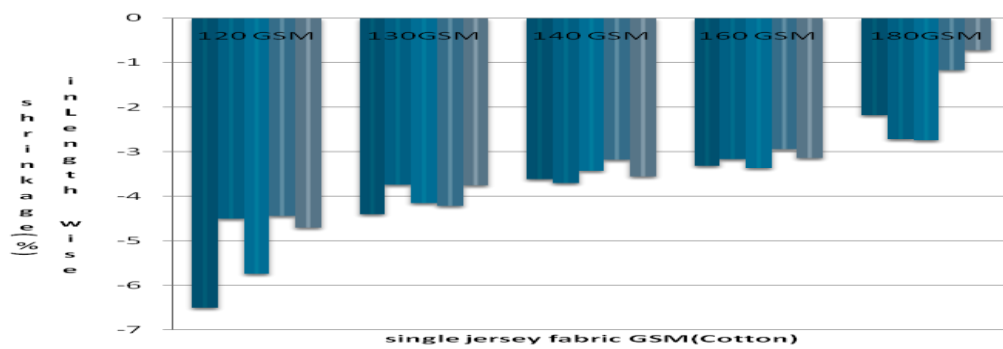


Fig: Effect of GSM on Shrinkage in lengthwise (Tumble Dry)

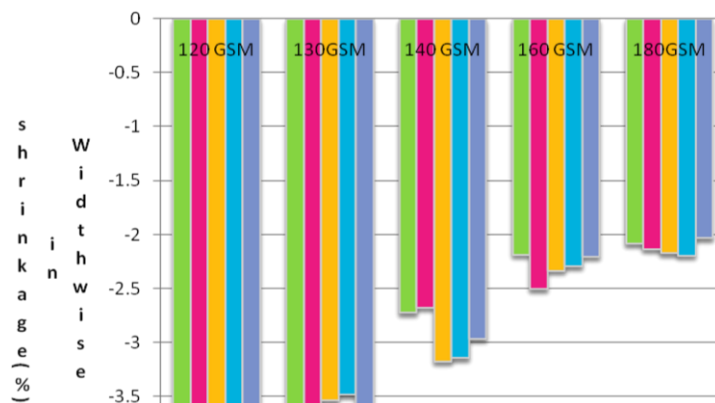


Fig: Effect of GSM on Shrinkage in widthwise (Tumble Dry)

### 3.14 Effect of Fabric Structure on Shrinkage(Tumble Dry)

- In plain single jersey fabric has higher shrinkage than rib and interlock.

