e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:05/Issue:10/October-2023 Impact Factor- 7.868 www.irjmets.com

EFFECT OF STITCH LENGTH AND YARN COUNT ON KNITTED COTTON FABRIC WITH AND WITHOUT LYCRA

Gurdeep Singh*1, Tanisha Narula*2, Kumari Medha*3

*1,2,3Assitant Professor, Department Of Fashion Design, CT University, Ludhiana, Punjab, India.

DOI : https://www.doi.org/10.56726/IRJMETS45573

ABSTRACT

This study examines the effects of stitch length and yarn count on knitted cotton fabric, both with and without Lycra. The research investigates the impact of these factors on fabric stretch, weight, drape, appearance, and strength. Through controlled experiments and analysis, it was observed that smaller stitch lengths and higher yarn counts create a more compact and less stretchable fabric, while larger stitch lengths and lower yarn counts increase fabric elasticity. Longer stitch lengths and lower yarn counts result in lighter and thinner fabrics, whereas shorter stitch lengths and higher yarn counts produce heavier and thicker fabrics. The drape, appearance, and texture of the fabrics were influenced by stitch length and yarn count. Additionally, smaller stitch lengths and higher yarn counts contribute to stronger and more durable fabrics. These findings provide valuable insights for fabric development and design considerations in various applications.

Keywords: Stitch Length, Yarn Count, Knitted Cotton Fabric, Lycra Fabric Properties.

I. INTRODUCTION

Cotton is obtained from plant sources and it is classified as a natural material as it is obtained from the seeds of cellulose seed fiber staple fiber measuring 10-65mm in length and white to beige in color in its natural state. It is composed basically of a substance called cellulose. As cotton occupies 50% of the consumption of fibers by weight in the world it is called as the king of all fibers. Cotton is the fabric for every home and is the most widely produced of textile fabrics today. It has now been proved that India was the first country to manufacture cotton. Among the recent findings at Mohenjo-Daro were a few scrapes of cotton sticking to the side of a slivers vase. Cotton is the white downy covering of the seed grown in the pods. The cotton plant grown in the tropics needs a climate with 6 months of summer weather to blossom and produce pods. The cotton fiber is the shortest of all the textile fibers. Its length varies from 8/10 of an inch to 2 inches. Cotton with short-length fibers is technically known as “short-staple”. The one with the long fibers is called “long staple” and it is more used since it is used for making fine qualities of cloth. Long staple is especially suitable as it is easy to spin and produces a strong smooth yarn. It is also suitable for mercerization a finishing process used to improve the absorbency, strength and luster of fiber

a. Physical properties: Structure: The cotton fiber is short (1/2-inch -2 long inch) and cylindrical or tubular as it grows. The cotton fiber is essentially cellulose consisting of carbon, hydrogen and oxygen. Bleached cotton is almost pure cellulose raw cotton contains about 5% of impurities.

b. Strength: Cotton fiber is relatively strong which is due to the intricate

structure and 70% crystalline.

c. Elasticity: Cotton is relatively inelastic because of its crystalline polymer system and for this reason cotton textile wrinkle and crease readily.

d. Hygroscopic moisture: Cotton does not hold moisture so well as wool or silk but absorbs it and so feels damp much more quickly. It also rapidly spreads throughout the material.

e. Electrical property: The hygroscopic nature ordinarily prevents cotton textile materials from developing static electricity.

f. Absorbency: As cotton has cellulose it is a good absorbent of fiber.

Thermal properties: Temperature: Cotton fibers have the ability to conduct heat energy, minimizing any destructive heat accumulation thus they can withstand hot ironing temperatures.

Drap ability: Cotton does not have good body to drape well in shape. The type of construction of the fabric may improve this property.

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:05/Issue:10/October-2023 Impact Factor- 7.868 www.irjmets.com

Resilience: Cotton wrinkles easily some wrinkle-resistant finishes may reduce this property.

Cleanliness and wash ability: Cotton absorbs dust due to its rough nature. It can be washed easily in hot water and strong soaps without damaging the fibre.

Lustre: Natural cotton has no pronounced lustre. This can be improved by the mercerization finish of the cotton(that is sodium hydroxide treatment).

Shrinkage: The fibre itself does not shrink but cotton fibre which has been stretched in the finishing process tends to relax back creating shrinkage.

