Journal of Textile Science and Technology, 2022, 8, 203-220
https://www.scirp.org/journal/jtst
ISSN Online: 2379-1551
ISSN Print: 2379-1543

Influence of Lycra Content and Stitch Length on the Dimensional and Physical Characteristics of Lycra Back Plaited Cotton (LBPC) Single Jersey Fabrics

Md. Razib Sheikh[1*], Md. Kawsar Hossain[2], Mohammad Mahmudur Rahman Khan[1]

[1]Department of Textile Engineering, Bangladesh University of Business and Technology, Dhaka, Bangladesh
[2]Department of Textile Engineering, Khulna University of Engineering and Technology, Khulna, Bangladesh
Email: *sheikhm.razib@gmail.com

How to cite this paper: Sheikh, Md.R., Hossain, Md.K. and Khan, M.M.R. (2022) Influence of Lycra Content and Stitch Length on the Dimensional and Physical Characteristics of Lycra Back Plaited Cotton (LBPC) Single Jersey Fabrics. *Journal of Textile Science and Technology*, **8**, 203-220.
https://doi.org/10.4236/jtst.2022.84015

Received: June 26, 2022
Accepted: September 18, 2022
Published: September 21, 2022

Abstract

The physical and dimensional characteristics, *i.e.* course and wale spacing, stitch density, tightness factor, diameter, porosity, dimensional stability and bursting strength of single jersey knitted items containing lycra yarn with the variations in stitch length and lycra content have been examined and a detail investigation on the lycra filament has been discussed in this study. Six different samples were knitted with identical cotton and lycra yarn but different in lycra contents and stitch length. After conditioning in a controlled environment, all the samples were tested as per the established methods. After analyzing the test results, noticeable effects of variations in stitch length and lycra content on physical and dimensional characteristics of single jersey knitted fabric has been found. As smaller the stitch length and as greater the lycra content, the dimensional stability and bursting strength are better; on the other hand, the air permeability is lower.

Keywords

Lycra Content, Stitch Length, Back Plaited, Dimensional Stability, Porosity, Bursting Strength

1. Introduction

Normally single jersey knitted fabrics are used to make underwear and outer-wears. Knit fabric can be more easily deformed or stretched by compressing or elongating the individual stitches that form the fabric. Cotton yarn having no elastomeric properties cannot be recovered to its original position after extension or compression. So permanent deformation is shown by 100 percent cotton single jersey knitted fabric. For enhancing the recovery performance of single jersey knitted items, the established practice is to add a small amount of lycra yarn to the cotton yarn.

1.1. History and Origin of Lycra

Technically referred to as a segmented polyurethane, LYCRA® is a type of synthetic fiber that falls under the general category of elastane (also known as spandex in the US and Canada). It is made up of "soft," or flexible, segments that are joined by "hard," or stiff, segments. This provides the fiber with its inherent, long-lasting suppleness. [1]

During World War II, the creation of lycra got underway. At this time, chemists started the task of creating artificial rubber substitutes. Their study was motivated by two main considerations. First, the majority of the rubber that was available for building equipment was first used for the war effort. Second, the cost of rubber was unstable and constantly changed. Creating a rubber substitute might be able to address both of these issues. [1]

Even though DuPont created and patented elastomeric block copolymer fibers in 1950, their first commercial fiber wasn't released under the name "Lycra" until 1962. Poly (tetra-methylene ether) glycol was used to create the polymer for Lycra, which was then "chain extended" using hydrazine to create the segmented elastomer. This reaction produced a capped glycol with isocyanate end groups. Lycra fibers were then created by dry and wet spinning solvent (dimethyl formamide) solutions. [1]

1.2. Chemical Composition of Lycra

Lycra is a long-chain synthetic polymeric fiber that is actually synthesized and compares to at least 85% segmented urethane, sensationally weird polyurethane. Polyester or polyether polyol fibers include supple, rubbery segments that enable the fiber to stretch up to 600 percent before returning to its original shape. The stiffness of hard segments, which are often made of urethanes or urethane-ureas, imparts tensile strength and restricts plastic flow (**Figure 1**).

Elastomeric fiber known as lycra is frequently utilized as a small part of stretch clothing to offer stretch with recovery. Lycra fibers, commonly known as elastane fibers, are ones that contain at least 85% segmented polyurethane. Hard and soft segments alternately make up segmented polyurethanes, which are

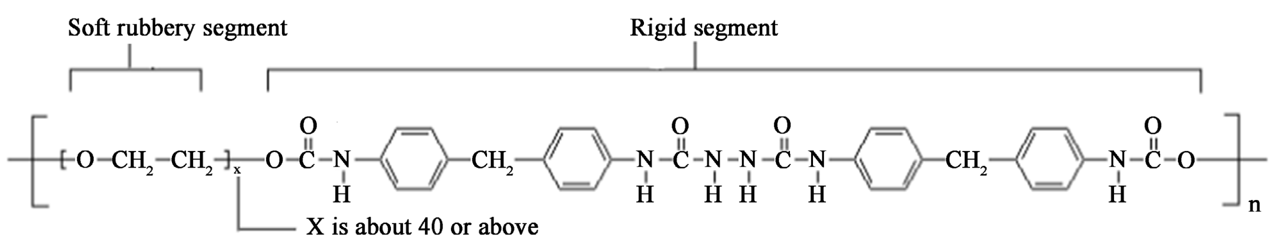

Figure 1. Polymeric structure of lycra [1].

connected by urethane linkages (NH-CO-O).

1.3. Properties of Lycra

The fit of sports apparel to the human body determines how comfortable it is. A second skin has been connected to clothing. Human skin is very extensible, and once the stress is removed, it returns to its natural place. Depending on the molecular weight of the soft section, elastic fibers can elongate five to six hundred percent at the break. Lycra is utilized in both male and female active sports clothes as well as dress, suit, and shirt constructions. Only a small amount, 2 - 5 percent of the fabric's overall weight is made up of lycra, ensuring fit and comfort (Table 1, Figure 2).

1.4. Use of Lycra in the Garments

One of the top five major sectors in the United States now is clothing and textile production, which was predominantly a domestic industry in the early nineteenth century. People have traditionally valued clothing because it satisfies one of their fundamental requirements.