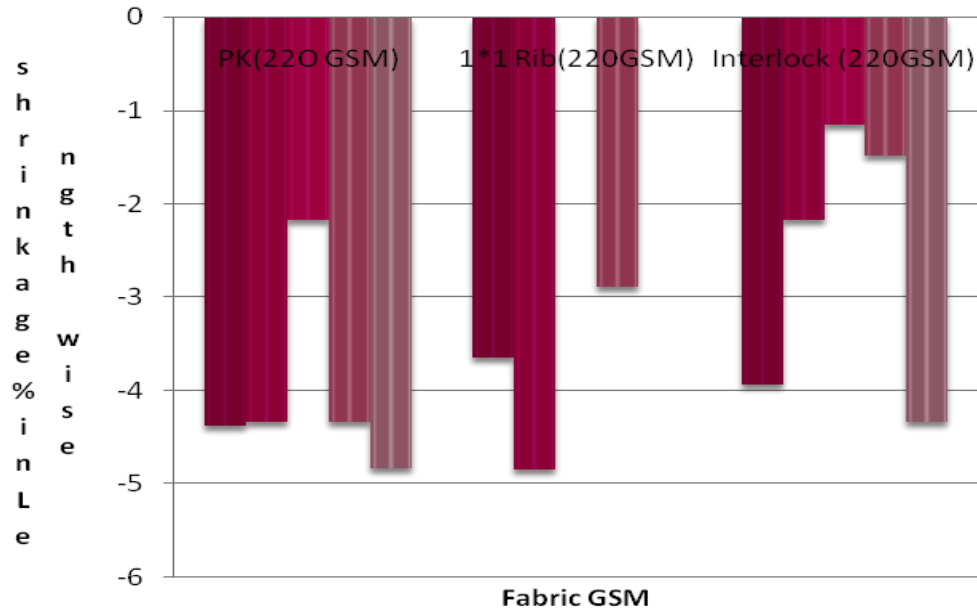


Fig: Effect of GSM on Shrinkage of different types of fabrics in length wise (Tumble Dry)

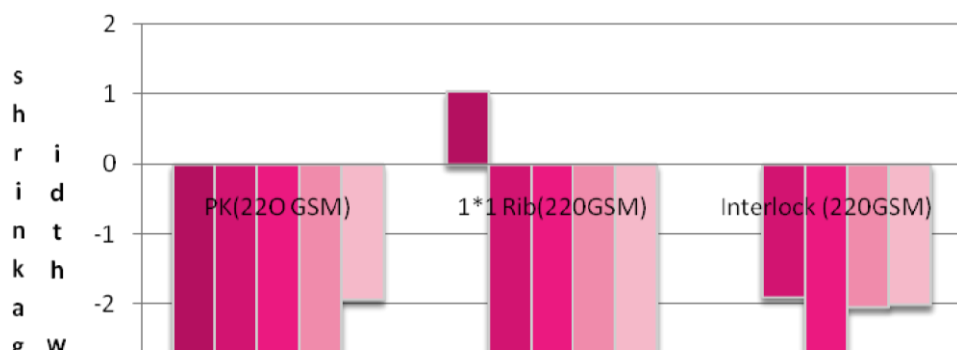


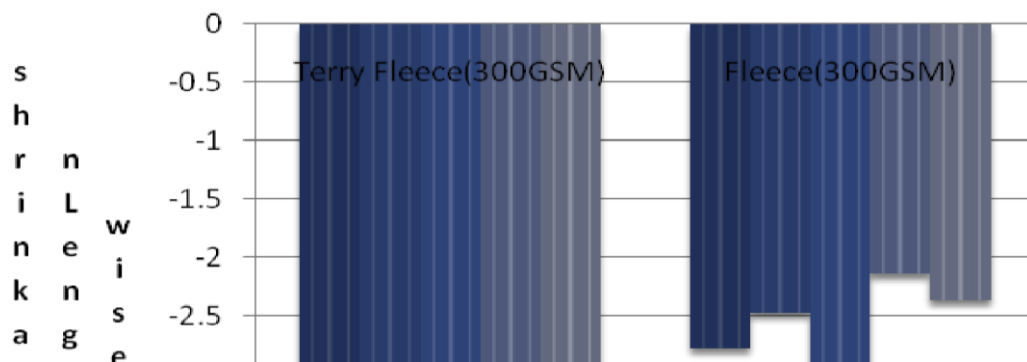
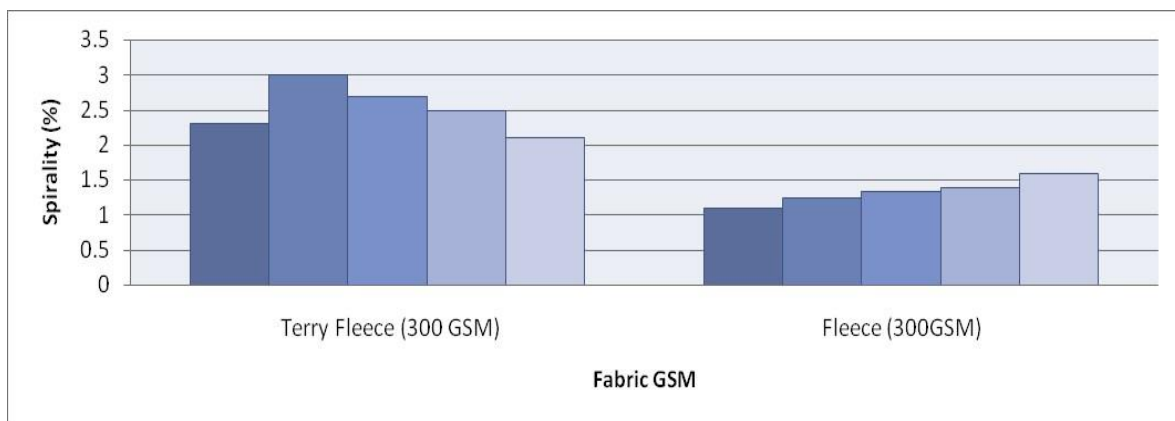
Fig: Effect of GSM on Shrinkage of different types of fabrics in widthwise (Tumble Dry)

