Effect of Delivery Speed and Roller Pressure of Slitting Machine on Shrinkage of a Single Lacoste Fabric

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Abstract

The main goal of this study to determine the impact of variable delivery speed and squeezing roller pressure of the slitting machine on shrinkage of the finished single lacoste fabric, particularly length wise shrinkage. Because it is difficult to control length wise shrinkage and shrinkage has a significant effect on final products. To control shrinkage, different combinations of parameters can be set regarding yarn, stitch length, fabric structure, machine gauge, dyeing, finishing, etc. In this study, focus is given on two such weak zones of a slitting machine where wet fabric gets maximum stretch; firstly from de-twister to slitting knife and secondly the padder (both squeezing and stenter). If it is possible to minimize the stretch in these two points then the length wise shrinkage will be less. To determine the impact, the slitting machine was run in two combinations. In combination 1, the delivery speed was 60 meter/minute with roller pressure 3 bar and in combination 2, delivery speed 80 meter/minute with roller pressure 5 bar was maintained. It was found that combination 1 provides less shrinkage. This convenience continued in drying & compacting machine too, 3 bar and 5 bar pressure was applied and 3 bar pressure was found effective to decrease the fabric shrinkage.

Keywords: Shrinkage, delivery speed, pressure roller, single lacoste, slitting, drying, compacting.

1. Introduction

Knitting is a process of fabric formation by the intermeshing of loops of yarn (Anbumani 2007). Basically, there are two types of knitting, warp and weft knitting. Weft knitted fabric is most commonly used for dress making. Knitted fabric is not only very comfortable to wear but also easy to care than woven fabric (Hannan, M. A., Islam, M. M., Kabir, S. F., Kafi, A., & Sheikh 2014). Commonly after washing the dimension changes significantly. Maintaining a constant dimension of fabric is called dimensional stability. Generally, when a T-shirt is purchased, after washing a few times it shrinks to appropriate fit. Basically, this phenomenon is defined as shrinkage. Shrinkage can create problems during apparel manufacturing or washing. Shrinkage may occur due to the integrated effect of fabric relaxation, finishing or dyeing even machine settings (Onal, Levent; Candan 2003). Most of the causes are affected by hydrophilic fiber but any kind of fiber can be affected by relaxation shrinkage. Relaxation shrinkage accomplished after releasing tension from fabric. Knitted fabric subjected to tension during dyeing, slitting, washing process. When the tube knitted fabric passed through the slitting machine it is subjected to raise high and pressed by the squeezing roller. The level of tension applied to the knit fabric by these two parameters is affected by machine's delivery speed. It is very important to set the appropriate machine speed and squeezing roller pressure for maintaining proper shrinkage. In this paper, it has been attempted to determine the impact of machine's delivery speed and squeezing roller pressure on shrinkage of single lacoste fabric.

2. Literature Review

Knit fabric getting popularity for the last few decades. In the past time, it was used for casual use but by this time it is using for formal wear too. There are some faults are found in the knit fabric. Shrinkage is one of the prominent problems in the knitted fabric. Shrinkage is more found in single jersey knit fabric than double jersey knit fabric (Spencer 2001). This problem occurs due

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to the application of pressure and water and measured by applying bench marks. In single jersey knit fabric, the seam puckering problem is vigorously found during sewing for shrinkage. Many researchers showed the effect of yarn count, twist, stitch length, machine parameters on knit fabric shrinkage, GSM and spirality. VK Kothari showed relation among the spirality of cotton plain knitted fabric with respect to variation in yarn count and machine parameters (Kothari et al. 2011). Black proposed that by precise settings of knitting machine for tension free knitting, the problem arose for shrinkage could be eliminated (Black 1974).

Several Researchers have discovered different influencing factors of shrinkage. Some of the research related to machine parameters such as the number of feeders, gauge, some are related to dyeing, drying and constituent yarn (Azharul Islam 2014)(Heap et al. 1983)(Lo, Ng, and Lai 2012). But the effect of roller pressure and delivery speed of slitting machine on shrinkage of single lacoste fabric was not investigated. Slitting is the process which is used to cut the tubular knit fabric into open width. After pretreatment and dyeing, excess amount of water is also removed from the fabric during this process (Amin 2014)(Khandaker et al. 2014).