Woven fabrics are made by weaving together two or more sets of yarns; therefore unless they are specifically stretch woven, they cannot stretch significantly. Weaving is the primary method used to create fabrics since it results in a sturdy, long-lasting product. More body and less porosity are provided by the fabric's compactness, which warms the cloth. The stress-strain and recovery

Table 1. Lycra properties [2].

Behavior on heating	Sticks at 350 - 3900 F and melts above 5000 F
Reaction with bleaching agents and solvents	Good resistance to oxidizing agents. Poor resistance to bleaching agents
Reaction with acids and alkalis	Good in diluted but degrades in strong acids and bases
Abrasion behavior	Good
Mildew, aging and sunlight effect	Excellent aging and mildew resistance and good resistance against sunlight

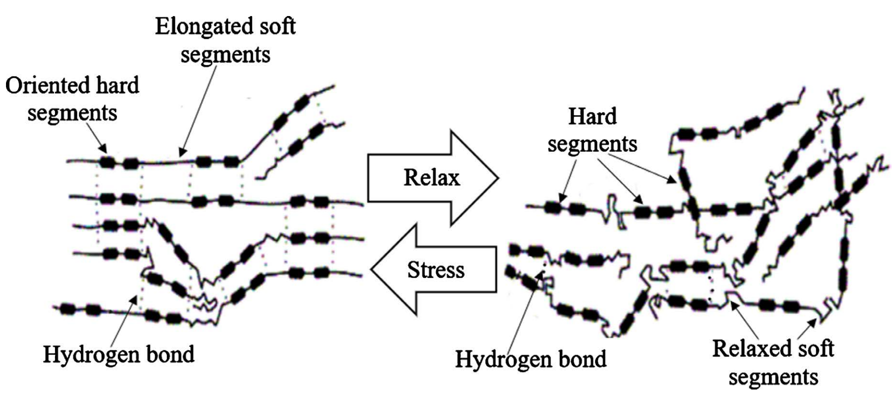

Figure 2. Lycra filament with relaxed and extended polymer and hydrogen bonds [3].

characteristics of woven fabrics are not adequate because they do not respond fully to an applied stress system.

The interdependence of each stitch with its neighbors on either side, above and below it, determines many of the features of knitted constructions. Knitted loops are referred to as "wale" and "course" respectively because they are arranged in columns and rows that roughly correspond to the warp and weft of woven constructions. Certain characteristics are shared by all knit materials and clothing. Excellent elongation and elastic recovery in both directions, which enable them to conform to the body so effortlessly, are probably the most significant for the average consumer. Some clothing can be knit into shape and then "fashioned"; cutting or sewing is not necessary.

Because of its comfort and fit, lycra is used in a wide variety of products, including swimwear, active athletics, and floor gymnastics. Knitted fabric has stretch, allowing for complete flexibility of movement, and in particular, serves two crucial functions: allowing for complete freedom of movement and transferring body moisture to the following textile layer in the garment system. Knitted cloths seem to be the appropriate foundation for functionally sound sportswear thanks to innovative combinations of fabrics and yarns and advancements in fabric manufacturing. Knitted clothing should receive special consideration because it is frequently worn adjacent to the skin [1].

In both knits and wovens, lycra can be incorporated lengthwise, crosswise, or both ways. There isn't actually a fabric produced purely of Lycra that is readily available in the market; it is always coupled with another fiber (or fibers), both natural and synthetic, either in back plaited or core-spun form.

The type and quantity of Lycra needed to give the best possible performance and appearance depends on the fabric type and its intended application. The mobility, drape, and shape retention of fabric can be improved with just 2 percent of Lycra, whereas textiles for high-performance apparel like active sportswear and swimwear may have up to 30 percent of Lycra. The use of Lycra in bare or coated yarn forms depends on weaving or knitting techniques, fabric type, and end use. In a weft jersey knit, lycra is plated in with every other yarn to provide crosswise elasticity (**Figure 3** & **Figure 4**).

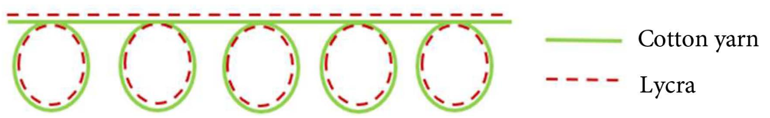

Figure 3. Pattern of lycra back plaited cotton (LBPC) single jersey plain knitted fabric [4].

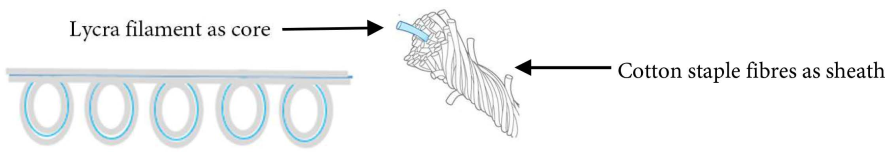

Figure 4. Pattern of lycra core cotton spun (LCCS) single jersey plain knitted fabric [4] [5].

1.5. Review

Haji [3] examined the physical characteristics of single jerseys made of cotton and lycra as well as cotton-only knit fabric. The statistical research demonstrated that the proportion of lycra has a negative impact on dimensional stability and air permeability. Increasing the lycra percentage increased the weight of the fabric. He demonstrated that raising the lycra ratio considerably improved cloth crease recovery. Eman Eltahan [6] examined that the properties of lycra plaited single jersey fabrics improved than only cotton knitted fabric. With the same purpose Herath [7] used lycra core cotton spun yarn. Senthil Kumar [8] discovered that stretch sportswear should be made with lycra back plaited cotton (LBPC) knitted textiles rather than lycra core cotton spun (LCCS) knitted fabrics. Additionally, they discovered that because of the cotton wrapped surface in the yarn periphery, LCCS knitted fabric absorbs a drop of water more quickly than LBPC fabric. Furthermore, due to its increased stitch density, LBPC fabric has smaller inter-yarn gaps. According to Prakash and Thangamani [9], cloth dimensions significantly changed after wet relaxation. After wet relaxation, the courses per inch rise from 17.65 to 70.49 percent, with an average percentage change of 47.56 percent. After wet relaxation, the wales per inch dropped from 59.57 to 31.75 percent, with an average percentage decline of 44.2 percent. They came to the conclusion that the fabric looks better with a 2.5mm loop length and a 10 percent stretch level. The impact of Lycra content on single jersey qualities was researched by Sadek *et al.* [10]. The course density rose by 40 percent, the wale density rose by 6 percent, the thickness rose by 25 percent, the air permeability dropped by 78 percent, and the initial elasticity modulus dropped by 55 percent as the Lycra extension percent rose to 232 percent in the case of the half plating fabrics. Additionally, for the full plating fabrics, the initial elasticity modulus decreased by 69 percent, the air permeability decreased by 92 percent, the thickness increased by 46 percent, the wale density increased by 14 percent, the course density increased by 77 percent, and the wale density increased by 14 percent. The entire plated fabric's abrasion resistance is enhanced by an average value of 15 percent. As a result, the course density and wale density findings for the half-plated fabrics were improved.

