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Effects of different count and stitch length on Spirality, Shrinkage and GSM of knit fabrics

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Abstract: *This article focused on the effect of spirality, shrinkage and the GSM (Gram per square meter) of different types of knit fabris by changing the count and stitch length. Textile industries face some common problems regarding the selection of accurate GSM, count and stitch length as inappropriate selection create poor spirality, shrinkage as well as desired GSM fails to achieve. Different types of fabrics were produced with different count and with relevant stitch length where it is found that if the count(Ne) increases then the GSM decreases. It is also found that higher count and smaller loop length give better shrinkage and spirality. This study is based on finished GSM of knit fabric where yarn counts used were 24Ne, 28Ne, 26Ne, 20Ne for S/J. In this experiment, we compared both the theoretical as well as the practical implications from the industry and we have also tried our best to emphasize on the adjustable points of fabric GSM, Spirality, Shinkage, count and stitch length directly or indirectly. This study establishes an acceptable result which would be preferable for the effective use and would also facilitate for carrying out further activities related with this research.*
Keywords: Yarn Count, S/J fabric; stitch length, Spirallity, Shrinkage; Finish GSM.

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I. Introduction

The most widely used fabric forming method is knitting and its principles is divided into two major sections namely warp and weft knitting [1]. In general, the knitted fabrics have more stretchable property compared to the woven fabrics [2,3]. Rib is a more costly and heavier structured fabric to produce than plain fabric [4]. The main utilization of knitted rib structures are in providing welts, cuffs, and collars for garments with plain-knitted bodies and sleeves [5]. Moreover, the knitted rib structures are also widely used in body lengths for outerwear. The impact of different factors such as yarn count, twist, stitch length, various processing stage such as dyeing, finishing and washing process on the dimensional and physical properties such as pilling resistance, abrasion resistance, shrinkage and tightness factor of knitted fabric have been examined by many researchers. Pilling is a surface defect and it's a noteworthy problem for textile manufacturers. The fabric quality considerably decreases and a negative influence on the user's comfort observed due to pilling [6]. The pilling is noticed as small fiber balls or group consisting of intervened fibers during wear and washing [7]. The fabric of compact construction shows less pills and opposite phenomenon for loosely knitted or woven fabric. Many scientists have investigated the factors affecting the pilling performance [8-12]. Pilling attitude is prejudiced by fiber properties, e.g. tensile strength, percent elongation, bending rigidity, shape of fiber cross-section and friction and structure of the yarn and fabric [13,14]. Physical damage of textile materials like fibres, yarns, and fabrics has made due to abrasion and abrasion occurs during wearing and washing. Abrasion ultimately results in the loss of performance characteristics, such as strength, but it also affects the appearance of the fabric [15]. The service life of the garment seriously depends on its end use. Abrasion is a serious problem for home textiles like as carpets and upholstery fabrics, socks and technical textiles as well [16,17]. The abrasion property of textile materials is effected by many factors (e.g. fibre fineness, yarn count, yarn type, weave etc.) in a very complex manner [18]. Many researchers have investigated the influence of raw material, yarn production technology, yarn twist and chemical treatment on the abrasion resistance property [12,13,18-21]. Fabric shrinkage is a serious problem for knitwear, which originates from dimensional changes in the fabric and it is a combined effect of number of factors such as relaxation, finishing, dyeing, and effects of machinery [22,23]. Shrinkage is very important to maintain the aesthetics of knitted products in the user ends. Different factors such as fiber characteristics, yarn parameters, Stitch length, yarn count, structure of fabric, machine parameters influence the dimensional characteristics of knitted fabrics [24,25]. The significance of shrinkage was investigated by many researchers [8,13,14,26-31]. Fabric tightness implies the looseness and tightness and it varies with the stitch length of knitted fabrics. When the stitch length is big, the fabrics become slack and when the loops are small, the fabric is tighter [32,33]. Fabric area shrinkage is lower with a lower tightness factor and increases with the twist factor of the yarn. Tightness factor significantly influences the dimensional changes of knitted fabrics. Fabric tightness factor has examined by several researchers [34-36]. "Spirality" arises from twist stress in the constituents yams of plain fabric, causing all loops to distort and throwing the fabric wales and courses into an angular relationship other than 90 degree.