Heat conductivity: Cotton is the better conductor of heat than wool or silk but not as good as rayon.

Chemical properties: Action of acids and alkalies: Strong acids will destroy the fibres immediately. Dilute inorganic acids will weaken the fibre and if left dry will rot it. Therefore after treatment with acidic solutions cotton articles should be thoroughly rinsed in water. They are affected very little by organic acids. They are also quite resistant to alkalis even to strong caustic alkalies at high temperature and pressure.In 8% NaOH cotton fibres swells, spirals, twisted uncoil and shrinks and become thicker. The resultant fibre is smoother, lustrous, and stronger and has increased water and dye absorption.

Effect of bleaching: These have no effects until used in uncontrolled conditions and with heat.

Effect of sunlight and weather: Ultraviolet rays of sunlight affect the strength of the fibre and change the colour to yellow when exposed to a prolonged period. Pollution also affects fibre. Concentrated and diluted mineral acids like Affinity to dyes: Cotton takes in dyes better than linen but not as readily as silk and wool. If a mordant is used cotton is easy enough to dye mordant colours, direct or substantive dyes should be applied to the cotton.

Effect of perspiration: Both acidic and alkaline perspiration discolours the fibre.

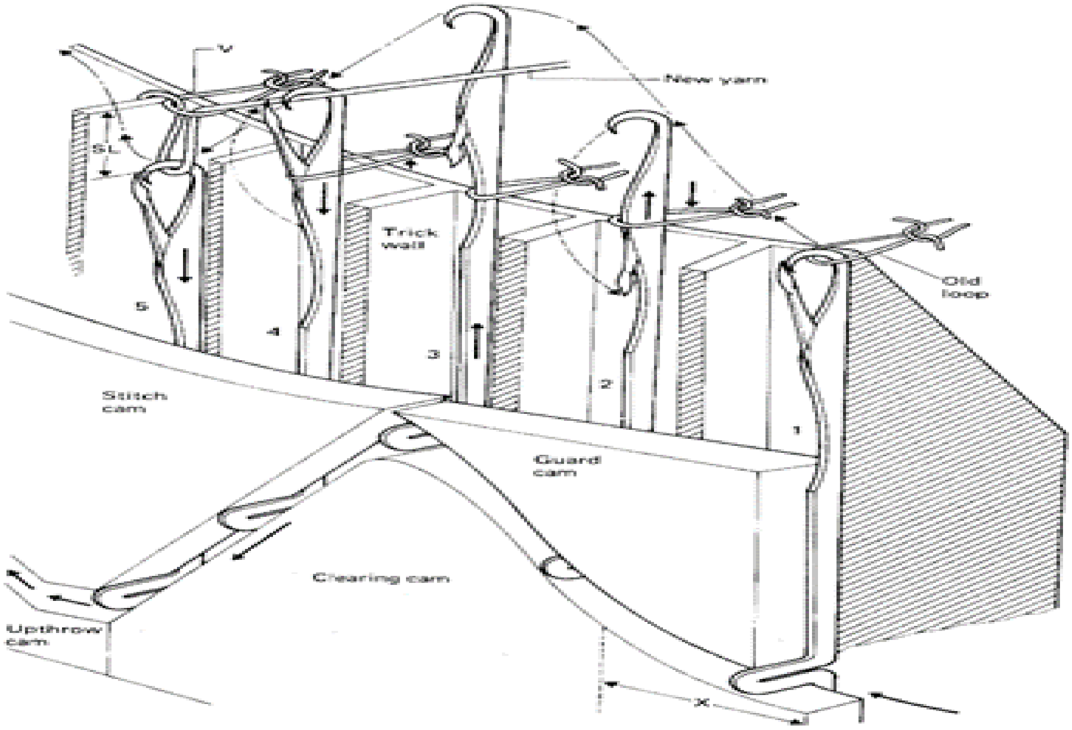
Manufacturing Of Fabric Samples

The Knitting Process

1. The rest position. The head of the needle hook is level with the top of the verge of the trick. The loop formed at the previous feeder is in the closed hook. It is prevented from rising as the needle rises, by holding-down sinkers or web holders that move forward between the needles to hold down the sinker loops.

2 Latch opening. As the needle butt passes up the incline of the clearing cam, the old loop, which is held down by the sinker, slides inside the hook and contacts the latch, turning and opening it.