2. Materials and Methods

2.1. Materials

There are six separate single jersey samples knitted: three with different stitch lengths having the same lycra content and the other three as different lycra content of the same stitch length. Samples were produced in Jiunn Long plain jersey circular knitting machine of 34 diameters and 24 gauges. 40 Ne ring spun cotton yarn and 20 denier lycra yarn were used in the project (**Table 2**).

2.2. Methods

The methods for this experimental project are summarized in **Table 3** as follows:

Table 2. Material details and specifications.

Materials	Brand	Specifications
Knitting Machine	JIUNN LONG	• Diameter: 34” • Gauge: 24 • No. of needles: 2560 • No. of cam: 102 • Maximum speed: 25 rpm • Standard speed: 21 rpm • Operating speed: 16.8 rpm • Rotation: Anti-clockwise • Lycra feeding system: IRO MER2 [4]
Cotton yarn	KAMAL	• Count: 40 Ne • Type: Combed • Color: Grey
Lycra filament	CREORA	• Count: 20 D • Color: Clear • Elongation percentage: 650 ± 30

Table 3. Testing methods and equipment’s used [4].

Tests	Methods	Equipment’s
WPI & CPI	Manually	Counting Glass, Needles
Stitch Density	Manually	N/A
Diameter	Manually	Measuring tape
Fabric Weight	ASTM D 3776	GSM Cutter, Electronic Balance
Shrinkage	ISO 6330, ASTM D1204	Wascator, Shrinkage template
Diaphragm bursting strength	ASTM D3786	DigiBurst
Spirality	ISO 16322	N/A
Porosity & Loop shape factor	Manually	N/A

The project work was split into two sections. The first section was to knit fabrics with cotton of different loop lengths, *i.e.* 2.7, 2.8 & 3.0, keeping lycra content constant. In the second section, fabrics were knitted with different lycra content *i.e.*, 3%, 4% & 5.5%, keeping stitch length constant. The six different samples were conditioned for 24 hours in a controlled environment of 20 ± 1 degree Celsius and 65 ± 2 relative humidity percentage. [11]

2.3. Finishing Processes

The finishing processes [6] of the samples were as follows (**Table 4**):

1) Heat-setting.

2) Peroxide bleaching.

Table 4. Heat setting parameters [12] and open compacting parameters [8].

Heat setting		Open compacting	
Parameters	**Value**	**Parameters**	**Value**
Speed	22 m/min	Speed	12 m/min
Temperature	185˚C	Temperature	120˚C
Over feed	35%	Over feed	100%
		Compaction	5%

3) Rinsing.
4) Neutralization (Acetic Acid).
5) Cold wash.
6) Drying.
7) Compacting.
8) Relaxation in store for 24 hours.

2.4. Measuring the Physical and Dimensional Properties

The physical and dimensional characteristics of lycra jersey fabric are described below:

1) Fabric Diameter: The diameter of the knit fabric means the width of the fabric. Normally two types of diameters are used in industry: i) Tube diameter and ii) Open diameter. When the knit fabric after knitting in circular knitting machine is not slitted and width is measured the diameter is tube diameter and after slitting the tube fabric the measured diameter is known as open diameter.

2) Courses per Inch (CPI): A course contains the stitches/loop of adjacent needles and stays in the width direction of fabric. The number of courses per inch of length of fabric is known as CPI.

3) Wales per Inch (WPI): A wale contains the stitches formed by same needle and stay in length direction of the fabric. The number of wales per inch of width of fabric is known as WPI.

4) Stitch Density: Stitch density is the number of stitches per unit area. It is the product of CPI and WPI. That means stitch density is the product of course density and wales density.

5) Fabric weight (GSM): It is the measure of weight in gram per square meter of fabric. More GSM of the fabric means more compact and thicker fabric.

6) Shrinkage: The reduction in the length or width of fabric after washing. As per [ASTM D1204],

Shrinkage percentage = ((length of fabric before wash) − (length of fabric after wash))/((length of fabric before wash)) × 100

7) 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 in about zero.

Spirality percentage = (Average Deviation of side seam line)/(Total hem length) × 100 [ISO 16322]

8) Tightness Factor/Loop shape factor [13]: Ratio of the area covered by yarn in one loop to the area occupied by that loop. Generally, the loop shape factor or tightness factor is calculated from the equation:

$$\text{Tightness factor} = \sqrt{\text{Tex}}/L \text{, here, } L = \text{Loop length in mm}$$

9) Porosity [6]: Porosity of knitted fabric can be defined as – "the ratio between the volume of the fibers in the cell and the volume of the unit cell of knitted fabric". Therefore,

$$\text{Porosity percentage} = (1 - (\text{volume of fibers})/(\text{volume of cell})) \times 100$$

$$\text{Volume of the fibers} = (\text{weight of the yarn in the cell})/(\text{fiber density})$$

$$\text{Weight of yarn} = L \times \text{Tex}/10^6$$

Where L is the loop length in mm and $\text{Tex}/10^6$ is the weight of yarn per mm:

$$\text{Volume of cell} = t/(c \times w)$$

where (t) is the fabric thickness, which is $2d$ for single jersey; that is, $t = 2d$, $d = 0.044\sqrt{\text{tex}}$, in mm

$$\text{Porosity percentage} = \left(1 - \left(c \times w \times L \times \pi \times d\right)/8\right) \times 100,$$

where, c = courses/mm; w = wales/mm.