The ultimate benefit of studying the spirality phenomenon is to understand the various factors influencing the dimensional stability of knit fabrics, particularly fabric spirality so that ways to select appropriate levels of these factors that result in optimum dimensional stability can be established. This can be achieved through a cause and effect analysis of the various potential factors influencing fabric spirality.

The objectives of this study were to disclose the effect of yarn count and stitch length on various fabric properties such as pilling resistance, abrasion resistance, and shrinkage and tightness factor (Figures 1-4).

II. Literature Survey

Literature review Manufacturing of knitted fabrics involves intermeshing of yarn loops where one loop is drawn through another loop to form a stitch (Shah, 2003; Saufley, 1992). Since the last few years knitted fabrics are used in manufacturing of fashion garments and even it has the potential in the formal wear segments also. Shrinkage is one of the most serious problem of the fabric faults. Especially, it is obtained in single jersey knitted fabric. Because of different of both side of single jersey knit fabric & side (Face or back) of the single jersey always tends to create curling. Thus, shrinkage is formed in single jersey mostly, where the other fabric are not so affected greatly as compared with it. Shrinkage on fabric creates, stitching problem which resulting seam pucker problem. Human feels uncomfort due to wear of shrinked cloth.(Vishal Desale et al., 2008). Apart from this, spirality is another serious problem for single jersey knitted fabrics due to their asymmetrical loop formation. The fabric spirality is minimized up to 50% after the finishing process as compared to its gray stage spirality(Vishal Desale et al., 2008). Many developments have taken place in the machinery for processing of knitted fabrics in both tubular process and open width forms. Specification methods of knitted fabrics, usually, include loop density, width of the fabric, weight per square meter and the loop length (Bourah, 2004). Flexibility exists at the various stages of wet processing in terms of process machinery and methods followed by calendaring or compacting which is often, the final operation prior to the packaging step (Tendulkar et al., 1994; Euscher et al., 1997).The level of shrinkage control needed, composition of yarn (100% cotton, blends) and type of chemicals applied to the fabric decide the final process, i.e., whether calendaring or compacting. Variable compactors are used to achieve specific stitch count and wet compacting is also carried out in certain cases (Baser et al., 1993). Yarns of different counts knitted to the same loop length display different physical properties such as drape, openness, permeability, handle and spirality etc. Başer and Çeken (Baser et al., 1993) produced knitted fabrics on hand knitting machines to research the effects of yarn properties on fabric spirality by using acrylic and cotton yarns with two different yarn counts and four different twist factors at different tightness factors. As a result the most important factor that affected the fabric European Scientific Journal December 2014 edition vol.10, No.36 ISSN: 1857 – 7881 (Print) e - ISSN 1857- 7431 190 spirality on acrylic and cotton knitted fabrics is observed as twist liveliness. It is observed that the angle of spirality is decreasing on knitted fabrics, when yarns are fixed with vapor. At the same time by using two-ply yarns, the spirality is prevented, because the twist direction of the two-ply yarn is opposite to the twist of one-ply yarn. On the other hand using fine yarns and slack fabrics, it is observed that on knitted fabrics the angle of spirality is very high. Araujo and Smith (De Araujo et al., 1989) investigated the spirality on single jersey fabrics, by usingCotton / Polyester yarns with different yarn counts and twist factors, which are produced with different spinning techniques. It is observed that the twist liveliness of 100 % cotton is higher than the 50/50 Co/PES knitted fabrics.They observed that, 50/50 Ring Co/PES yarns have higher twist factor than the 100 % Cotton yarns, for this reason the blended yarns have lower twist liveliness. 50/50 Co/PES yarns produced with open-end technique and air jet spun technique have lower twist factor than the 100 % Cotton yarns, so the fabrics with blended yarns have lower twist liveliness. In friction spinning 100% Cotton yarns' twist factor reaches its maximum value. Related with the spinning techniques, the angles of spirality from the biggest to the smallest values in 100 % cotton knitted fabrics are observed in friction spinning, ring, open-end and air jet spinning techniques respectively. The angles of spirality in 50/50 Co/PES knitted fabrics are observed as the smallest in air jet end open-end spinning techniques.Tao, Dhingra, Chan and Abbas (Tao et al., 1997) are investigated the spirality on single jersey fabrics. They used ring yarns with four different yarn counts and four different twist factors. Before knitting processes, they fixed yarn for 30 minutes with vapor. They observed a linear relation between the spirality and the twist factor. The fabrics which are knitted with high twisted yarns have great angles of spirality. At the same time they have high correlation coefficients between the spirality and the tightness factors. At different twist factors, the angles of spirality are getting lower when the tightness factor is getting higher. After wet relaxation state, the angles of spirality are increased, after washing and drying state the angles of spirality are increased more than the wet relaxation state. From the above reveals as the literatures stitch length on shrinkage, spirality and GSM, where yarn count is constant .cited, it is evident that the effect of shrinkage, spirality, GSM etc. of knit fabric properties are sometimes fateful, and thus needs to be controlled. But the construction and processing parameters of the knit fabric are exclusively related with the properties. Within the parameters, yarn count and stitch length are the vital most, on which the till-dated works could not focus clearly. In this consequence, the present job is targetted in dealing with the following objectives: i) To dig into the effect of yarn count on shrinkage, spirality and GSM, European Scientific Journal December 2014 edition vol.10, No.36 ISSN: 1857 – 7881 (Print) e - ISSN 1857- 7431 191 where stitch length is constant, ii) To study the effect of