Between the twisting zone and slitting zone, wet fabric gets maximum stretch and length wise elongation is high due to this stretch. If we can minimize this elongation, we can get better result minimizing shrinkage. Due to containing water, wet fabric weighed more than dry fabric. For this overweight, during slitting wet fabric gets the maximum stretch. As well as owing to padder pressure fabric gets more elongated in length wise which leads to more shrinkage.

3. Materials and methods

3.1 Yarn selection

For conducting this experiment 100% cotton yarn of 22/1 count was used.

3.2 Knit fabric production

Three fabric rolls were produced following the same specification. Single Lacoste grey knit fabric with knit loop length K = 2.65 mm and tuck loop length T = 2.60 mm was produced by a knitting machine having the following specification. These 3 fabric rolls are named as B1, B2 and B3.

Table 1: Specification of the knitting machine

Origin	TAIWAN
Brand	PAILUNG
Model	PL-XS 3B/A/CE
Needle	1944
Feeder	78
RPM	40
Diameter X Gauge	26 X 24

3.3 Dyeing process

The fabric was dyed by the following process:
Raw Fabric → Deionization→ Scouring and Bleaching → Enzyme Treatment→ Dosing Optical Brightening Agent →Run Time → Hot Wash → Neutralization → Add Sequestering Agent → Softening → Dyed Fabric.

3.4 Slitting process

During experiment, all parameters of slitting machine except delivery speed and squeezing roller pressure remained constant. Such as, 1st padder pressure 2.5-3 bar and 2nd padder pressure 2-2.5

bar, blower speed 8 meter/minute etc. The delivery speed of slitting machine was maintained at 60 and 80 meter/minute and roller pressure was 3 and 5 bar.

As the object of this study was to find out the impact of delivery speed and roller pressure of a slitting machine on fabric shrinkage, slitting was done in 2 setting combinations.

Combination 1: Delivery speed 60 m/min & roller pressure 3 bar

Combination 2: Delivery speed 80 m/min & roller pressure 5 bar

3.5 Drying process

The fabric is dried with the following machine:

Table 2: Specification of the drying machine

Origin	**Korea**
Brand	IL SUNG SUNSUPER II
Model	ISST II 8GP 2800
Padder Pressure	0 to 10 Bar
Setting Scale	40" to 80"
Speed	100 m/min
Blower RPM	10
Temperature	200 ℃

3.6 Compacting process

This process conducted by the following machine:

Table 3: Specification of the compacting machine

Origin	**ITALY**
Brand	BIANCO
Model	600 MM DIAM WITH 6.0 CHAIN
Setting Scale	max-98", min-42"
Speed	40 m/min
Temperature	170°C
Over Feed	100
Teflon Pressure	0-27%
Felt Tension	5-5.3 kg
Steam Pressure	0-10

3.7 Washing

Method: ISO 6330: 2001 2A/5 was followed for washing by using the following machine. A domestic front loading washing machine was used.

3.8 Drying

The drying procedure was conducted by using the following machine. A front loading tumble dryer (Indesit, Italy) was used.

3.9 Calculation of shrinkage %

After completing the dyeing, slitting, drying and compacting process those 3 fabric rolls were collected. For shrinkage test, ISO 3759 standard was maintained, where the samples dimension was 50 cm wale wise and 50 cm course wise. During testing, no tension was applied on the test specimen. Shrinkage was calculated by the following formula

Percentage shrinkage, $S = (Lo\text{-}L_1/Lo) \times 100\%$

Here, Lo = Distance between the datum line before washing

L_1 = Distance between the datum line after washing

4. Results and discussions

4.1 Dimensional change in the fabric after dyeing and slitting in combination 1

Below figure reveals the dimensional change occurred in the fabric after dyeing and slitting at 60 m/min with a roller pressure 3 bar (combination 1). Figure 1 depicts that, among 3 fabric rolls after slitting, B1 shows a slight shrinkage but samples from other two rolls show considerable lengthwise elongation.