10) Bursting Strength: Bursting strength is a method of measuring strength in which the material is stressed in all directions at the same time and is therefore more suitable for materials such as knitted fabrics. [ASTM D3786]

3. Data Analysis

3.1. Data for CPI, WPI and Stitch Density (Table 5)

Table 5. CPI, WPI and stitch density.

Sample no.	Data type	Stitch Length (mm)	Lycra content	CPI	WPI	Stitch Density (Inch^{-2})
1 (a)	Stitch Length variation	2.7	5%	56	41	2296
1 (b)		2.8	5%	54	38	2052
1 (c)		3.0	5%	50	32	1600
2 (a)	Lycra content variation	2.7	3%	54	41	2214
2 (b)		2.7	4%	55	41	2255
2 (c)		2.7	5.5%	57	42	2394

3.2. Data for Fabric Weight (Table 6)

Table 6. Fabric weight in different states.

Sample no.	Data type	Stitch Length (mm)	Lycra content	Fabric GSM		
				Gray	After Heat Set	Final
1 (a)	Stitch Length Variation	2.7	5%	198	157	165
1 (b)		2.8	5%	190	148	155
1 (c)		3.0	5%	172	138	145

Continued

2 (a)	Lycra content variation	2.7	3%	175	138	145
2 (b)		2.7	4%	187	149	156
2 (c)		2.7	5.5%	195	154	162

3.3. Data for Fabric Diameter (Table 7)

Table 7. Fabric diameters in different states.

Sample no.	Data type	Stitch Length (mm)	Lycra content	Fabric Diameter (inch)		
				Gray	After Heat Set	Final
1 (a)	Stitch Length Variation	2.7	5%	58.3	70.2	64.3
1 (b)		2.8	5%	61.5	71.1	66
1 (c)		3.0	5%	67.2	73.6	68.8
2 (a)	Lycra content variation	2.7	3%	60.4	74	64.4
2 (b)		2.7	4%	59	71.5	63.7
2 (c)		2.7	5.5%	58.9	70.8	62.0

3.4. Data for Shrinkage and Spirality (Table 8)

Table 8. Shrinkage and spirality.

Sample no.	Data type	Stitch Length (mm)	Lycra content	Shrinkage (percentage)		Spirality (percentage)
				Length	Width	
1 (a)	Stitch Length variation	2.7	5%	−3	−3.2	0.5
1 (b)		2.8	5%	−3.2	−4.5	2.2
1 (c)		3.0	5%	−6.1	−4.5	2.8
2 (a)	Lycra content variation	2.7	3%	−4.8	−6.5	2.4
2 (b)		2.7	4%	−3.2	−4	1.8
2 (c)		2.7	5.5%	−1.5	−2.8	0.5

3.5. Data for Loop Shape Factor, Porosity and Bursting Strength (Table 9)

Table 9. Loop shape factor, porosity and bursting strength.

Sample no.	Data type	Stitch length (mm)	Lycra content	Loop shape factor	Porosity (percentage)	Bursting strength (kPa)
1 (a)	Stitch Length variation	2.7	5%	15.271	31.544	259.5
1 (b)		2.8	5%	14.725	36.553	251.3
1 (c)		3.0	5%	13.744	46.995	238.9
2 (a)	Lycra content variation	2.7	3%	15.271	33.989	234.4
2 (b)		2.7	4%	15.271	32.767	248.7
2 (c)		2.7	5.5%	15.271	28.622	265.2

4. Results and Discussion

4.1. Coarse per Inch and Wales per Inch

From Figure 5, the wales per inch or courses per inch fall when the loop length increases which is independent on the lycra contents in the fabric. This is because the Lycra in the yarn tends to contract the loops to each other.

From Figure 6, by adding Lycra to the fabric, the course density increases with the increase in Lycra feed percentage, and by adding more Lycra to the cloth, it was possible to see the fabric shrink longitudinally. The fall in course density caused by lengthening the fed loop is already fairly obvious at various loop lengths.

4.2. Stitch Density

Figure 7 demonstrates that the stitch density falls with the rising loop length which is independent on the lycra content in the fabric. Having same percentage of Lycra fed to the samples while varying the stitch length which increases air permeability and decreases CPI or WPI and thus stitches density.

Figure 8 shows that the density of the course and wales of knitted fabrics increases when Lycra is added, and that the fabric contracts in the lengthwise direction as the lycra content is increased.

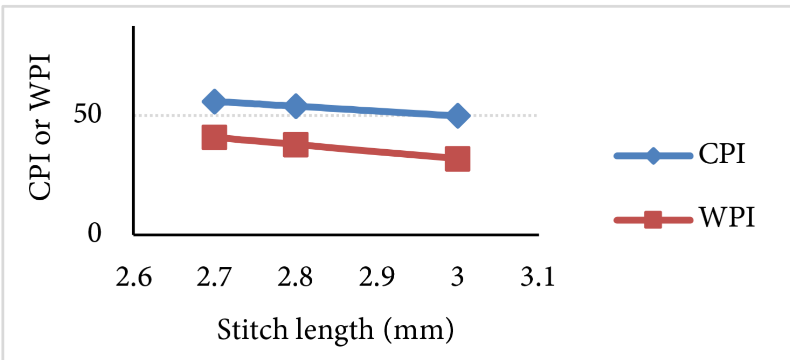

Figure 5. Effect of stitch length on CPI or WPI.

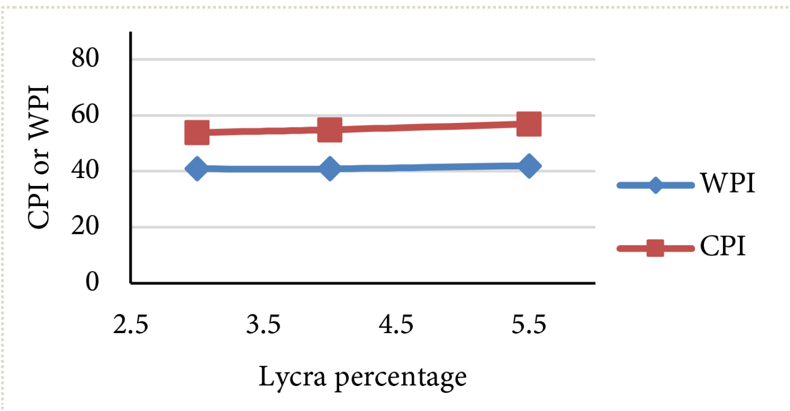

Figure 6. Effect of lycra content on CPI or WPI.

