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EFFECT OF LYCRA (SPANDEX) PERCENTAGE ON PROPERTIES OF WEFT KNITTED SINGLE JERSEY FABRIC

HABIBUR RAHMAN, PRASHANTA KUMAR ROY, LABLU MIAN and JOYKRISNA SAHA*

Department of Textile Engineering, Mawlana Bhashani Science and Technology University, Santosh, Tangail-1902, Bangladesh

Abstract

Weft knitted single jersey elastic fabrics are produced by cotton-lycra (spandex) yarn in a circular knitting machine. This type of fabrics and their garments have a great response and gain their original size and shape due to physical extension by any part of human body. Lycra yarn has much capability to give large stretch and dimensional recovery than can be achieved by cotton yarn alone. This research analyzed the effect of lycra percentage on the single jersey knitted fabric properties such as Shrinkage, Spirality, Pilling, Bursting strength etc. These properties depend on various production parameters such as count of cotton and lycra yarn, lycra percentage, stitch length, machine diameter, number of feeder, machine setting, RPM, treatment processes etc. The aim of this study is to find out the effect of lycra (Spandex) percentage on single jersey knitted fabric properties though all the production parameters were same in case of 2% lycra and 4% lycra single jersey weft knitted fabrics. The work revealed that Shrinkage and bursting strength decreases with the decrease of lycra percentage, Spirality decreases and Pilling quality increases with the increase of lycra percentage and vice versa.

Key words: Lycra percentage, Shrinkage, Spirality, Pilling, Bursting strength

Introduction

Single jersey knitted fabrics are generally used to make underwear and outerwear such as T-shirts, polo shirt, sports wear, swimming wear etc. Knit fabric can more easily deform or stretch by compressing or elongating the individual stitches (Chathura, 2008). This ability to stretch by stitch rearrangement adds to wearing comfort that, among other factors, is affected by properties such as Shrinkage, Spirality, Pilling and Bursting strength. To improve the recovery performance of circular single jersey knitted fabrics, it is now common practice to co-knit a small amount of lycra (spandex) yarn with companion cotton yarn. As used herein, Lycra means a manufactured fiber in which the fiber forming substance is a long–chain synthetic polymer comprised of at least 85% of segmented polyurethane (Meredith, 2004). The polyurethane is prepared from a polyether glycol and chain extender and then melt-spun, dry spun or wet-spun to form the spandex fibers. There are different counts and types of lycra in the market. A fabric knitted from two yarns of different properties both of which are used in the same loop whilst

* Author for correspondence: joykrishnakaratia@yahoo.com

positioned one behind other is known as plated fabric (Mclntyre, 1997). When the cotton and the lycra yarn are knitted parallel or side-by-side in every course, with the lycra yarn always kept on one side of the cotton yarn, the method is classified as "full plating or full feeder".

When the Lycra is placed in alternating courses, the method is classified as half plating or half feeder (Sadek *et al.*, 2012). Feeding of the Lycra yarn to knitting machine with a rate less than the required stitch length of cotton yarn results in yarn extension which in turn generates tension and as the knitted loops leave the needles the spacing of courses and wales decrease and the fabric shrinks in both directions, pilling quality also increase and require more strength to tear the fabric thus affecting the properties of knitted fabric (Sadek *et al.*, 2012). The effect of lycra fibre on the extension-at-peak load, immediate recovery, delayed recovery, permanent set and resiliency of cotton-lycra blended knitted fabric. It was observed that the immediate recovery, extension and resiliency of lycra fabric are higher than 100% cotton fabric (Mukhopadhyay *et al.*, 2004).

Materials and Method

Materials

The single jersey knitted cotton fabrics with 2 and 4% lycra were produced in circular knitting machine from 34's combed cotton yarn with 20D lycra yarn and heat was setted, dyed, finished with the same parameters. Yarn, fabric, machine specification, finishing parameters is given bellow in table 1, 2, 3 and 4 respectively.