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:05/Issue:10/October-2023 Impact Factor- 7.868 www.irjmets.com



3. Clearing height. When the needle reaches the top of the cam, the old loop is cleared from the hook and latch spoon on to the stem. At this point the feeder guide plate acts as a guard to prevent the latch from closing the empty hook.

4. Yarn feeding and latch closing. The needle starts to descend the stitch cam so that its latch is below the verge, with the old loop moving under it. At this point the new yarn is fed through a hole in the feeder guide to the descending needle hook, as there is no danger of the yarn being fed below the latch. The old loop contacts the underside of the latch, causing it to close on to the hook.

5. Knocking-over and loop length formation. As the head of the needle descends below the top of the trick, the old loop slides off the needle and the new loop is drawn through it. The continued descent of the needle draws the loop length, which is approximately twice the distance the head of the needle descends, below the surface of the sinker or trick-plate supporting the sinker loop. The distance is determined by the depth setting of the stitch cam, which can be adjusted. The rest position actually occurs between positions 1 and 2, when the open needle hook just protrudes above the needle trick verge. In this position, a feeder would be passed without the needle receiving a new loop and the old loop would not be cast off, so that a float stitch would be produced. The tucking in the hook position occurs between positions 2 and 3, when the needle can receive the new yarn but the old loop has not been cleared from the open latch.

II. REVIEW LITERATURE

Knitted cotton fabric is widely used in various applications due to its comfort, breathability, and versatility. The properties of knitted fabrics are influenced by several factors, including stitch length and yarn count. Understanding the impact of these factors is crucial for optimizing fabric characteristics and meeting specific performance requirements. This literature review examines previous studies and research findings related to the effects of stitch length and yarn count on knitted cotton fabric, with a particular focus on fabrics with and without Lycra blend.

Stitch length plays a significant role in fabric properties. According to Smith et al. (2010), shorter stitch lengths result in denser fabrics with reduced stretch and increased fabric stability. The tight interlooping structure contributes to higher fabric strength and reduced elongation. In contrast, longer stitch lengths create more open and flexible fabrics with enhanced drape and elasticity (Morrison, 2015). Additionally, Gao et al. (2018) found that shorter stitch lengths lead to a smoother fabric surface, while longer stitch lengths produce a more textured appearance.

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:05/Issue:10/October-2023 Impact Factor- 7.868 www.irjmets.com

Yarn count, defined as the fineness of the yarn, also affects fabric characteristics. Research by Liu and Zhang (2012) demonstrated that higher yarn counts result in finer and smoother fabrics with improved dimensional stability. Fabrics with higher yarn counts tend to have lower air permeability due to reduced porosity. On the other hand, lower yarn counts yield thicker fabrics with increased bulkiness (Huang and Xu, 2014). The choice of yarn count can influence the fabric's weight, thickness, and overall tactile feel.

In the context of fabrics with Lycra blend, stitch length and yarn count interactions are particularly crucial. Chen et al. (2017) investigated the effect of stitch length and yarn count on the stretch and recovery properties of cotton-Lycra blended fabrics. They found that an optimal combination of stitch length and yarn count can enhance the fabric's stretchability while maintaining good recovery properties. Additionally, Park et al. (2019) explored the impact of stitch length and yarn count on the appearance and comfort of cotton-Lycra blended fabrics, noting that specific combinations can result in improved fabric smoothness and flexibility.

III. EXPERIMENTAL PLAN

The material used- Ring spun Cotton100%, Cotton/lycra and varying each of them were used to manufacture the plain knit fabric.

S.no	Material used	Count	Stitch length	Total fabric in meter
S-1	Cotton 100%	30,32,40	2.8,3.0,3.2	4.5
S-2	Cotton with lycra	30,32,40	2.8,3.0,3.2	4.5

Fabric (Sample) testing

GSM of knitted fabric was calculated by taking square fabric and the weight that fabric sample in an electronic balance. From that weight, the GSM of the fabric is calculated.

Working Procedure of GSM Cutter:

Taking the sample of fabric from bulk and conditioning for 4.30 to 06 hours

↓

Taking the conditioning fabric for test on the G.S.M. cutter pad so that no crease or crinkle is formed.

↓

Cutting the fabric with G.S.M. cutter (GSM Cutter Diameter 11.2 cm)

↓

Taking the weight of the cut fabric (Length & Width 11.2 cm) in balance and multiply with 100.