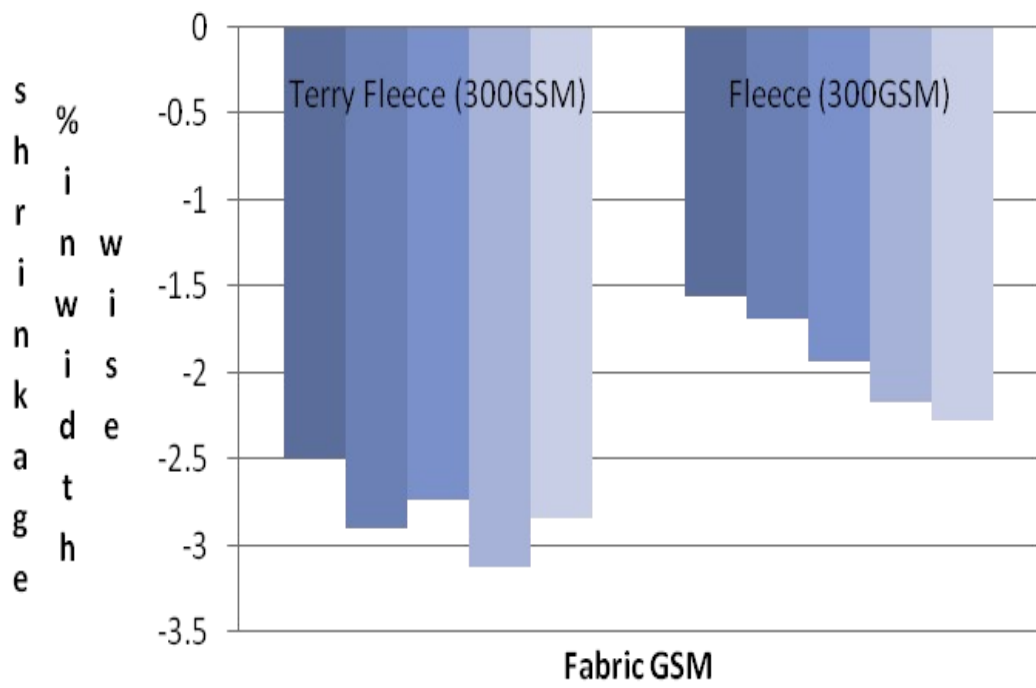


### 3.15 EFFECT OF SINGLE JERSEY DERIVATIVES ON SPIRALITY & SHRINKAGE

(FLEECE & TERRY FLEECE)

- In Terry Fleece Fabric spirality and shrinkage are increases then Fleece Fabric.





**CHAPTER – IV**

**RESULT AND DISCUSSION**

## **4.1 Result and discussion:**

From our project work we can conclude that, in case of higher count, combed yarn, lower GSM, 100% cotton yarn used, single jersey structure cause the higher spirality in the weft knitted fabrics. Also, if anti-clockwise machine direction and Z twisted yarn causes lower spirality. By using plying yarn we get lower spirality. From our experiment we can also see that among the three drying processes the result of tumble dry shows greater spirality and flat dry is lower.