Table 1. Yarn specification

Name of Yarn	Nominal count	Actual count	Type of yarn	Brand name	Origin
Cotton	34^s/1 Ne	33.76^s/1 Ne	Combed	Square	Bangladesh
Lycra	20D	20D	Elastomeric	Roica	Korean

Table 2. Fabric specification

Fabric sample	Type of fabric	Stitch length (mm)	Grey GSM
A	2% lycra cotton	2.90	182
B	4% lycra cotton	2.90	200

Table 3. Machine specification of single jersey knitting machine

Company Name	Jiunn Long
Country of origin	Taiwan
Machine diameter	34"
Number of feeder	102
Machine gauge	24
Number of needles	2544
Machine speed	25 rpm

Table 4. Finishing parameters

Finishing Machine	Temperature	Over feed%	Speed	Compacting
Stenter	150°C	60-80%	45 m/min	-
Open compactor	115°C	50%	28 m/min	15%

Methods

An increase or decrease in the length or width of a fabric is called a dimensional change, decrease in size is referred to as shrinkage and an increase as growth. Dimensional change is usually expressed as a percentage of the original size of the specimen. The horizontal distortion of wales yarn from its grain line is called spirality. Spirality is very important for control the quality of fabric. Spirality of knitted fabric is obtained when the wale is not perpendicular to the course, forming an angle of spirality with vertical direction of the fabric. The ability of a material to resist rupture by pressure is called bursting strength. The force required to rupture a fabric by extending it with a force applied at angles to the plane of the fabric under specified condition. Pilling is a condition that arises in wear due to the formation of little pills of entangled fibre clinging to the fabric surface giving it an ugly appearance. Pills are formed by a rubbing action on loose fibres which are present on the fabric surface. Spirality, shrinkage, bursting strength and pilling varies due to changing lycra percentage. For measuring spirality and shrinkage samples are marked with scale at 50cm (lengthwise and widthwise). No tension is applied to samples during measuring spirality and shrinkage percentage. At first it was washed by the ISO:6330 method. We had to wash those sample fabrics at 40°C for 40 min. After washing we took those sample for tumble drying. We had to dry those sample fabrics for 30min 60°C temperature. The specimen are then allowed to cool, precondition and then condition for another 24 hour to bring these into the same state they were in when these were marked. They are then remeasured on a flat smooth surface and the percentage of dimensional change can be calculated.

Calculation of shrinkage:

Shrinkage can be calculated from the following formula:

$$\text{Shrinkage} = \frac{\text{After wash measurement} - \text{Before wash measurement}}{\text{Before wash measurement}} \times 100\%$$

Calculation of Spirality:

Spirality has been calculated from the following formula:

$$\text{Spirality} = \frac{\text{Left side deformation} + \text{Right side deformantion}}{\text{Fabric length}} \times 100\%$$

(Factory source: Impress-Newtex Composite Textiles Ltd. Gorai, Mirzapur)

Sequences for measuring Shrinkage and Spirality:

1. Liquor Ratio 1:50
2. Temperature : 30 to 35°C
3. Suitable Wetting agents (detergent) 0.5% on the weight of the sample.
4. Sample size 50 x 50 cm.
5. Marking area 35 x 35 cm (mark with marking scale).
6. Total Time: 2 hours
7. After that dry at 30°C.
8. Measurement.

The bursting strength was measured by the true burst automatic bursting machine at ISO:13937 standard . At first the machine calibration was checked without fabric. After that sample fabric was placed on the machine. At least four tests were carried out and average values were measured. For measuring pilling by the Method: ISO-12945, two specimens dimension of 125mm X 125mm are cut from the fabric. A seam allowance of 12mm is marked on the back of each square. In two of the samples the seam is marked parallel to the warp direction and in the other two parallel to the weft direction. The samples are then folded face to face and a seam is sewn on the marked line. This gives two specimens with the seam parallel to the warp and two with the seam parallel to the weft. Each specimen is turned inside out and 6mm cut off each end of it thus removing any sewing distortion. The fabric tubes made are then mounted on rubber tubes so that the length of tube showing at each end is the same. Each of the loose ends is taped with Poly vinyl chloride (PVC) tape so that 6mm of the rubber tube is left exposed. We follow the procedure in laboratory with two samples. Such as full feeder 4% lycra single jersey and 2% lycra single jersey, then this two tube containing these two samples are placed inside pilling box and then start the circulation of box by switching on the machine for 14400 times for two hours as per requirement or method.

