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Effect of Loop Length in Different Stitches on Dimensional and Mechanical Property of Single Jersey Knitted Fabrics

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Abstract

Single jersey knitted fabrics are generally used to make underwear and outerwear. To investigate the impact of loop length and stitches design on the dimensional and mechanical properties of single jersey knitted fabrics, which are develop high-performance knitted goods has been expanded by changing the loop length and the type stiches design. To analysis the effect of loop length and stitches type on dimensional and mechanical property, 12 sample knitted fabrics by varying loop length such as 2.5mm,2.7mm,2.9mm and 3.0mm were produced by circular knitting machine. These sample fabrics were produced from 100% cotton 30Ne ring spun yarn by varying loop length and stitch design. The specimens used for sampling were determined like: CPI, WPI, GSM thickness, stiches density, breaking force and extensibility properties by using ASTM standards for each test fabric sample. As observed in the result, with an increase in loop length, the dimensional properties CPI, WPI, GSM, thickness and stitches density decreased for all the stitches design, while mechanical properties like maximum breaking force and extensibility increase with an increase loop length. Tuck stitch is thickest and heaviest of other stitches for each loop length and knit stitch is highest maximum breaking force and extensibility `of other stiches. Float stitches fabric is lightest in weight, thinnest in thickness, least extensibility, required lowest breaking force and highest stitch density when compare to tuck and knit stitches on each loop length. In general loop length and stitch design affects all the dimensional and mechanical properties of knitting fabric. This paper worked on single jersey, from the analysis grey stage of knit fabrics, that source will show better performance for the summer inner wear and some for winter outwear by change loop and stitch design.

Keywords: Stitches design • loop Length • GSM • Dimensional Properties • Mechanical Properties

Introduction

Knitted fabrics are very popular and important part of textile material. It is a method by which thread or yarn is turned into cloth or intermeshing loops. Stitch is knitted fabric consists of consecutive rows of loops. As each row progresses, a new loop is pulled through an existing loop [1-4]. In knitting industries, many derivatives of single jersey construction can be developed by knit, tuck, float stitches and their combinations for different reasons mainly for design purposes. A loop is a stitch exhibiting four binding or interlacement zones, that is, two around the needle loop and two around the base. A tuck stitch is composed of a held loop, one or more tuck loops and knitted loops. Tuck loops reduce fabric length and lengthwise elasticity because the higher yarn tension on the tuck loop causes them to rob yarn from adjacent knitted loops, making them smaller and providing greater stability and shape retention. Float stitch is composed of a held loop, one of more float loops and knitted loops. Float stitch fabrics are narrower than equivalent all-knit fabrics because the wales are drawn closer together by the floats, thereby reducing width-wise elasticity and improving fabric stability [5]. The different stitch combinations have a significant effect on by different fabric properties of single jersey knitted fabrics [6]. The physical and mechanical properties of these basic structures differ widely. Due to the structural difference, knitted fabrics are used in different applications [7]. The previous studies reported the effects of physical parameters such as yarn linear density, yarn twist, loop length, the tightness factor, finishing treatment and degree of washing on the dimensional properties of knitted fabrics. According to these studies, the strength and the elongation of weft knitted fabrics increased with increasing density. In the fabrics, loop lengths combine in the form of course lengths and different stich design influences fabrics dimensional and mechanical properties [8,9]. In general, many researchers have done work on the effect of knitting parameters on some physical properties, and they studied the effect of yarn parameters mainly yarn count, types of raw material, and yarn twist on mechanical and dimensional properties of knitted fabric. Few researchers have also done work on the effect of knitting parameters mainly machine gauge, stitch density feeding and takedown tension on fabric dimensional and comfort properties, such as shrinkage, Spirality, bursting, pilling and air permeability[10]. Both dimensional properties and mechanical properties of knitted fabrics are influenced by the structural parameters of the fabrics and finishing process. According to these studies, the strength and the elongation of weft knitted fabrics increased with increasing density. In the fabrics, loop lengths combine in the form of course lengths and different stich design influences fabric dimensions and mechanical properties. The present work is focused on the combined effect of three different types of stitches knit stitch, tuck stitch and float stitches on some of the dimensional properties of single jersey knitted fabrics such as: CPI, WPI, GSM thickness and stiches density and also so mechanical properties are: - breaking force and extensibility. But a gap between producer and customer because of unaware of the dimensional and mechanical properties of the knitted fabric and also do not know the effect in different stitch design and loop length variation on properties of knitted fabric. So, this research focus on to solve those problems by varies stitch design and loop length. Therefore, by using vary loop length and stiches, to produce different dimensional and mechanical properties of knitted fabrics. All the tests for fabric properties were carried out for grey stage; there properties can considerably vary after further finishing of the fabrics.

Materials and Methods

Materials

100 % cotton ring spun yarn was taken as raw material. The cotton yarn has 860m - 1 twist, 30 Ne count, 9.21% U% 0.6 thin - 50% 27.5 thick + 50% and 30.5 Neps +200%. The single jersey sample knit, tuck and float are produced

Methods

- **Sample fabric production:** Four samples were produced from each stitches design knit, tuck and float by by using single-bed circular knitting

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machine (Mayer $ Cie, Germany) with 30 cylinder diameter, 72needles, 4 cam tracks, 4 feeders and 120 creel tracks.

