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An Investigation on the Dependency of Bursting Strength of Knitted Fabrics on Knit Structures

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Abstract

Knitted fabrics bursting strength dependency was investigated. The investigation was by reviewing previously done and published research articles. In this investigation the dependency of bursting strengths on knit structures was identified and analyzed. Different findings of different scholars on bursting strengths of different knitted fabrics have been discussed in this review.

Keywords: Bursting strength; Knit structures; Dependency

Introduction

Strength of the fabric is an important property that decides and influences all other performance properties of the knitted fabrics. Consideration of the strength of the fabric is very essential while selecting the appropriate fabric for the intended garment [1]. The physical and mechanical properties of knitted fabrics are very important in many ways. Among these properties, the bursting strength is extremely important. Bursting strength is the force that must be exerted perpendicularly to the fabric surface to break off fabric. Bursting strengths of knitted fabrics can be affected by knit structure as investigated by different scholars.

Materials

The materials used in this review are previously published articles those studied by different scholars.

Methods

The methods are identifying the most recent publications on bursting strengths of knitted fabrics, selecting the factors which significantly influencing the bursting strength, collections of articles related to bursting strength dependency, deep reading, analyzing, writing the analyzed review and conclude.

Results and Discussion

Dependency of bursting strength on fabric structure

Fabric structures have significant effect on bursting strength of knitted fabrics. As Abd El-Hady and Abd El-Baky [2,3] reporting their finding, bursting strength revealed that the effect of knit structure is highly significant in produced fabrics. Fleece fabrics have weaker bursting strength performance compared with plush fabrics due to the tuck and miss loop in these structures. That higher tuck loop presence decreases the bursting strength; Miss Loop also reduces the bursting strength but bursting strength of miss loop containing derivatives is higher than tuck loop containing derivatives. The structures with the higher thickness (Figure 1, Sample No.3) have the higher bursting strength properties for both fleece and plush fabrics. This is most probably due not only to thickness, but also to stitches density (Figure 1). The number and position of tuck stitch has an effect on the bursting strength of knitted fabrics. Uyanik et al. [4] reported the effect of number and location of tuck stitch by investigating twelve samples. As shown in Table 1, the number of tuck stitches found in one knit structure is different from the other. Similarly the position of each tuck stitch is different one from the other. This leads to the variation in the bursting strength of knitted fabrics.

As Uyanik et al. [4] described the number and locations of tuck stitches of the sample knitted fabrics are different from each other. To see the effect of the number and location of tuck stitches on the bursting strength of the fabrics, a graph was drawn, in Figure 2.

According to Figure 2 the bursting strength of the sample knitted fabrics changes between approximately 363 to 774 kPa. Uyanik et al. [4] conclude that the bursting strength degree of the sample knitted fabrics, the values and patterns are evaluated together. Sample 1 is plain fabric and has no tuck stitch. The bursting strength of this sample is presented as a control group. As seen from Figure 3, the bursting strength of samples 3, 5 and 6 are lower than the others. The pattern designs of tuck stitches in these samples are not zigzag. When the location of tuck stitches are not in a zigzag form, the fabric will not pick up very much; in other words the loops inside the fabrics do not come together very much. Then the tightness of the structure is low, and hence the resistances of the fabrics to air pressure decreased

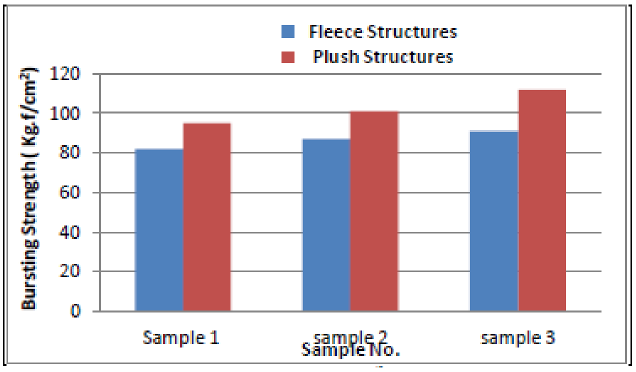

Figure 1: Bursting Strength (Kg.f/cm^2) for produced samples.