4.3. Fabric Weight

Figure 9 makes it clear that the weight of the fabric reduces as stitch length increases. This is due to the fact that longer stitches result in longer loop legs, which causes the courses to move farther apart and, as a result, the course density to drop.

However, **Figure 10** shows that when different Lycra contents are present for the same stitch length, the fabric weight somewhat increases. This indicates that the impact of Lycra on knitted fabric is greater than the impact of stitch length increase, which causes the cloth to compact together. This example involves any Lycra yarn proportion between 3 percent, 4 percent, and 5.5 percent.

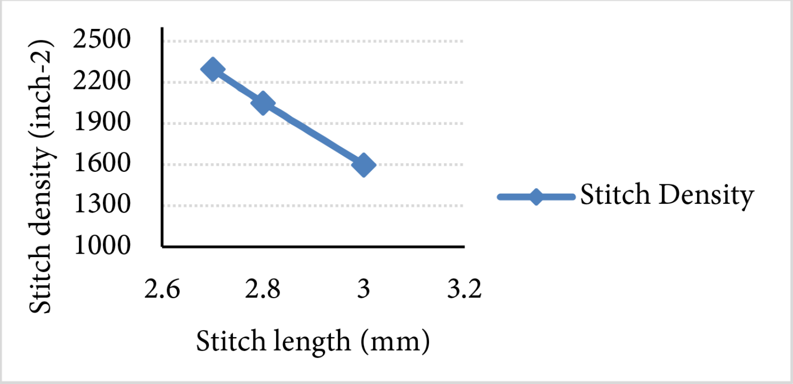

Figure 7. Effect of stitch length on stitch density.

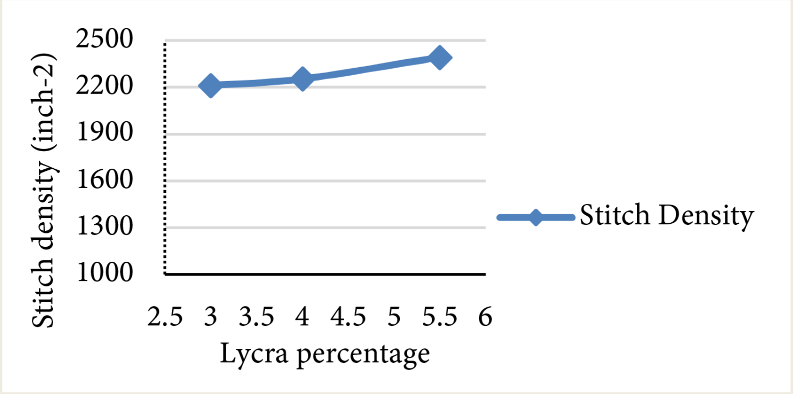

Figure 8. Effect of lycra content on stitch density.

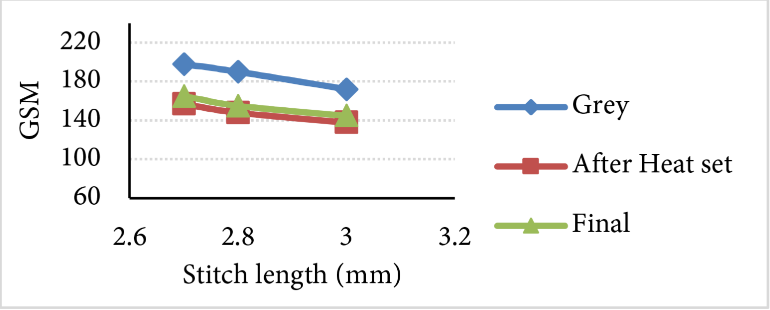

Figure 9. Effect of stitch length on fabric weight.

4.4. Fabric Diameter

No matter what the amount of Lycra is, Figure 11 demonstrates that an increase in stitch length results in an increase in fabric diameter. The largest diameter of fabric is displayed by a stitch length of 3 mm. This is because the diameter has shrunk due to lycra's great capacity to shrink.

On the other hand, Figure 12 demonstrates that the effectiveness of loop length on fabric diameter depends on the amount of Lycra present. Therefore,

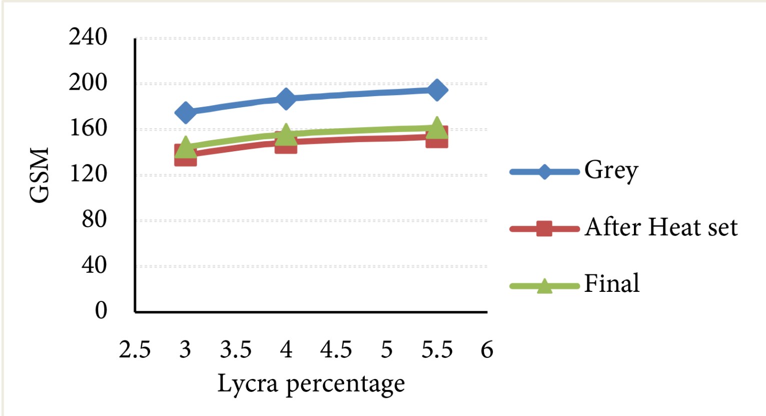

Figure 10. Effect of lycra content on fabric weight.

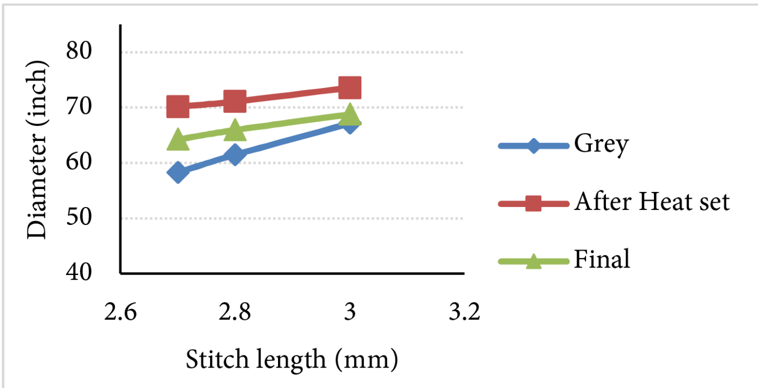

Figure 11. Effect of stitch length on fabric diameter.