- **Sample preparation:** By using ASTM and ISO standard.

Determination of WPI, CPI and Stitch density: By the help of counting glass to measure WPI and CPI of various stitch length and, to calculate stitch density.

Stitch density = WPI × CPI

Where WPI is Wale per inch and CPI is Course per inch

Determination of Fabric Weight (GSM): Standard Test Method ISO 33071 Fabric weight (GSM).

Determination of Fabric Thickness: Standard Test Method ASTM D1777- 96 (2011) thickness (mm).

Determination of Tensile strength: Standard Test Method ASTM D5034 (strip) measuring Breaking force (N) and Elongation (%).

Determination of extensibility: Standard Test Method ASTM D2594-2004Testing property Extensibility (%).

Result and Discussion

Effect Loop Length on CPI, WPI and Stitch Density

Table 1 Show clear that CPI & WPI change with the change of loop length. For single jersey knitting fabric, CPI and WPI decrease with the increase of loop length for three stitches design. Tuck stitch is lowest WPI of other stiches due to the structure with tuck stitches loop shape has a widest base and tuck is higher CPI than knit stiches, during tuck stitch the knitting action up to tuck height and float stitch is highest both CPI and WPI of other stiches for each loop length, because the loop are drawn closer together by the floats and also float stitch is highest stitch density in each loop length, because loops closed each other in wale and course direction when compare to other stiches. When loop length increase the stitch density single jersey knitting fabric decrease.

Effect of loop Length on GSM

GSM depends on knit structure, and loop length of knit fabrics. It is clear that GSM change with the change of stitch length for three stitches of single jersey fabric have been seen in bar chart. The figure 1 shows that with the increase of loop length GSM of the fabric decreases for each stitch design. It is found that with the increase of loop length there must be more open space in the fabric hence areal density will decrease **Figure 1**.

Effect loop length on fabric thickness

From figure 2. It is clear that thickness change with the change of stitch length for three stitches of single jersey fabric have been seen in bar chart. show that, fabric thickness decreases with the increased loop length for three stitches, this happen compactness of structure and relative closeness of the loops decrease when loop length increase and single jersey knitting Fabric which contain tuck stitches is thickest stitches due to accumulation of yarn in stitches at tucking places for each loop length and float is thinnest other stitch due to float yarn on fabric **(Figure 2)**.

Effect loop length on fabric tensile property

From **Table 2** show that maximum force required to break the fabrics increase when loop length increase and also elongation is the fabrics extension percent (%) until the fabric is broken increase for three stitches, this happen compactness of structure & relative closeness of the loops decrease when loop length increase and fabric with knit stitches is maximum force (N) required to break and elongation(%) other stitches due to most loop configuration occur

Table 1. Averages of WPI, CPI and Stitch density three stitches with vary loop length.

Sample No	Loop length	WPI			CPI			Stitch density (WPI× CPI)		
	(mm)	Knit	Tuck	Float	Knit	Tuck	Float	Knit	Tuck	Float
1	2.5	25	20	31	37	43	50	925	860	1550
2	2.7	23	18	29	35	41	48	805	738	1392
3	2.9	21	16	28	33	39	46	693	624	1092
4	3	20	15	27	32	38	45	640	570	1026

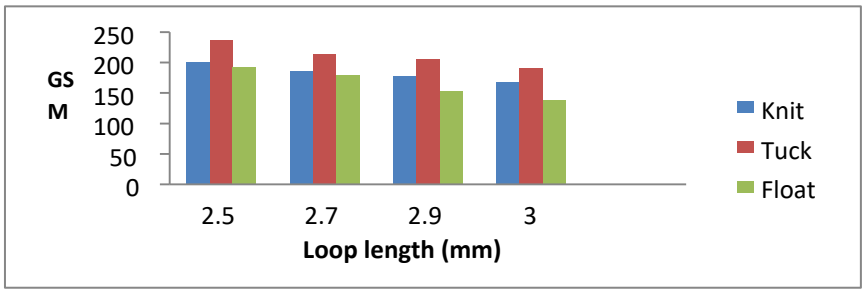

Figure 1. Average of GSM three stitches with varies loop length.

Table 2. Averages of tensile property three stitches with different loop length.