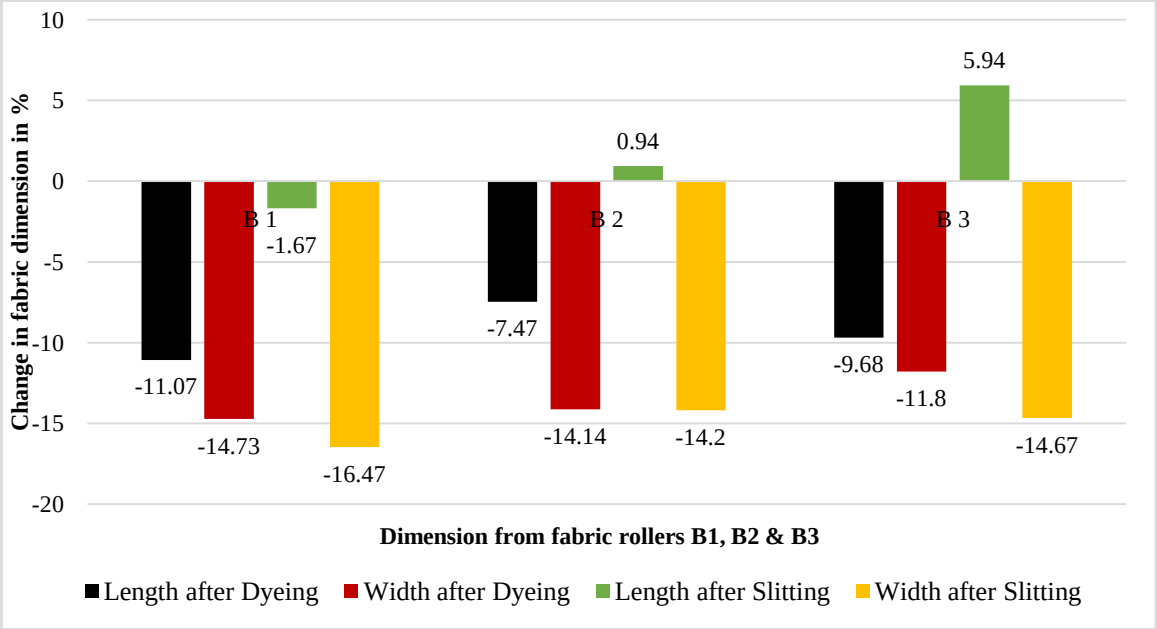

Figure 1: Change in fabric dimension % with setting combination 1 after dyeing & slitting

4.2 Dimensional change in the fabric after dyeing and slitting in combination 2

Figure 2 states that, after slitting process, lengthwise elongation increases a lot for all of three fabric rolls, if machine runs in higher delivery speed of 80 m/min and 5 bar roller pressure.