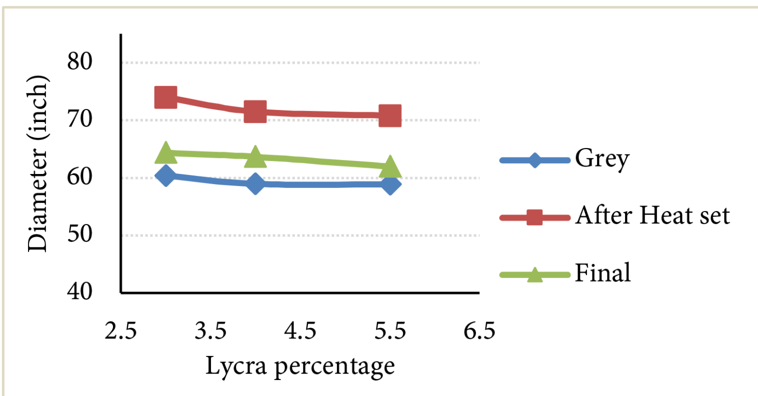

Figure 12. Effect of lycra content on fabric diameter.

for the same stitch length, the cloth diameter is lowest when the Lycra content is maximum, *i.e.* 5.5 percent.

4.5. Fabric Shrinkage

From Figure 13, it is clearly shown that the stitch length has an adverse impact on the fabric shrinkage. While the feeding percentage of Lycra is the same, the increase in stitch length creates more shrinkage in both the length and widthwise direction of the fabric.

On the contrary, from Figure 14, the feeding percentage of Lycra has a very good impact on the fabric shrinkage. While the stitch lengths are the same, the increase of Lycra content creates less shrinkage in the fabric, and the least shrinkage is found when the percentage of Lycra is the highest.

4.6. Fabric spirality

Figure 15 shows the adverse impact of stitch length on the spirality or twisting of the Lycra single jersey knit fabric. As the stitch length is a burning issue for the spirality of single jersey fabric, therefore the increase of the stitch length of the same lycra feeding percentage creates more spirality whereas the lowest stitch length creates least spirality. Figure 16 shows clearly the opposite of the previous figure as it shows the lowest spirality or twisting has occurred when the lycra feeding percentage is the highest.

4.7. Tightness Factor or Loop Shape Factor

The influence of stitch length on loop form factor is comparable to the effect of

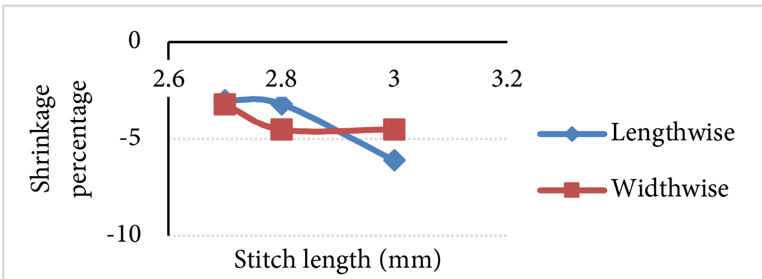

Figure 13. Effect of stitch length on fabric shrinkage.

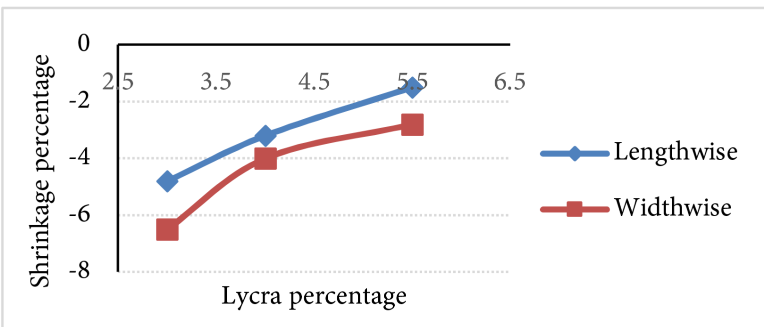

Figure 14. Effect of lycra content on fabric shrinkage.

stitch length on course and wales density. According to **Figure 17**, as the stitch length rises, the loop form factor drops because the course density and wales density also go down.

On the other hand, from **Figure 18**, as the yarn count and stitch lengths are constant, the loop shape factor is not affected here.

4.8. Fabric porosity

Because the porosity of the fabric has an effect on its air permeability, *i.e.*, as the porosity of the fabric increases, the fabric's air permeability also increases; this is clear from **Figure 19** and **Figure 20** The fabric's air permeability also increases

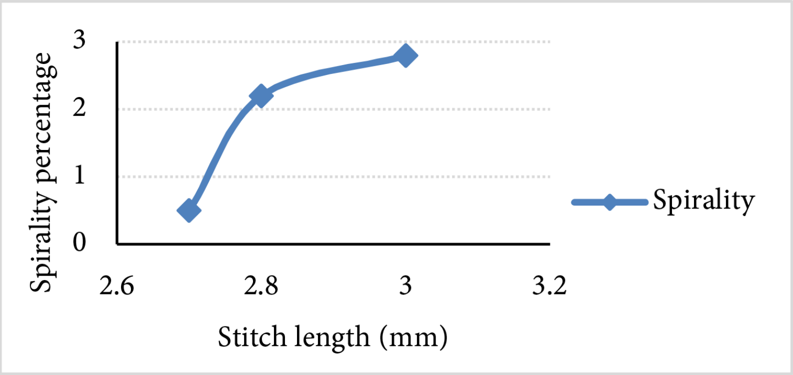

Figure 15. Effect of stitch length on fabric spirality.

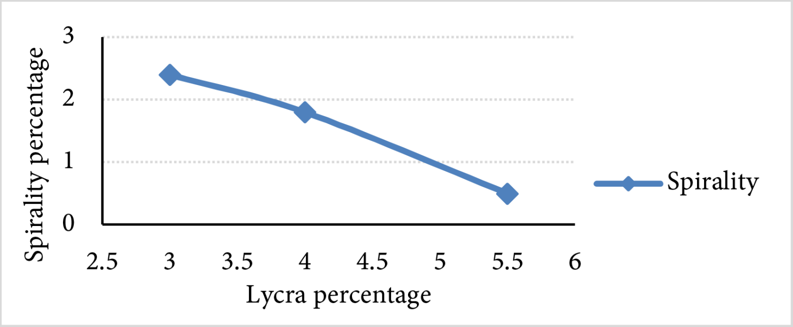

Figure 16. Effect of lycra content on fabric spirality.