Sample	Loop	Tensile property											
		Widthwise						Lengthwise					
No	length (mm)	Max .Breaking force			Elongation (%)			Max .Breaking force			Elongation (%)		
		Knit	Tuck	Float	Knit	Tuck	Float	Knit	Tuck	Float	Knit	Tuck	Float
1	2.5	230	210.1	155	162	134	102	201	183	134	136	115	103
2	2.7	256	228.3	177	184	164	125	222	199	153	161	131	125
3	2.9	265	254.6	189	207	179	149	249	218	163	178	153	146
4	3	279	266.2	266	213	191	161	257	232	171	180	167	157

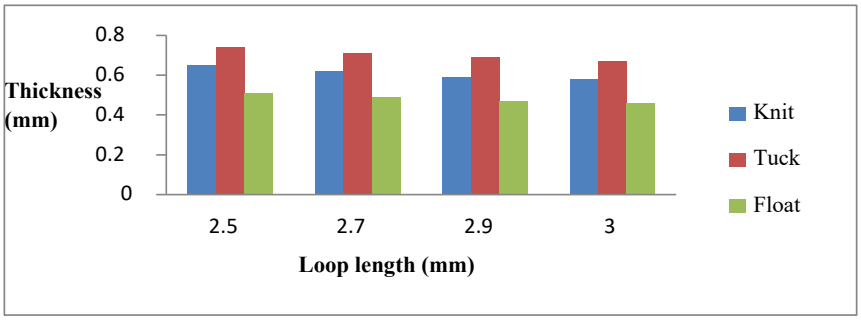

Figure 2. Average of thickness three stitches with varies loop length.

Table 3. Average of extensibility properties three stitch with different loop length.

Sample No	Loop Length (mm)	Extensibility (%)					
		Lengthwise			Widthwise		Widthfloat
		knit	tuck	float	knit	tuck	float
1	2.5	70.2	61.5	49.2	102.5	81.8	60.3
2	2.7	81.6	73.5	57.8	123.5	103.5	75.8
3	2.9	95.3	86.5	69.6	146.8	125.8	89.6
4	3	103.8	92.1	74.5	160.3	141.2	102.4

for each loop length. widthwise directions have maximum breaking force and elongation than lengthwise direction for each loop length of three stitches single jersey knitting fabric, because in widthwise direction they loop formed, those loop easily elongated with the highest requiring maximum breaking force.

Effect loop length on fabric extensibility property

It is clear that show with the increase of loop length of the extensibility single jersey knit fabric increase for each stitch design. When load applied on fabric the large amount loop length of fabric have highly extended **(Table 3)**. Widthwise extensibility fabric greater than lengthwise direction for each three stitches, because of loop formation in width direction. Float stitches is less extensible than either knitted or tucked structure. As the fabric are drawn closer together by the floats, thus reducing extensibility. Extensibility tuck less than knit stitches, because the higher yarn tension on the tuck and held loops causes them to rob yarn from adjacent knitted loops making them smaller.

Conclusion

In this research loop length is the fundamental unit which controls the properties of weft knitted fabrics. Mainly loop length and stitch design affects all the dimensional and mechanical properties of knitting fabric. From the analysis, we can get idea about grey stage of knit fabrics, that source will show better performance for the summer inner wear and some for winter outwear by change loop and stitch design. Among the various properties, CPI, WPI, Stitch density, GSM, thickness, tensile and extensibility were examined. Four different loop lengths and three stitches were used to produce the plain single jersey fabric for this research. The yarn count and other machine parameters were constant. A significant change was observed for the various loop lengths for three stitches design of single jersey knitting fabric's, WPI, stitch density, thickness and GSM decrease with the increase of stitch length. But extensibility and maximum breaking force increase with the increase of loop length. Knit stitch is highest extensibility and maximum breaking force of other stitches and tuck stitch is highest weight and thickness of other stitches design and float stitch is highest stitch density.

References

1. Emdadul Haque and Md Shamim Alam . "Understanding Textiles for a Merchandiser." BMN foundation Press, Dhaka (2009).
2. Anbumani N. "Knitting Fundamentals, Machines, Structures and Developments." New Age International, India, (2007).
3. "Standard Test Method for Thickness of Textile Materials." ASTM D1777 – 1796, (2011).
4. Zuleyha, Degirmencil, Ebru Coruh. "The Influences of Raw Material on Bursting Strength Air Permeability and Physical Characteristics of Single Jersey Knitted Fabric." *J Ind Text* 41 (2011): 41-56.
5. Azharul, Islam. "Effect of wale wise increasing of tuck and miss loops on bursting strength of single jersey fabric at grey and finish state." *Int J Res Eng Technol* 3(2014): 286–291.
6. Uyanik, Seval and Topalbekiroglu M. "The effect of knit structures with tucks stitches on fabric properties and pilling resistance". *J Text Inst 108*(2017):1584-1589.
7. Jamshaid H, Mishra R, Novak J. "End use performance characterization of unconventional knitted fabrics". *Fiber Polym* 16(2015): 2477–2490.
8. Khalil, Elias, Solaiman MD. "Effect of Stitch Length on Physical and Mechanical Properties of Single Jersey Cotton Knitted Fabric." *In J Sci Res* 3(2014):2319-7064.
9. Mikucioniene, Daiva, Arbataitis E. "Comparative analysis of the influence of bamboo and other cellulose fibres on selected structural parameters and physical properties of knitted fabrics." Fibres& Textiles in Eastern Europe 99(2013):76-80.
10. Assefa A and Govindan N. "Physical properties of single jersey derivative knitted cotton fabric with tuck and miss stitches." *J Eng Fibers Fabr 15* (2020): 1558925020928532.

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