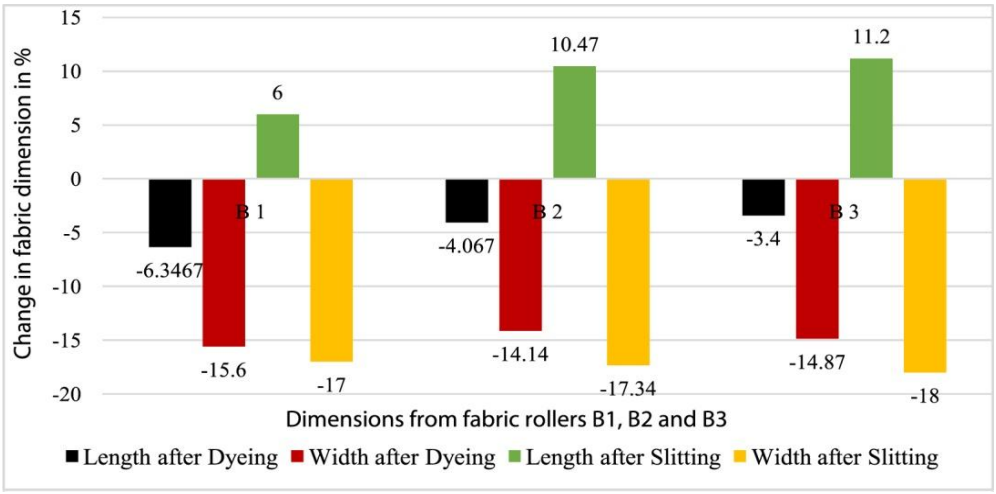

Figure 2: Change in fabric dimension % with setting combination 2 after dyeing & slitting

The figure 3 reveals the impact of delivery speed and squeezing roller pressure on fabric elongation after the process. Higher delivery speed and roller pressure provides higher lengthwise elongation which will lead to more lengthwise shrinkage.

The above figure 3 states that the setting combination 2 provides less dimensionally stable fabric compared to combination 1 as higher fabric elongation is recorded here.

4.3 Dimensional change in the fabric after drying and compacting

Combination 1 with lower delivery speed and lower pressure achieved the better result in previous processes according to figure 1, 2, and 3 providing less elongation and higher dimensional stability. This phenomena continues up to drying and compacting.

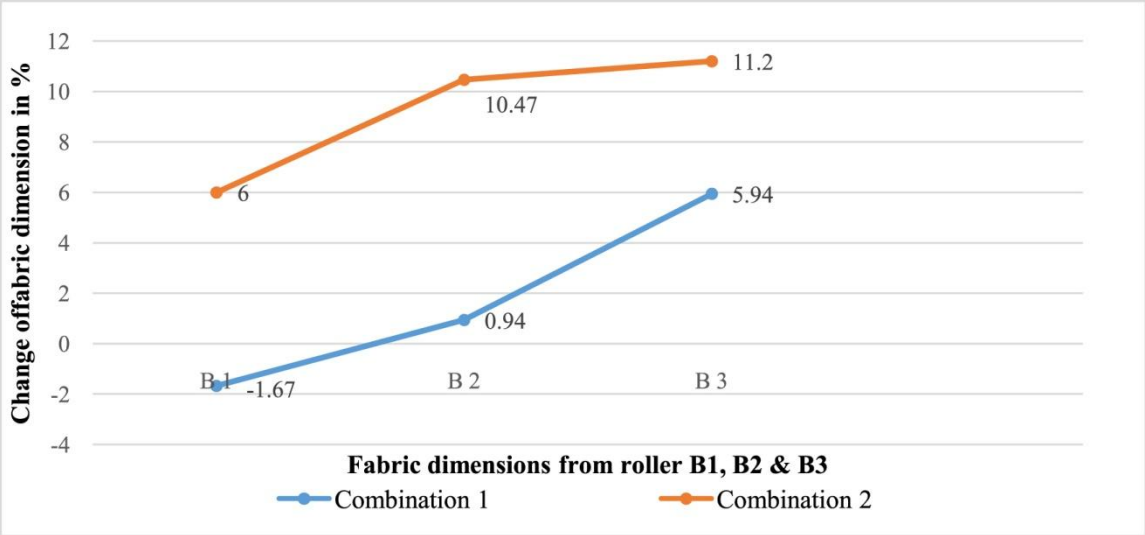

Figure 3: Change of fabric dimension % after slitting process in both setting combinations

Table 4: Change in dimension % after drying & compacting the fabric from combination 1

Fabric roll	Fabric dimension after drying		Change of dimension %		Fabric dimension after compacting		Change of dimension %	
	L(cm)	W(cm)	L(cm)	W(cm)	L(cm)	W(cm)	L(cm)	W(cm)
B1	40	49.5	-20.1	0	40.5	49.5	-18.3	-2
	40	50			40.5	49		
	39.8	50.5			41.5	48.5		
B2	40	50	-18.8	1	42.3	50	-15.1	-1.2
	40.8	50.5			42.5	49.5		
	41	51			42.5	48.7		
B3	40.2	50	-19.7	0.33	42.2	50	-15.8	-0.67
	40	50.5			42	49.5		
	40.2	52.5			42	49.5		