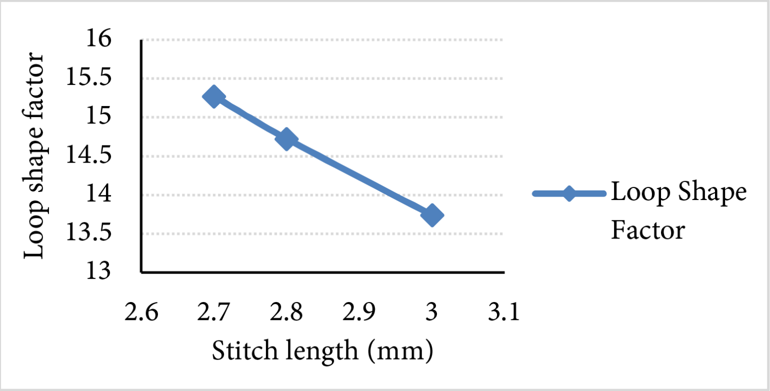

Figure 17. Effect of stitch length on tightness Factor or loop shape factor.

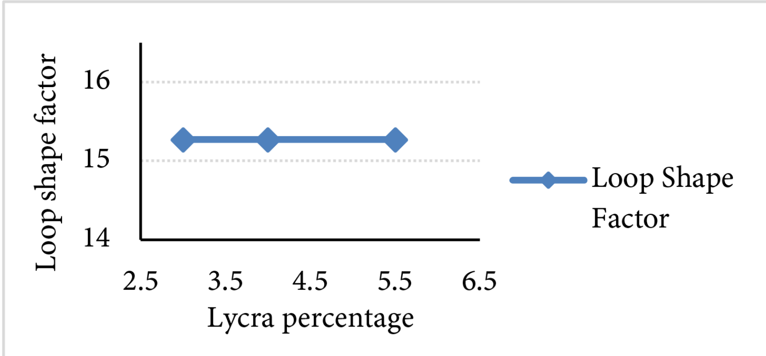

Figure 18. Effect of lycra content on tightness Factor or loop shape factor.

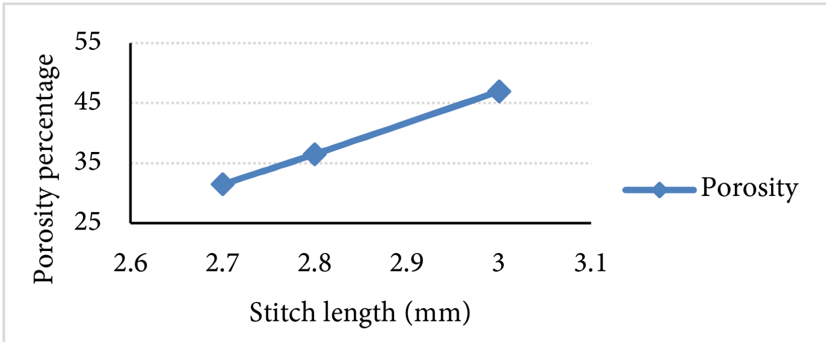

Figure 19. Effect of stitch length on fabric porosity.

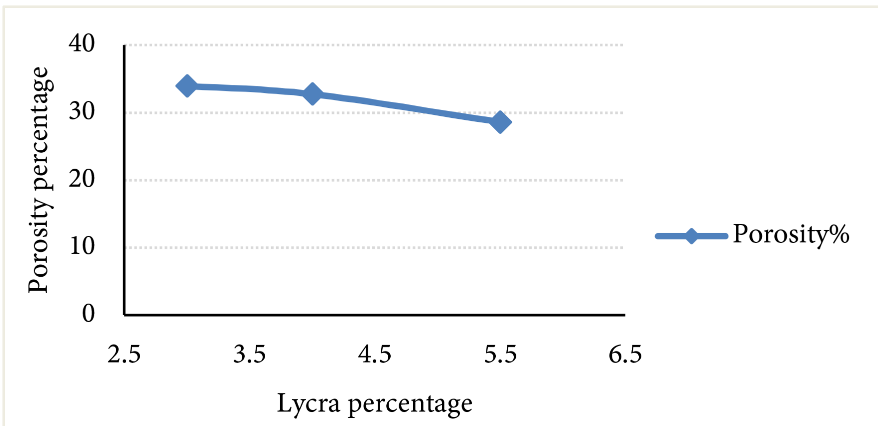

Figure 20. Effect of lycra content on fabric porosity.

as the stitch length increases and as the Lycra content decreases.

4.9. Bursting Strength

Figure 21 makes it clear that increasing stitch length, regardless of the lycra content, results in a decrease in bursting strength. This occurs because the fabric's structure opens out further.

On the contrary, from Figure 22, by increasing the percentage of Lycra from 3 percent to 4 percent and 5.5 percent, the bursting strength increases and the best bursting strength is found when the Lycra is fed to the maximum of percent.

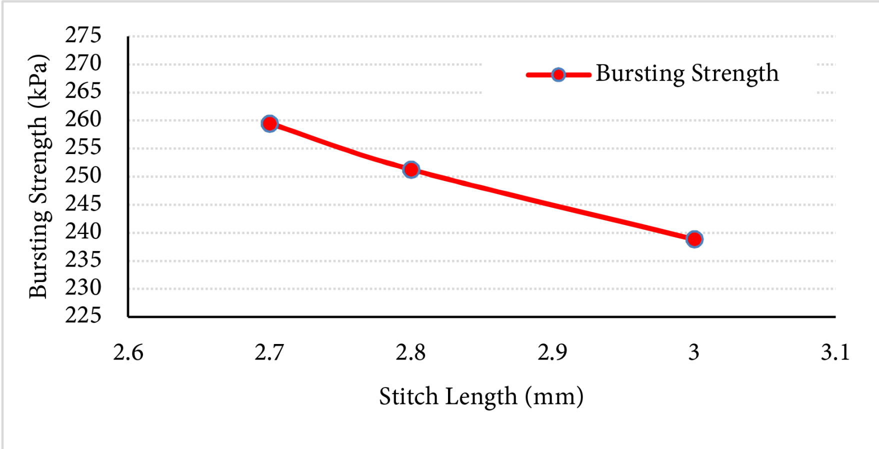

Figure 21. Effect of stitch length on bursting strength.