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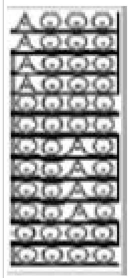
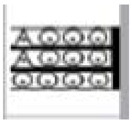
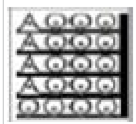
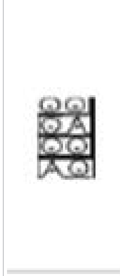
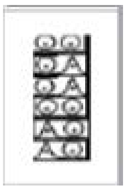
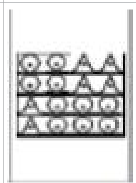
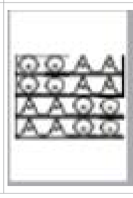
Sample No.	Pattern properties	Needle diagram	Sample No	Pattern properties	Needle diagram
1	This sample is named single jersey and it has no tuck stitch		2	This sample is a combination of sample 4 with 48 courses and sample 1 with 36 courses.	
3	This sample is a combination of sample 6 with 54 courses and sample 1 with 30 courses.			This sample is named "honeycomb" and it has 4 tuck stitches in the same needle. This type is known as zigzag pattern.	
5	This sample has 2 tuck stitches and 1 plain stitch in the same needle.			This sample has 4 stuck stitches in the same needle	
7	This sample is named "honeycomb" and it has 5 tuck stitches 1 plain stitch in the same needle. This type is known as zigzag pattern.			This sample is named "single lacoste" and it has 1 tuck stitch and 1 palin stitch in the same needle. This type is known as zigzag pattern	
9	This sample is named "double lacoste" and it has 2 tuck stitches 1 plain stitch in the same needle. This type is known as zigzag pattern.			This sample has 2 tuck stitches in the adjacent needles for the 1st and 2nd courses and then 1 tuck stitch in the other needles for the 3rd and 4th courses. This type is known as zigzag pattern	
11	This sample is named "English plque" and it has 2 tuck stitches but no plain stitch in the same needle. This type is known as zigzag pattern.			This sample has 2 tuck stitches in the adjacent needles for the 1st and 2nd courses and then 1 tuck stitch in the other needles for the 3rd and 4th courses. This type is known as zigzag pattern.	

Table 1: Pattern properties and needle diagrams of samples.

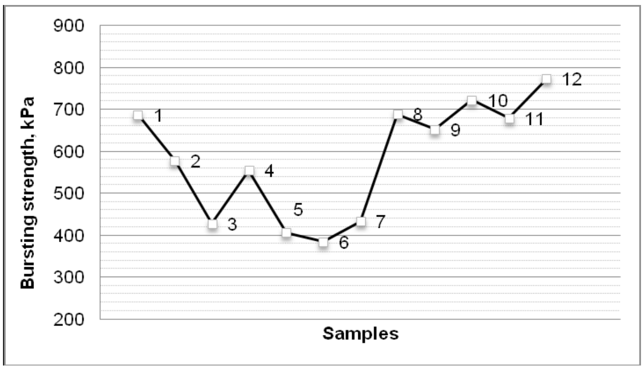


Figure 2: Bursting strength of gray fabrics according to the number and location of tuck stitches.

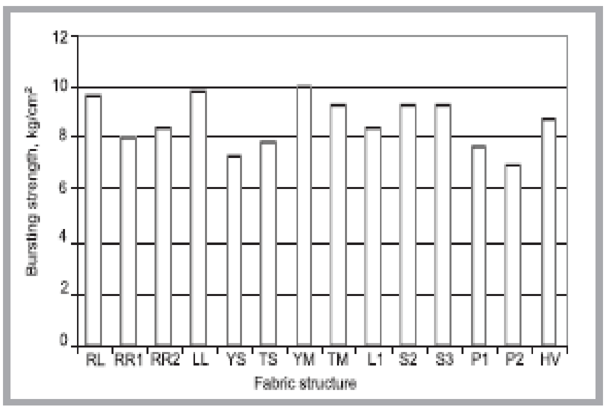


Figure 3: Effects of knit structure on bursting strength for washed fabrics.

and the bursting strength of these samples is low. Especially with an increasing number of tuck stitches, the width of the fabric increases and the slackness of the structure grow. Therefore the bursting strength of sample 6 is lower than the others.

In the honeycomb patterns, which have zigzag structures, the tightness of the fabric is high. Bursting strength values of the honeycomb patterned fabrics are high too, but in these patterns the loops come together lengthwise, and while the length of the fabric decreases, the width of the fabric increases. Therefore in these patterns the fabric does not pick up as the other zigzag structured fabrics. The difference is seen clearly in numbered samples 4 and 7. Although their repeat is the same, in sample 7 there are five tuck stitches over one needle; while there are four tuck stitches in samples 4 (Table 1). As a result, sample 7 expands widthwise more than sample 4, and the toughness of the sample decreases; therefore the bursting strength of sample 7 is lower than that of sample 4.