Table 5: Change in dimension % after drying & compacting the fabric from combination 2

Fabric roll	Fabric dimension after drying		Changeof dimension %		Fabric dimension after compacting		Change of dimension %	
	L(cm)	W(cm)	L(cm)	W(cm)	L(cm)	W(cm)	L(cm)	W(cm)
B1	38.4	49.5	-23.9	-1.73	40	48.2	-20	-3.2
	37.9	48.5			39.5	48.5		
	37.8	48.9			40	48.5		
B2	38.7	50.3	-21.7	1.53	41	49.5	-18	-1.33
	40	51			41.7	49		
	38.8	51			41	49.5		
B3	39	52.5	-20.5	5	40.2	51	-19	2.333
	40	52.5			40.7	51.5		
	40.2	52.5			41	51		

From above tables, it can be calculated that, after drying length wise shrinkage improved from an average L = (22.03–19.53) = 2.5% and after compacting length wise shrinkage improved on an average L = (19 - 16.4) = 2.6 % after following combination 1. The comparison is expressed in below figure 4.

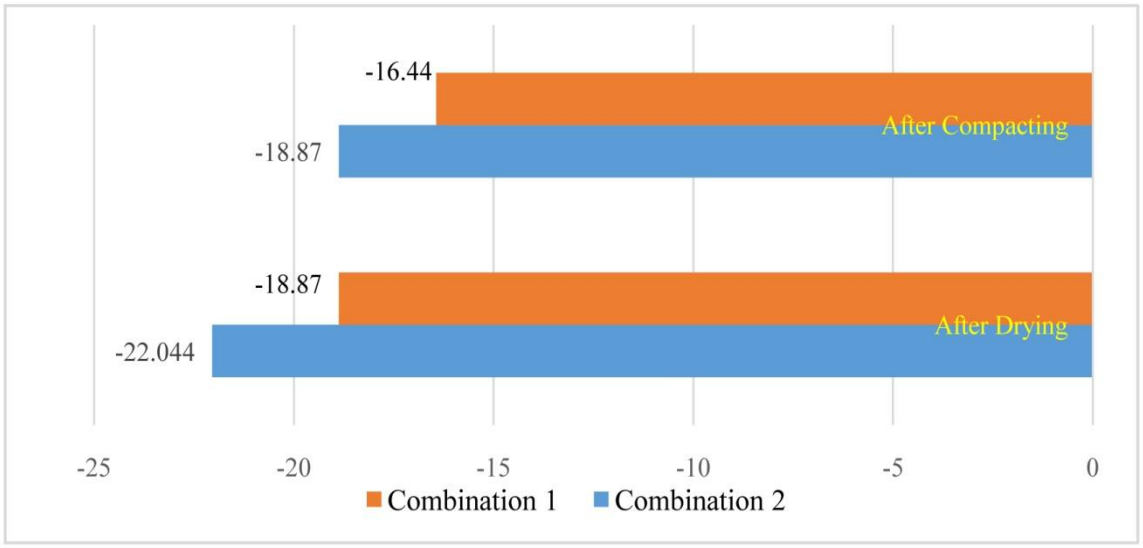

Figure 4: Comparison of shrinkage % from two setting combinations after drying and compacting process

5. Conclusion

Delivery speed and squeezer pressure have been found as impactful on fabric shrinkage of a single lacoste fabric. Results showed that length wise shrinkage improved on an average 2.5% after drying and 2.6 % after compacting in the 60 m/min delivery speed and 3 bar pressure. This study will be very beneficial for the persons who are associated with knit dyeing. The same impact of delivery speed and roller pressure on fabric shrinkage may be found in other knit structures too. But, as this study was done for tuck and knit based fabric maintaining single Lacoste structure only, it is suggested to the future researchers to conduct more experiments by varying fabric structure, yarn count, gsm etc.

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