Results and Discussions

The above mentioned tested samples were produced by same cotton and lycra yarn with same machine, loop length and other process parameters. But the tested result of Shrinkage, Spirality, Pilling and Bursting strength varies only due to change of lycra percentage. The results and discussions are mentioned bellow.

The above results shown that fabric shrinkage percentage decreased with the decreasing of lycra percentage and vice versa. Due to more amount of lycra yarn present in full feeder lycra cotton fabric, it shown more tendency of shrinkage than half feeder lycra fabric.

Table 5. Shrinkage% of sample fabric

Sample No.	Types of fabric	Dimensional change% (length wise)	Dimensional change% (width wise)
1	Full feeder 4% lycra cotton fabric	-1.4	-1.4
2	Half feeder 2% lycra cotton fabric	-0.8	-1.2

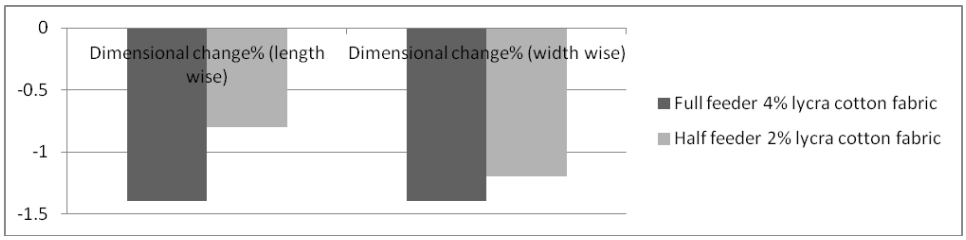

Fig. 1. Lengthwise and widthwise Shrinkage% of single jersey fabric.

When apply stress to the full feeder lycra fabric then extend more due to washing than half feeder lycra fabric, as like as after removal of additional force it shrinks comparatively more than half feeder lycra fabric after washing and tumble drying. Therefore full feeder lycra fabric has been shrunk more than half feeder lycra fabric. If we consider fabric dia, the half feeder fabric dia is more than full feeder lycra fabric at the same finishing process.

Table 6. Spirality % of sample fabrics

Sample No.	Types of fabrics	Spirality%
1	Full feeder 4% lycra cotton fabric	1
2	Half feeder 2% lycra cotton fabric	2

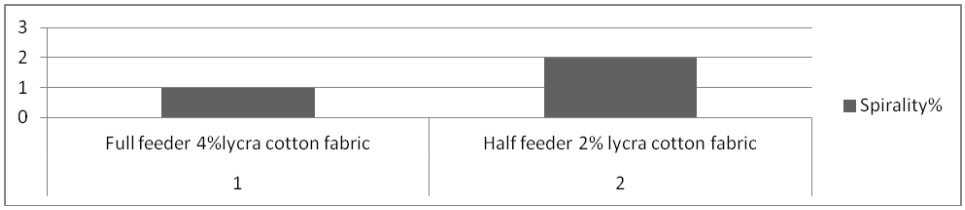

Fig. 2. Spirality % of the tested fabrics due to washing.

From the above results we have seen that with the decreasing of lycra percent spirality is increased. Due to more amount of lycra yarn present in full feeder lycra cotton fabric the recovery of its original state occurred immediately than half feeder lycra fabric. Therefore full feeder lycra has less deformation than half feeder lycra fabric. Finally it has been seen that, full feeder lycra fabric's spirality is better than half feeder lycra fabric.