In the samples with a zigzag structure whose repeats in the lengthwise and widthwise direction is short, the fabrics are extremely tough due to the effect of tuck stitches, which increases the bursting strength of the fabrics. The bursting strength values of samples 8, 9, 10, 11 and 12 are very close to that of sample 1, namely single jersey fabric and notably high. The reason for this situation is the toughness of these samples.

The number of tuck stitches of samples 11 and 12 are the same, but the bursting strength value of sample 12 is higher than that of sample 11. In sample 12, tuck stitches are formed over adjacent needles and tuck stitches transformed to float the loop form at the same time. This float behaves like reinforcement in this sample; thus the bursting strength value of sample 12 increases.

In samples 11 and 10, the bursting strength value of sample 10 is higher than that of sample 11. The tuck stitches are over adjacent needles in both of the two samples, but the number of tuck stitches of sample 10 is higher than that of sample 11, and hence there is a difference between two samples.

Emirhanova et al. [5] investigating the effect of knit structures on bursting strength of washed knitted fabrics. As shown in Figure 3, the results of their investigation for bursting strength revealed that the effect of knit structure is highly significant in washed fabrics. Moss stitch and half cardigan fabrics have weaker bursting strength performance. Half Milano, links-links and plain fabrics have the strongest bursting strength performance (Figure 3).

Nassif [6], showed the relationship between knit structures and bursting strength of the knitted fabrics during his study on the effects of machine gauge and some knit structures on the physical properties of weft knitted fabrics. The statistical analysis listed in Table 2 revealed that knit structure and knitting machine gauge have a significant effect on the knitted fabric bursting strength at 0.01significance level. From Figure 4 it is shown that machine gauge has a positive influence on knitted fabric bursting strength. An increasing trend is detected, assuring that as the machine gauge increases the bursting strength of the knitted fabrics increases. It is also shown that there is significant difference between the fabric structures in relation to its bursting strength. The bursting strength of the knitted fabrics was found to have the following order: Single jersey > Rib > Interlock.

Nassif [6] gives the method to predict the bursting strength of the different knitted fabrics at the different levels of knitting machine gauges, by using the following regression models:

Source of variation	SS	DF	MS	F	P-value	F-crit
Knit structure	18	2	9	10.8	0.024414	6.944276
Machine Gauge	140.6667	2	70.3333	84.4	0.000536	6.944276
Error	3.3333	4	0.8333			
Total	162	8				

Table 2: Effect of knit structures and machine gauge on bursting strength of knitted fabrics (ANOVA).

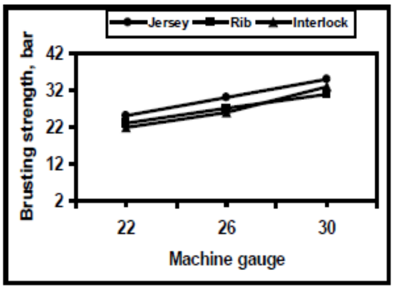


Figure 4: Effect of knitting machine gauge on knitted fabric Bursting strength for different knit structures.

Fabric Type	Bursting Strength(PSI)	
	Grey	Finish
Single jersey	90	77
Single Pique	72	61
Double Pique	61	49

Table 3: Bursting strength of pique fabrics.

Fabric Type	Bursting Strength(PSI)	
	Grey	Finish
Single jersey	90	77
Single Lacoste	77	60
Double Lacoste	71	56

Table 4: Bursting strength of lacoste fabrics.

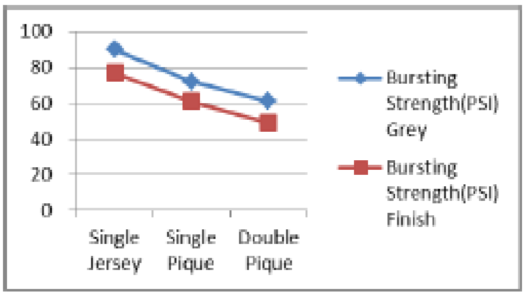


Figure 5: Bursting strength of pique fabrics.

Bursting strength, bar (for single jersey)=5× gauge+20

Bursting strength, bar (for Rib)=4× gauge+19

Bursting strength, bar (for Interlock)=5.5 × gauge+16.