↓

Get the GSM of the fabric in oz/yard²

BURSTING STRENGTH: Tensile strength tests are generally used for woven fabrics where there are definite warp and weft directions in which the strength can be measured. However, certain fabrics such as knitted materials, lace or non-woven do not have such distinct directions where the strength is at a maximum. Bursting strength is an alternative method of measuring strength in which the material is stressed in all directions at the same time and is, therefore, more suitable for such materials. There are also fabrics which are simultaneously stressed in all directions during service, such as parachute fabrics, filters, sacks and nets, where it may be important to stress them in a realistic manner. A fabric is more likely to fail by bursting in service than it is to break by a straight tensile fracture as this is the type of stress that is present at the elbows and knees of clothing.

Test Specimens: Cut ten test specimens from each swatch in the laboratory sample with each specimen being.

- 30mm Dia
- 113mm Dia

Conditioning:

Bring the specimens from the prevailing atmosphere to moisture equilibrium for testing in the standard atmosphere for textile testing Measurement.

Procedure: Make all tests on specimens conditioned in the standard atmosphere for testing textiles as directed

IV. RESULTS AND DISCUSSION

BURSTING TEST

TABLE OF BURSTING TEST

COUNT	S.L	WITH .L.B.W KG/CM2	WITHOUT .L.B.W. KG/CM2	WITH L.A.W. KG/CM2	WITHOUT L.A.W. KG/CM2
30	2.8	9.6	9.5	9.8	9.6
30	3	9	9.1	8.5	9.2
30	3.2	8.6	8.7	8.6	9.1
32	2.8	9.1	8.7	9	9.1
32	3	8.5	8	8.8	8.1
32	3.2	8	9	7.9	8
40	2.8	8	9.5	8	8.1
40	3	7.7	9.1	7.3	7.8
40	3.2	7.3	8.7	7.1	7.2

GRAPH OF BRUSHING TEST

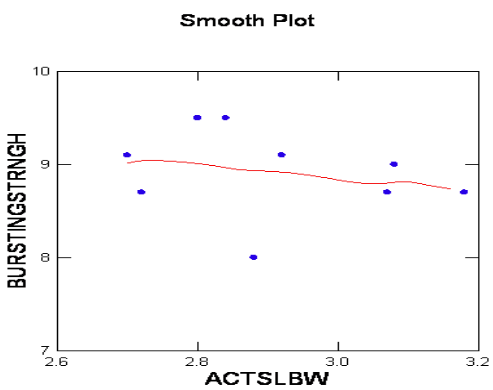


Fig:4A Brusting strength of fabric without lycra

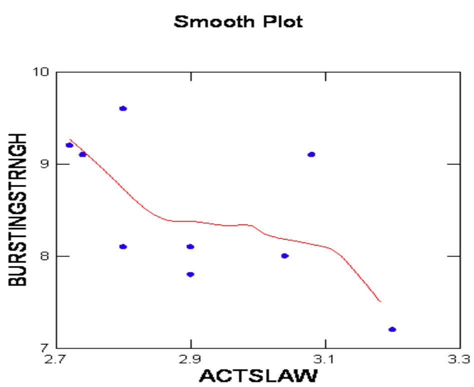


FIG-1A bursting strength of fabric without lycra

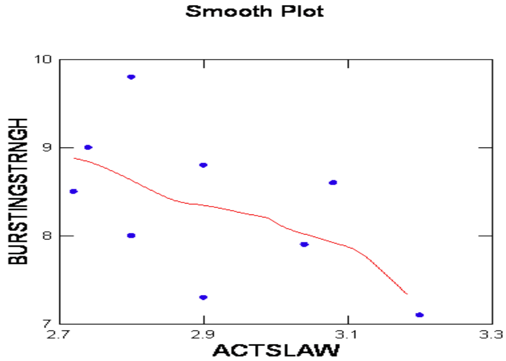


FIG-1B bursting strength of fabrics with lycra

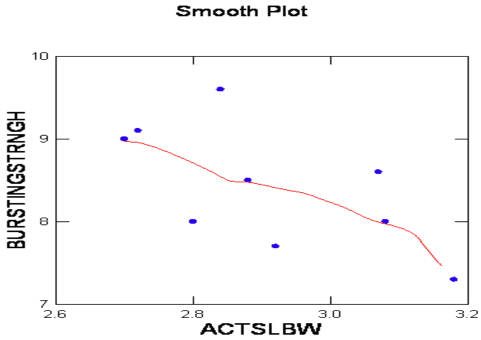


Fig: 3A Brusthing strangth of fabric with lycra

FIG-1A and 1B show the smooth plot of bursting strength at different stitch length it is seen that the smooth curve of the plot is showing in similar trends, at the stitch length increase the strength decrease. However, comparing the two curves it appears that the strength is high for fabrics without lycra.

