Effect of Weave on Width Shrinkage of Commercially Produced Two Way Stretch Denim Fabric

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Abstract

Cotton/spandex stretch denim fabrics for apparel are becoming more and more in use recently. The stretch properties of yarn and fabric are now more important to study to understand effect on the final fabric. The present study was undertaken to investigate the width changes of fabric at various critical points of denim production. Width contraction of two samples of commercially produced denim fabric with spandex weft was measured keeping all construction parameters same except weave. It was observed that the width contraction depends on weave, more specifically weave factor of fabric as other variables were kept same. The results will be useful in understanding effect of weave factor on contraction.

Key Words: Denim fabric, Width, Weave factor, Contraction, Float

Introduction

Denim is strong, durable fabric constructed in a warp dominant weave mainly with indigo dyed and white yarns. The blue indigo dyed yarns are the lengthwise warp threads which are parallel to selvedge and the white yarns i.e. weft threads run across the fabric width. As a result of warp dominant weave, face side of the fabric shows the blue warp threads and the other side shows the white weft threads[1].The scope for denim wear is increasing tremendously every year and its worldwide market share has increased substantially in last few decades. Recently the fashion trend is moving from denim to stretch denim where the elastane yarn is used mainly in weft direction providing what is commercially termed as two way stretch[2].

S. Khatun et al.[1]carried out an in-depth study to analyze the effect of weave structure, fabric width, fabric weight on skewness and shrinkage of denim fabric. They noted that the weave structure, fabric width and fabric weight are inherent problems of skewness of woven fabric and that the effect of fabric width and fabric weight on skewness and shrinkage cannot be neglected.

M. Topalbekiroglu[3] examined total 12 woven fabrics with different weave derivatives, woven with 100% cotton and Ne 30/1 combed ring spun yarn. The weave of fabric has significant effect on shrinkage with higher number of interlacement demonstrating lower shrinkage values. G.Darlene [4]examined that the association of each warp and weft yarn tension with fabric shrinkage ratio toward weft is in inverse correlation.

Bansal et al.[5]conducted work on elastic recovery and performance of denim fabric produced using cotton/lycra core spun yarns. They observed that the tensile strength and elastic performance coefficient of fabric increase with decrease in linear density and stretch percentage of the core spun stretch yarn.

B.K.Behra et al.[6] investigated the effect of various weave designs on the elongation, growth and shrinkage properties of fabrics, in which cotton/ spandex core spun yarn was used in weft direction keeping all other fabric constructional parameters constant. They concluded that weave with open structure exhibits higher amount of elongation and comparatively more growth and results in begging problem in garment. Some fabric parameters also affect the comfort properties of commercially produced denim fabric [7].

As one can see various researchers have studied the effect of weave type on fabric properties of stretch fabric containing various amount of elastane yarn. Most of the researches have been done with a control trial in laboratory. So in most of the works the warp yarn is constant and effect of changes in weft yarn with respect to linear density, elastane percentage or type of yarn have been studied. The current experiment was conducted using commercially produced varieties of two way stretch denim fabric. Hence actual values, as used in mill, are considered. While selecting fabric varieties, care was taken to see that all selected samples have the same cover factor values.

Material and Method

Materials

In this study, woven fabrics with two different weaves were selected. The warp yarn was 100% cotton OE spun and the weft yarn was 225 denier polyester with 40 denier Lycra. The weaving and finishing were done keeping all conditions same for both fabrics. The construction details of fabric samples are listed in Table 1.Two selected samples were having same EPI, PPI, cover factor, and count of warp and weft yarns. The weave of both samples A & B was different and is shown at Figure 1A and 1B.

Table 1. Details of the raw materials

Sample no	**Warp**		**Weft**		**EPI**	**PPI**	**Cover factor**
	Count	**Type of material**	**Count**	**Type of material**			
A	16	100% Cotton OE Spun	225D PFY+40D lycra	poly-spandex	104	66	27
B	16	100% Cotton OE Spun	225D PFY+40D lycra	poly-spandex	104	66	27

	X	X	X		X		X
X		X		X	X	X	X
X	X	X	X	X		X	
	X		X	X	X	X	X

Figure 1A. Weave of sample A

X	X		X	X
X	X	X	X	
X		X	X	X
X	X	X		X
	X	X	X	X

Figure 1B. Weave of sample B

Method:

Denim fabric was manufactured in the sequence: warping, dyeing- sizing, weaving and finishing. In present study the width of denim was measured and recorded at various critical points of manufacturing. The width of the fabric was measured as per ASTM D 3774-96.Both samples had same warping width of 160 cm.

Results and discussions

The width of the fabric was measured at weaver's beam, at reed, after temple, on cloth roll and after finishing treatment. The recorded width (an average of 20 readings) is shown at Table 2.