III. Methodology

3.1: Fabric Spirality

Fold the fabric along a Wale line.
Place the marking template on the fabric parallel to the wales and drawn round.
Cut out the double thickness specimen accurately along the knitted wale lines and cut at right angles to these to produce a "bag" square.
Note: The second cuts are not necessarily parallel to the knitted courses.
Sew the two pieces of fabric together to form an open ended bag i.e. similar to a garment. Overlock the single edges of the fabric to prevent unravelling.

3.2: Conditioning of Spirality Tester

The test specimens are to be conditioned in the standard atmosphere of 65% Relative Humidity (RH) +/- 2% and 20°C +/- 2°C for a minimum of 4 hours. Preparation of Test Specimens/Materials.
Garment:
Test the garment in its finished state.
Record whether any spirality test method is present in the garment prior to washing.
Measure original length and width dimensions.
Note: It is recommended that garments that already exhibit Spirality are not tested because deceptive results will be produced.

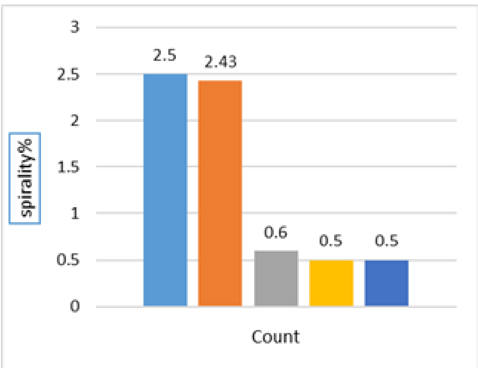
3.3: Test Procedure

Carry out Washing/Drying procedure as agreed, or specified

3.4: Results of Spirality Test Method

After conditioning, lay the specimen on a flat smooth surface so that the natural fold in the washed specimen is flat and free from wrinkles.
Measure the distance "d" to nearest 1mm from the natural dried fold of the fabric square to the inner edge of the seam (see diagram). Repeat on the other edge by gently lifting back the opposite edge to the seam. On garments these measurements are made at the hem. On garments these measurements are made at the hem.
Measure the length and width dimensions in order to determine the dimensional change:

S/J	
yarn Count	Sp%
28	2.5
28	2.43
26	0.6
24	0.5
26	0.5



3.5: GSM calculation with GSM Cutter

In the market, there are the number of manufacturers of cutter but the basic principle is to remain same.

This cutter is provided with the build in 4 knives by revolving the handle knob a quarter of a turn the cutter produces a circular sample of 100 sq.cm which is equal to 1/ 100 sq.meter so just by multiplying the weight by 100 it will give GSM.

The design and precision manufacture of the instrument ensures the specimens are perfectly circular and have smooth edges.

3.6: Procedure of GSM calculation

1) cut 5 swatches by the GSM cutter from the different parts of the fabric.
2) avoid the swatches from the selvedge area of the fabric.
3)then weigh one by one those 5 swatches on electronic balance accurately.
4) calculate the average weight of the swatch.
5) then simply by multiplying the average weight by 100 we directly get the actual GSM of fabric.