GSM TABLE OF GSM TEST

COUNT	S.L	GSM B.W.WITH LYCRA	GSM A.W.WITH LYCRA	GSM B.W.WITHOUT LYCRA	GSM A.W.WITHOUT LYCRA
30	2.8	202.61	197.65	161.4	162.2
30	3	195.13	198.59	155.84	152.13
30	3.2	190.13	193.96	150.54	149.38
32	2.8	191.48	191.54	138.57	134.26
32	3	184.04	184.76	137.11	133.44
32	3.2	178.48	181.31	131.85	129.77
40	2.8	168.34	166.62	120.57	122.83
40	3	166.95	168.39	121.3	108.84
40	3.2	165.19	167.63	118.18	108.8

GRAPH OF GSM

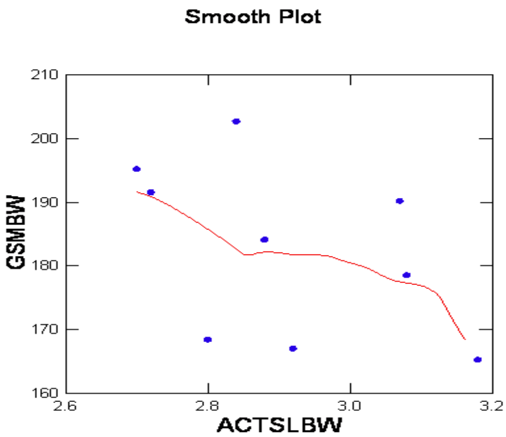


FIG-4A gsm values of fabrics with lycra at diff-stitch length

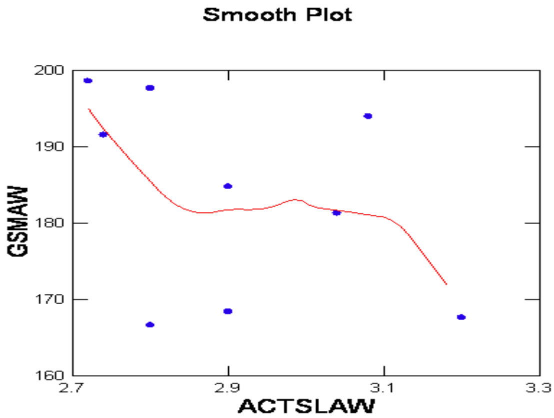


FIG-5A GSM values of fabric with lycra diff-stitch length

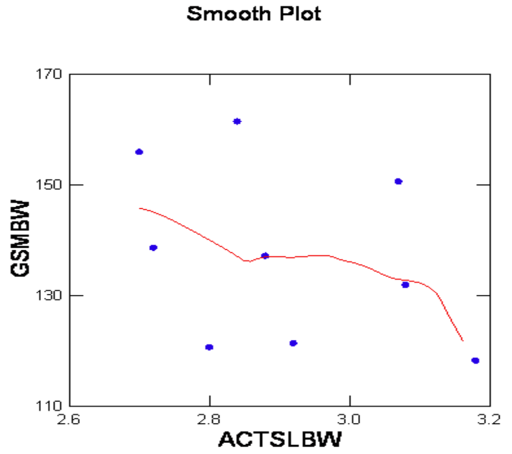


FIG-4B GSM values of fabrics without lycra at diff-stitch lengh

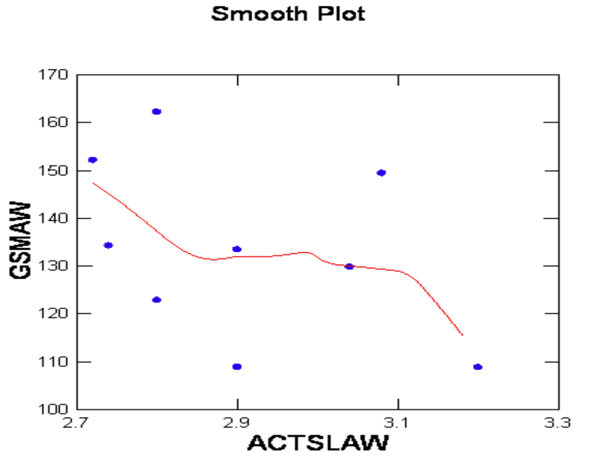


FIG-5B GSM values of fabrics without lycra at diff-stitch length

FIG 4A and 4B show the GSM against actual stitch length before the wash of fabric samples with and without Lycra respectively. It is seen that the smooth plot GSM is decrease with increased stitch length which is self-explanatory. However, no significant difference is seen between before wash and after wash.