Table 7. Bursting strength of sample fabrics

Sample No.	Types of fabrics	Pressure (psi)	Time(sec.)	Flowrate (cm^3/min)
1	Full feeder 4% lycra cotton fabric	50.68	20.2	114.9
2	Half feeder 2% lycra cotton fabric	40.24	19.9	105.7

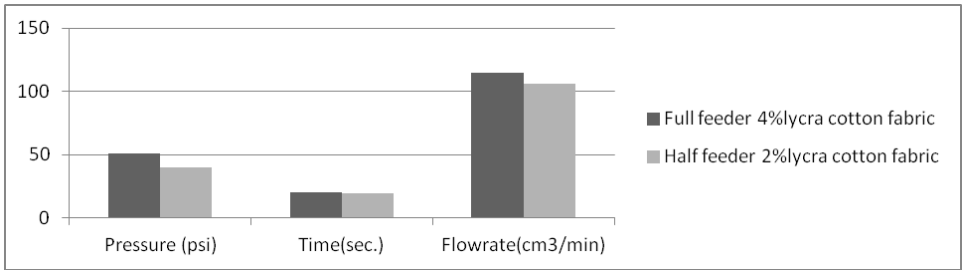

Fig. 3. Mean value of Bursting strength both full feeder and half feeder fabrics.

From the above result we have found that half feeder lycra fabric having low bursting strength because decreasing lycra percentage; time, flow rate and pressure is also decreasing. More lycra percentage show more elasticity or stretching since more flexible part present in full feeder lycra fabric. As a result full feeder lycra fabric gives more bursting strength.

Table 8. Pilling test result of sample fabrics

Sample No.	Types of fabrics	Grading No.	Grading Type
1	Full feeder 4% lycra cotton fabric	4-5	Between no pilling and slightly piling
2	Half feeder 2% lycra cotton fabric	4	Slightly pilling

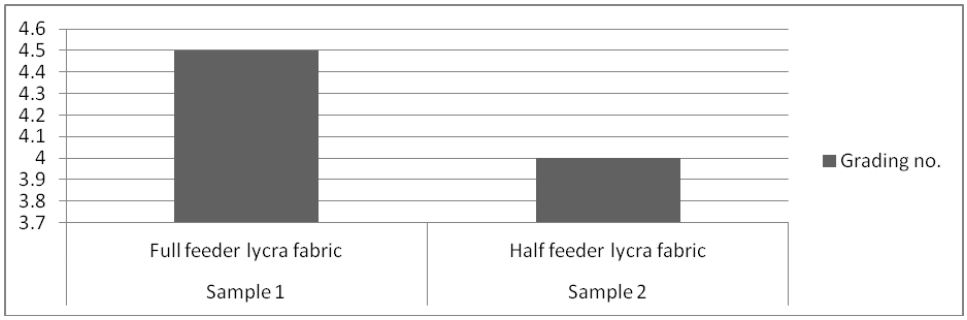

Fig. 4. Pilling test result of sample fabrics.

Pilling quality of fabrics is better in case of fabrics containing full feeder lycra than the fabric containing half feeder lycra. That is increasing lycra percentage shows better pilling quality. In case of full feeder lycra (4%) in single jersey knitted fabric grading

scale is 4-5, It means between no pilling and slight pilling and in case of half feeder lycra (2%) in single jersey knitted fabric grading scale is 4, it means slight pilling. Here it is seen that fabric with more cotton i.e. half feeder lycra fabric produces more pilling.

Conclusion

This study analyzed the effect of lycra percentage on shrinkage, spirality, pilling and bursting strength. Incase of shrinkage test; for 4% lycra cotton fabric has -1.4% both in length and width wise and for 2% lycra cotton fabric length wise -0.8% and width wise -1.2% dimensional change had been observed. In case of spirality test; 4% lycra cotton fabric has 1% and 2% lycra cotton fabric has 2% spirality. For pilling test; 4% lycra cotton fabric is in "Between no pilling and slightly piling" and 2% lycra cotton fabric is in "Slightly pilling". For bursting strength test; 4% lycra cotton fabric required 50.68 psi pressure and 2% lycra cotton fabric required 40.24 psi pressure. From the above discussion it is clear that except shrinkage all the fabric properties seems better with the increase of lycra percentage in fabric.

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