E.g. weights of 5 swatches are 1.2gm, 1.3gm, 1.5gm, 1.1gm, 1.2 gm respectively.

Average weight of cut swatches= (1.2+1.3+1.5+.1.1+1.2)/5

Average weight of cut swatches = 1.26 gm. Now,

Fabric GSM= average weight of cut swatch *100

=1.26*100

=126gm/ sq.meter

By Using GSM Formula

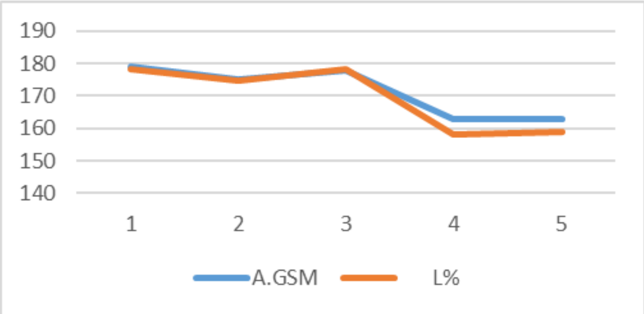
Fabric GSM can be calculated easily even if we don't have circular GSM cutter. It can be calculated by using following formula.

GSM of fabric= (weight of the sample in gram *10000)/ area of sample in sq.cm

For this, we just need to take the weight of the sample and take the area of the available sample in sq.cm.

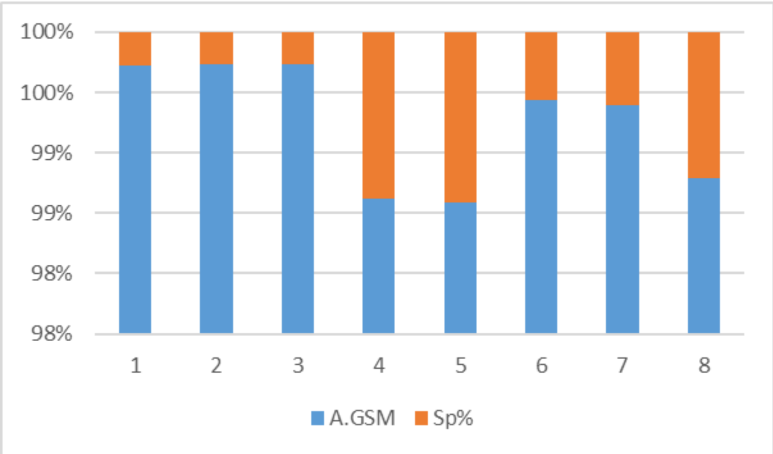
GSM differs due to shrinkage:

R.GSM	A.GSM	L%	W%
160	179	-0.8	-3.6
160	175	-0.3	-2.3
160	178	0.3	-3.8
160	163	-5	-4
160	163	-4	-5



GSM varies due to spirality:

R.GSM	A.GSM	Sp%
180	180	0.5
180	189	0.5
180	190	0.5
160	179	2.5
160	175	2.5
160	178	1
160	163	1
160	163	2



3.7: Fabric Shrinkage Percentage

The textile fabric has a common feature that it shrinks in wet processing. Shrinkage means the length of the fabric gets shorten after wash. So prior to cutting fabric for bulk production, you must check its shrinkage percentage in washing. The shrinkage percentage needed to add to the production pattern. Otherwise, you would not get garment of correct fit and measurement could not match the specification sheet.

3.8: calculation of fabric shrinkage

This post will discuss how to calculate fabric shrinkage percentage by your own at home or in a factory. Step by step guide to calculating fabric shrinkage percentage is shown below.

Step 1: Prepare the wash test sample

Cut fabric from the roll and take fabric specimen of 110 cm X 110 cm (length X width). If you have multiple lots of fabrics rolls, take a sample from each lot.

Step 2: Measure before washing

Mark a square of 100 cm X 100 cm (You can only mark + at the corner of the square.). Use a fabric marker to mark the fabric. This is before wash measurement of fabric length and width.

Step 3: Wash the fabric sample

Wash the specimen following dip wash or machine wash as needed. Follow washing instruction provided by your buyers. Or follow the standard washing method to find the shrinkage percentage for washing.