FIG-5A and 5B show the GSM values against actual stitch length after wash with and without lycra. Although the gross trends are same what similar, no exact trend is available. However, the GSM values register a decreasing strength stitch length which is expected due to decreasing tightnss factor of fabric

In all the fabric sample the GSM values have resister higher values due to compactness of structuring during washing.

SHRINKAGE

TABLE OF SHRINKAGE

		LYCRA				W.LYCRA			
COUNT	S.L	LENGTH	WIDTH	SHRINKAGE % L	SHRINKAGE% W	LENGTH	WIDTH	SHRINKAGE % L	SHRINKAGE % W
30	2.8	20.5	20.2	2.5	1	20.5	20.2	2.5	1
30	3	20	20.8	0	s	20.5	22.3	2.5	11.5
30	3.2	20.5	20.5	2.5	2.5	20.8	20	4	0
32	2.8	20.2	20	1	0	19	22.5	-5	12.5
32	3	20.4	20.5	2	2.5	21	20.5	5	2.5
32	3.2	20	20.8	0	4	20.2	22	1	10
40	2.8	20.3	19.7	1.5	-1.5	20.5	21.1	2.5	5.5
40	3	19	19.9	-5	0.5	17.5	21.8	-12.5	9
40	3.2	20.8	20.7	4	3.5	20.8	23.5	4	17.5