He found the coefficient of determination values for these models 1, 1 and 0.97 for single jersey, rib and interlock structures respectively.

Islam [7], Effect of Tuck Loops on Bursting Strength: Tables 3, 4, Figures 5 and 6 shows that bursting strength of pique design is lower than lacoste structure. In case of pique fabric (Table 3 and Figure 5), it was observed that with the increasing of tuck loops bursting strength decreases [8-10]. Grey and finish bursting strength of single pique (72 and 61 PSI) was found higher than double pique (61 and 49 PSI). Same result was found for lacoste fabrics; with the increasing of tuck loops bursting strength decreases where single lacoste grey and finish bursting strength (77 and 60 PSI) was higher than double lacoste (71 and 56 PSI) (Table 4 and Figure 6). On other hand, Grey and finish bursting strength of double pique was 61 and 49 in PSI whereas bursting strength of double lacoste design was 71 and 66 PSI [11]. It means all knit course insertion on double pique design increases the bursting strength. For all structures finish bursting strength was lower than grey bursting strength. It was also observed that involvedness of tuck loops decreases the bursting strength.

Effect of Miss Loops on Bursting Strength: Tables 5, 6, Figures 7 and 8 indicate that after finishing bursting strength decreases for every observation. But the decrement of bursting strength in case of cross miss design is higher than locknit designs [12,13]. Increasing of miss loops also reduces the bursting strength because single cross miss design shows the grey strength and finish strength as 73 and 63 PSI where double cross miss design shows 66 and 55 PSI (Table 5 and Figure 7). Same result found for locknit designs where single locknit designs shows 80 and 72 PSI in grey and finish state and double locknit

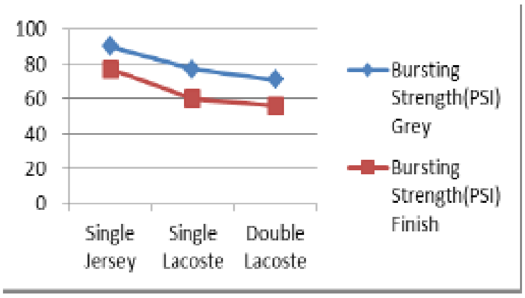


Figure 6: Bursting strength of lacoste fabrics.

Fabric Type	Bursting Strength(PSI)	
	Grey	Finish
Single jersey	90	77
Single cross miss	73	63
Double cross miss	66	55

Table 5: Bursting strength of cross miss fabrics.

Fabric Type	Bursting Strength(PSI)	
	Grey	Finish
Single jersey	90	77
Single locknit	80	72
Double locknit	74	64

Table 6: Bursting strength of locknit fabrics.

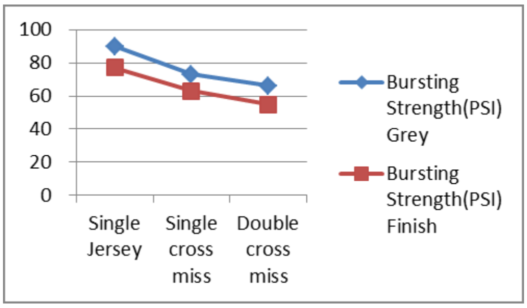


Figure 7: Bursting strength of cross miss fabrics.

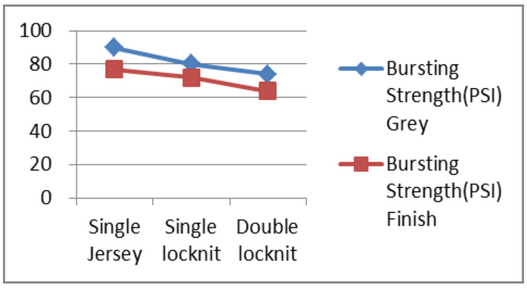


Figure 8: Bursting strength of locknit fabrics.

shows 74 and 64 PSI (Table 6 and Figure 8). It can be also discussed that locknit designs have more bursting strength than cross miss designs. It means that all knit course insertion in cross miss designs increases the bursting strength of the fabrics [14,15].

Conclusion

Bursting strength of different knitted fabrics is dependent up on different factors. In this review we can understand that bursting strengths of knitted fabrics are significantly dependent on fabric structures, fiber types and blends as well as yarns. These factors are the main factors in which bursting strength of knitted fabrics is dependent.

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