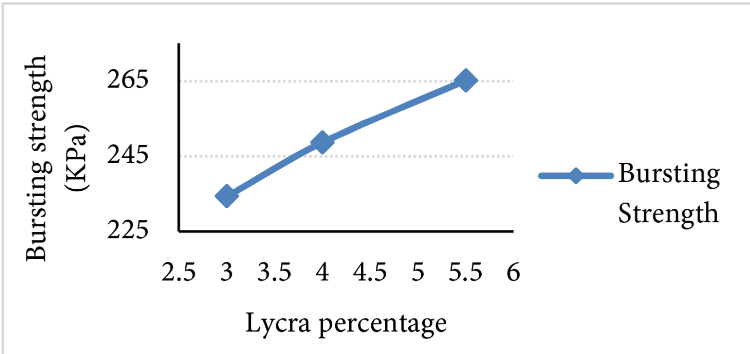

Figure 22. Effect of lycra content on bursting strength.

This indicates that the Lycra yarn increases the fabric's strength by increasing the structure's compactness and resistance to bursting forces.

4. Conclusions

The following can be deduced from the aforementioned findings and discussion:

1) The qualities of knitted fabrics are greatly influenced by the stitch length and the amount of Lycra in jersey knit fabrics.

2) As loop length grows, fabric diameter increases; it lowers as lycra content increases.

3) Wales per unit length and courses per unit length drop as the loop length grows, and vice versa is true for an increase in lycra content.

4) The stitch density lowers with increasing loop length, which in turn reduces fabric weight. The knitted fabric is made tighter by the addition of Lycra yarn, and the weight of the cloth rises as the Lycra content does too.

5) As the stitch length increases, the fabric GSM decreases while the increase of lycra feeding percentage increases the fabric GSM.

6) The more the stitch length, the higher the amount of Shrinkage & Spirality, whereas the least shrinkage & spirality is found when the lycra content is the highest.

7) As loop length rises, the tightness factor or loop form factor drops, but when more Lycra is added to the fabric, the tightness factor stays the same.

8) The porosity of single jersey knit fabrics rises with increasing loop length and falls with rising lycra content.

9) As loop length grows and when Lycra content is low, the bursting strength declines. However, there is a minor improvement in the fabric's bursting strength as the percentage of lycra increases.

Therefore, we may conclude at this point- keeping same percentage of Lycra, having all other parameters set constant, some physical and dimensional properties like fabric diameter, shrinkage, spirality and porosity are proportional to the stitch length of cotton.

Again, keeping the same stitch length, having all other parameters set constant, some physical and dimensional characteristics like CPI or WPI, Stitch density, GSM and bursting strength are proportional to the feeding percentage of lycra.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Singha, K. (2012) Analysis of Spandex/Cotton Elastomeric Properties: Spinning and Applications. *International Journal of Composite Materials*, **2**, 11-16. https://doi.org/10.5923/j.cmaterials.20120202.03

[2] Blandford, J.M. and Gurel, L.M. (1970) Fibres and Fabrics. United States Government Publishing Office, Washington D.C.

[3] Haji, M.M.A. (2013) Physical and Mechanical Properties of Cotton/Spandex Fabrics. *Pakistan Textile Journal*, **62**, 52-55.

[4] Yousuf Mohammad Anwarul Azim, A., Sowrov, K., Ahmed, M., Rakib Ul Hasan, H.M. and Abdullah Al Faruque, M. (2014) Effect of Elastane on Single Jersey Knit Fabric Properties-Physical & Dimensional Properties. *International Journal of Textile Science*, **3**, 12-16.

[5] Akankwasa, N.T., Siddiqui, Q., Kamalha, E. and Ndlovu, L. (2013) Cotton-Elastane Ring Core Spun Yarn: A Review. *Research & Reviews in Polymer*, **4**, 127-137.

[6] Eltahan, E. (2016) Effect of Lycra Percentages and Loop Length on the Physical and Mechanical Properties of Single Jersey Knitted Fabrics. *Journal of Composites*, **2016**, 1-7. https://doi.org/10.1155/2016/3846936

[7] Herath, C.N. (2016) Study the Physical Property Variations of Core Spun Cotton-Spandex Single Jersey Fabrics under Relaxation. *Journal of Engineering and Technology of the Open University of Sri Lanka*, **4**, 27-41.

[8] Senthilkumar, M. and Anbumani, N. (2011) Dynamics of Elastic Knitted Fabrics for Sports Wear. *Journal of Industrial Textiles*, **41**, 13-24. https://doi.org/10.1177/1528083710387175

[9] Prakash, C. and Thangamani, K. (2010) Establishing the Effect of Loop Length on Dimensional Stability of Single Jersey Knitted Fabric Made from Cotton/Lycra Core Spun Yarn. *Indian Journal of Science and Technology*, **3**, 287-289.

https://doi.org/10.17485/ijst/2010/v3i3.11

[10] Sadek, R., El-Hossini, A.M., Eldeeb, A.S. and Yassen, A.A. (2012) Effect of Lycra Extension Percent on Single Jersey Knitted Fabric Properties. *Journal of Engineered Fibers and Fabrics*, **7**, 11-16. https://doi.org/10.1177/155892501200700203

[11] Sitotaw, D.B. (2018) Dimensional Characteristics of Knitted Fabrics Made from 100% Cotton and Cotton/Elastane Yarns. *Journal of Engineering*, **2018**, Article ID: 8784692. https://doi.org/10.1155/2018/8784692

[12] Chowdhury, M., *et al*. (2022) A Feasibility Study to Analyze the Behavior of Heat Settings on the Cleaner Production of Knitted Fabrics. *Cleaner Engineering and Technology*, **7**, Article ID: 100429. https://doi.org/10.1016/j.clet.2022.100429

[13] Abramavičiute, J., Mikučioniene, D. and Čiukas, R. (2011) Structure Properties of Knits from Natural Yarns and their Combination with Elastane and Polyamide Threads. *Materials Science* (*Medžiagotyra*), **17**, 43-46. https://doi.org/10.5755/j01.ms.17.1.247