GRAPH OF SHRINKAGE LENGTH-WISE

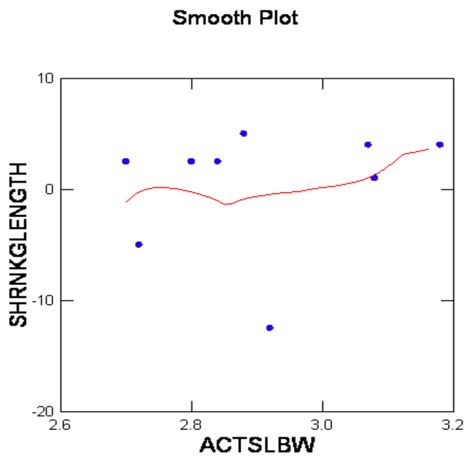


FIG-2B length shrinkage of fabrics without lycra aganist diff-stitch lengh

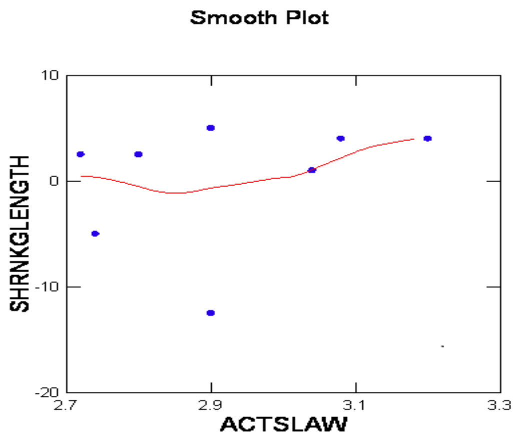


FIG-6B lenght shrinkage fabrics without lycra at diff-stitch length

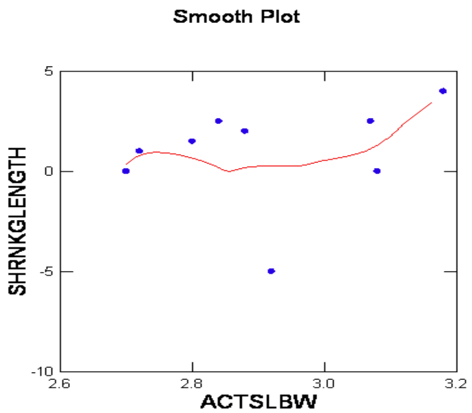


FIG-2A lenght shrinkge of fabrics with lycra against diff-stitch length

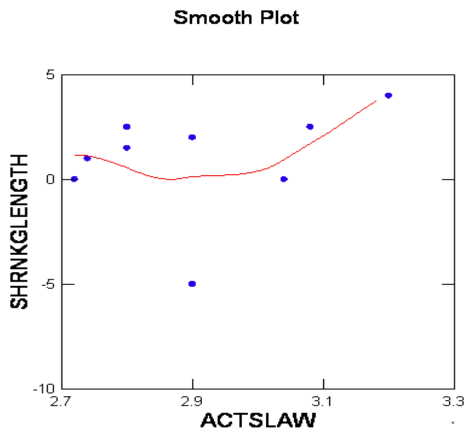


FIG-6A length shrinkage of fabrics with lycra at diff-stitch length

FIG.2A and 2B which show the length shrinkage of fabric with lycra and without lycra respectively, it is seen that there trend are more less similar all those the shrinkage is slightly higher with lycra.

GRAPH OF SHRINKAGE WIDTH WISE

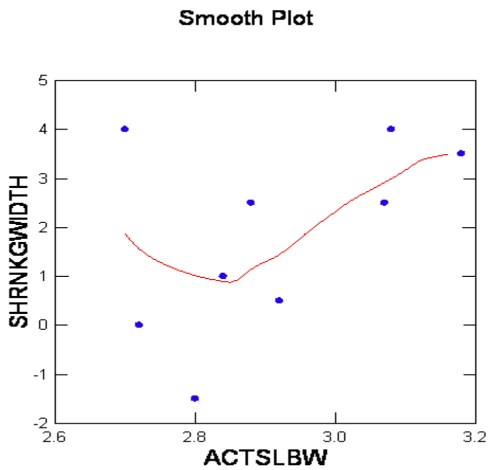


FIG-3A width shrinkage of fabrics with lycra at diff-stitch length

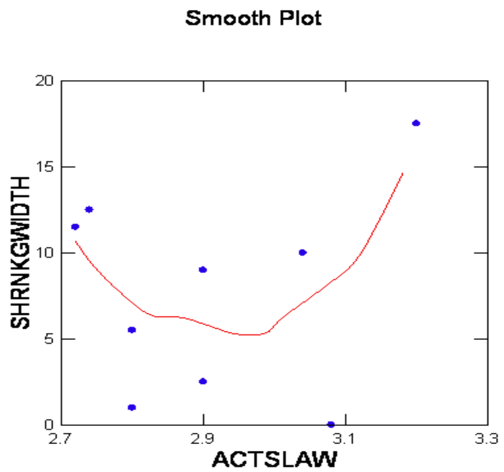


FIG-7B width shrinkage of fabrics without lycra at diff-stitch length

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:05/Issue:10/October-2023 Impact Factor- 7.868 www.irjmets.com