Step 4: Dry the sample after washing

Dry the fabric specimen as specified. Do line dry or tumble dry as specified in the test method.

Step 5: Measure after washing

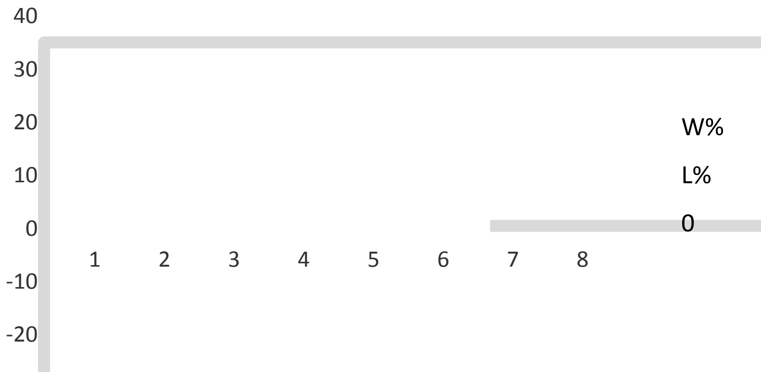
Lay the specimen on a flat table. Remove creases but don't stretch the fabric. Measure the fabric length and width following marking points and note it.

Now calculate shrinkage percentage specimen fabric using the following formula

Fabric Shrinkage %= (Length before washing - length after washing) *100/Length before washing

Use data from the above example:

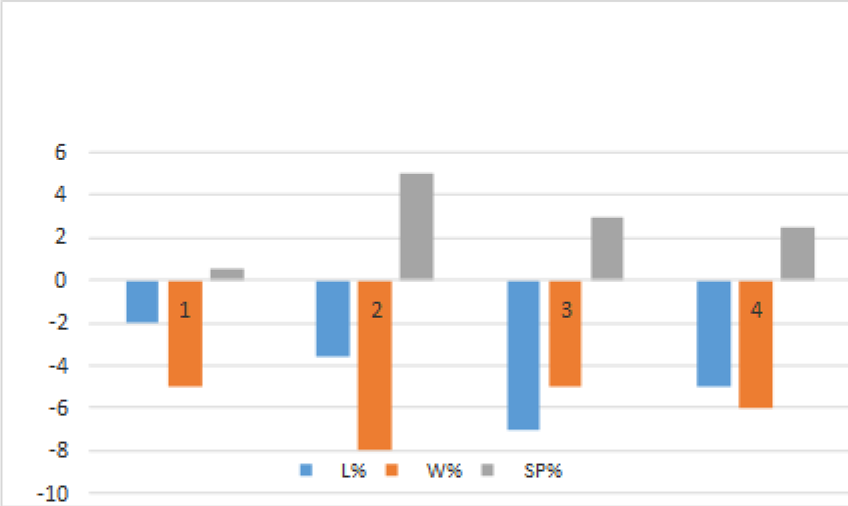
count	L%	W%
24	-2	-5
24	-0.5	-4
24	-2.3	-5
28	-0.8	-3.6
28	-0.3	-2.3
28	0.3	-3.8
28	-5	-4
32	-4	-5



IV. Result and Discussion

By testing spirality and shrinkage percentage of the samples according to the mentioned procedure and formula results are presented in Table 4.1. It was expected that the results obtained for the dimensional stability tests carried out would be significantly different for the fabric structures, due to the distinct nature of each structure. A positive value indicates extension of tested fabrics and negative value represents shrinkage. It was expected that the results obtained for the dimensional stability tests carried out would be significantly different for the fabric structures, due to the distinct nature of each structure.

Fabric Type	GSM(Avg)	Yarn count	L%	W%	SP%
s/j	200	20/1	-3.6	-8.0	5
S/J	180	24/1	-5.0	-5.0	5
s/j	160	26/1	-2.0	-4.0	3.0
s/j	150	28/1	-3.0	-4.0	2.5



The overall shrinkage and spirality percentage of the fabric samples is depicted on the above graph.If we separate the results and placed it in graph , the following graph may be appeared.

V. Conclusion

It is clear that GSM increases with the decrease of yarn count. As the finer yarn gives tighter fabric structure that's why shrinkage reduced gradually by using finer yarn. It is also evident that the percentage of spirality varies with the GSM and yarn count.

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