In case of shrinkage higher the GSM, higher the stitch length it cause higher shrinkage. In case of fleece, two thread fleece contains more shrinkage than three thread fleece. Also we observe from our experiment, the polyester fabric contains lower shrinkage than 100% cotton fabric.

Though our project is vast, but we don't get among time to arrange the experiment data exactly. It needs more time data to describe these topics.

## **4.2 Remedies For Spirality:**

### **Z and S contort yarn bundle utilized in exchange feeder:**

**In the event that Z and S turn yarn bundles are utilized in interchange feeder, at that point less than 1% spirality is found and this is the best method to decrease spirality;**

### **Resin treatment:**

**Cross connecting the texture by methods for entomb fiber holding additionally diminishes spirality. Pitch is the type of watery arrangement is applied and set by going the texture through a high temperature stenter this strategy isn't suggest for cotton textures, since it debilitates the cotton yarn.**

### **Heat setting:**

**Steam or boiling water setting decreases contort enthusiasm and thus spirality. Mercerization is suggested for cotton yarn, lush that strands are made to unwind for all time.**

### **Compacting:**

**In the event that the length of the texture dependent on its extension during handling which, thusly, decreases the width. It helps in controlling the shrinkage of the texture. There are two sorts of compactors, open and rounded. In cylindrical compacting the crushing line jumps on the sides in this procedure and is done on normal development along these lines controlling spirality. In the event that the ribs are fixed physically, at that point it brings about spirality.**

**Yarn wind course and machine revolution heading:**

**On the off chance that the machine turns clockwise, at that point the spirality can be diminished by suing yarn of S-wind. Generally if the machine pivots hostile to clockwise the spirality can be decreased by utilizing the yarn of Z-wind.**

**Use of exceptional sort of yarn:**

**One similar way limit the spirality is to utilize the vortex spun yarn which is gotten from Murata vortex turning framework. Furthermore, adjusted contact spun DREF III yarn lessens yarn growling and texture spirality.**

**By utilizing plating yarn:**

**In texture generation when utilized plating yarn it diminish the spirality.**

## **4.3 Remedies for Shrinkage**

### **Shrinkage controlling methods:**

There are different techniques to limit the leftover shrinkage of the textures, it starts with right determination of yarn check or denier to accomplish specific g.s.m(Grams per square meters),Right choice of snugness factor of circles (which is called circle length then substance methods like mercerizing of cotton, Resin of cotton if there should arise an occurrence of woven materials, Pre-heat-setting and post-heat setting of engineered and mixed textures( Heat setting is a warm procedure occurring for the most part in either a steam climate or a dry warmth condition. The impact of the procedure gives strands, yarns or

texture dimensional steadiness). Completing on machines like sanphorizing Mechanical contracting (here and there alluded to as sulfurizing), whereby the texture is compelled to shrivel width and additionally the long way, makes a texture wherein any lingering inclination to recoil after resulting washing is insignificant compacting machines. For fleece articles of clothing, shrinkage is because of scales on the strands which warmth, water and tumult cause to stay together. Different textures are extended by mechanical powers during generation, and can contract marginally when warmed (however to a lesser degree than fleece). Some garments are contracted in the production line to keep away from this issue.

1. In request to keep up the weight at a lower shrinkage, a better yarn is utilized.
2. In request to keep up the width, a bigger measurement sewing machine or a more drawn out join length is vital.
3. In request to keep up the equivalent weaved snugness factor, or spread factor (square base of tex isolated by join length) with a better yarn, a shorter normal line length must be sewn.
4. Changes in yarn check and line length likewise change the line thickness which again changes the weight and the width for a given degree of shrinkage. Changes in the snugness factor will change the extensibility of the texture and will likewise influence the measure of spirality (texture bending) which might be created.

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