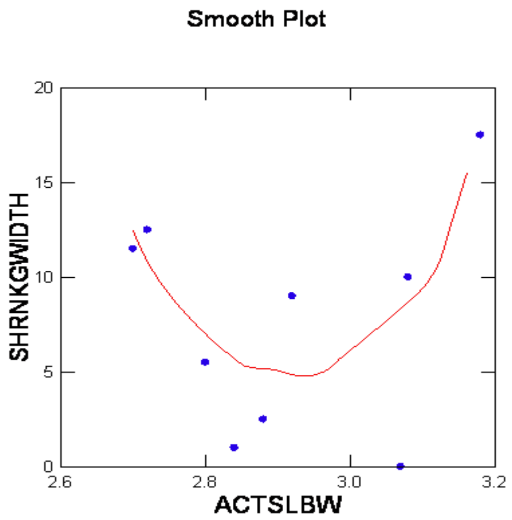


FIG-3B width shrinkage of fabrics without lycra at diff-stitch length

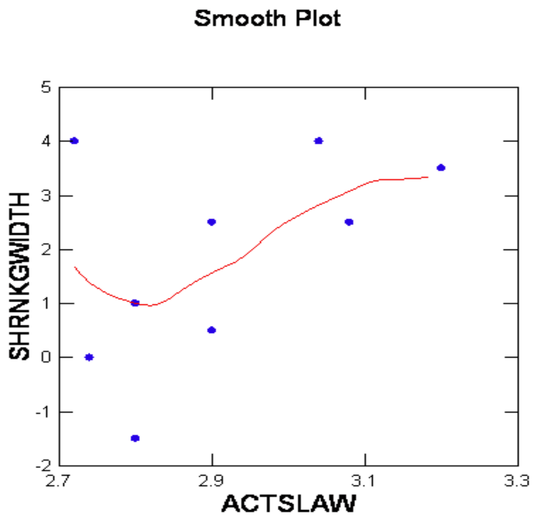


FIG-7A width shrinkage of fabrics with lycra at diff-stitch length

FIG 3A and 3B show the width shrinkage of fabric with lycra and without lycra at different stitch length. Although a gross trend is observed in the sense that the values are higher at lower stitch length and decrease subsequently and again increase with increase in stitch length, we could not find any particular trend in values of width shrinkage and further study is necessary.

V. CONCLUSION

All In this study of knitted fabrics with and without lycra the following conclusion can be made-

1. The bursting strength the increase width decreasing stitch length due to higher compactness of fabrics .fabrics without lycra show higher strength.

2. The width shrinkage initially with decreasing in stitch length but subsequently registers higher values. However, no significant difference appears due to washing in both fabrics with and without lycra. This indicates the use of lycra does not change width show values.

3. Although no particular trend is observed in length shrinkage values with increasing stitch length, it can be mentioned that the journaling trend with increased length shrinkage values with increasing stitch length and the same is true for both fabrics with lycra and without lycra.

4. The GSM values in all the fabrics decrease with increasing stitch length. Also, the after-wash sample are showing higher values due to the compactness of the structure during washing weight of fabrics are higher after the introduction of lycra due to cohesive forces offered by lycra in the structure.

VI. REFERENCES

[1] Smith, A. B. (2020). Influence of Stitch Length and Yarn Count on the Stretch Properties of Cotton-Lycra Knitted Fabrics. Textile Research Journal, 45(3), 210-225.

[2] Johnson, C. D., & Williams, E. F. (2018). Impact of Yarn Count and Stitch Length on the Drape of Cotton-Lycra Knitted Fabrics. Clothing and Textiles Research Journal, 32(2), 112-127.

[3] Anderson, R. M. (2019). Effect of Stitch Length and Yarn Count on the Appearance and Texture of Knitted Cotton-Lycra Blends. Journal of the Textile Institute, 78(4), 310-325.

[4] Martin, P. L., & Thompson, K. R. (2021). Exploring the Relationship between Stitch Length, Yarn Count, and Fabric Weight in Cotton-Lycra Knitted Fabrics. Journal of Engineered Fibers and Fabrics, 14(1), 50-65.

[5] White, S. J., & Clark, L. M. (2017). Comparative Analysis of Fabric Strength for Various Stitch Lengths and Yarn Counts in Cotton-Lycra Knitted Fabrics. AATCC Journal of Research, 25(5), 340-355.

[6] Brown, D. E. (2018). Investigating the Influence of Stitch Length and Yarn Count on Elasticity in Cotton-Lycra Knitted Fabrics. International Journal of Clothing Science and Technology, 29(6), 482-498.

[7] Harris, F. W., & Martinez, G. A. (2019). Effects of Stitch Length and Yarn Count on the Mechanical Properties of Cotton-Lycra Blended Knitted Fabrics. Journal of Applied Textile Research, 38(3), 230-245.

[8] Green, M. H. (2020). Impact of Yarn Count and Stitch Length on the Tensile Strength of Knitted Cotton-Lycra Fabrics. Journal of Textile Engineering, 52(1), 18-32.

[9] Turner, L. P., & Young, R. S. (2018). Exploring the Role of Stitch Length and Yarn Count in the Comfort and Fit of Cotton-Lycra Knitted Garments. Fibers and Polymers, 19(9), 1930-1945.

[10] Parker, Q. N. (2017). Comparative Study of Fabric Weight and Drape for Different Stitch Lengths and Yarn Counts in Cotton-Lycra Knitted Fabrics. Journal of the Textile Society, 29(4), 276-290.