Table 2. Details of width variation of samples A & B

Sample no.	Weaver Beam Width (cm)	Reed Space (cm)	After temple width (cm)	Width on Cloth roll (cm)	Finish width (cm)
A	187	186	183.2	178.4	160
B	187	186	177.3	174.8	154

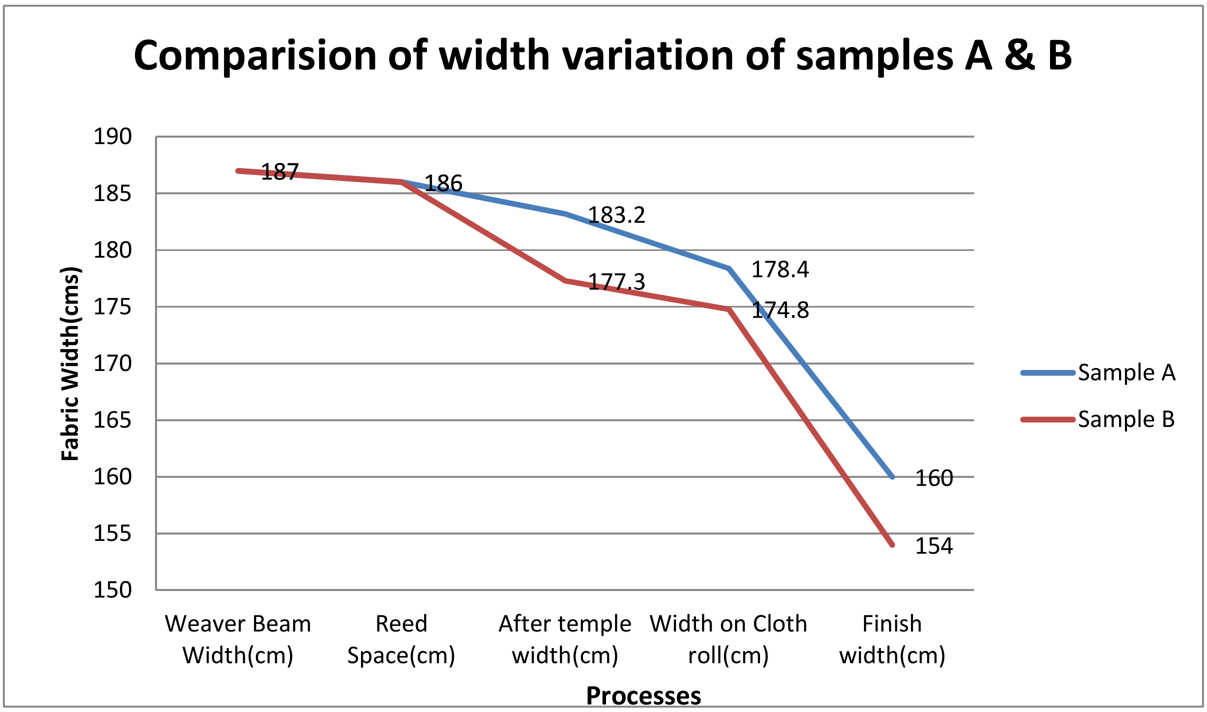

Figure 2. Fabric width v/s process for sample A&B

Fig. 2 shows the width changes from weaver's beam width to finished width of both the samples. An overall decrease in width can be seen as fabric leaves reed space, as it tends to relax from the induced stresses and tensions during weaving and hence contraction takes place. In case of different weave structures individually, we can find lesser width contraction in sample A. This can be attributed to the compact structure of sample A. As the float length increases in fabrics, the amount of width reduction increases. For fabrics with higher float length, yarns are relatively freer to come closer and result in higher width contraction. A further analysis was carried out by combining two parameters of weave viz number of threads in the repeat and interlacement. These two parameters are combined in a ratio popularly known as the weave factor. The analysis is given below.

Effect of weave factor on the width reduction of denim

The weave factor (M) is a number that accounts for the number of interlacements of warp and weft in a given repeat. It is also equal to average float and is expressed as equation 1.

$$M=E/I \quad (1)$$

Where, E is number of threads per repeat and I is number of intersections per repeat of the cross-thread. The weave interlacing patterns of warp and weft yarns may be different. In such cases, weave factors are calculated separately with suffixes 1 and 2 for warp and weft respectively.

Therefore,

M1 = E1/I2; E1 and I2 can be found by observing individual pick in a repeat and

M2 = E2/I1; E2 and I1 can be found by observing individual warp end in a repeat [8].

Sample A is having irregular weave. In weave of sample A, the number of intersections of each thread in the weave repeat is not equal. In such cases the weave factor is obtained as under:

$$M=\Sigma E/\Sigma I \quad (2)$$

Table 3. Details of weave factor calculation of samples A & B

Samples	E1	E2	I1	I2	M1	M2
A	32	32	18	20	1.78	1.6
B	5	5	2	2	2.5	2.5

A weave factor of 1 represents that the number of threads in repeat and number of interlacements are equal. This normally happens in plain weave for an example. Any value above 1 indicates that number of interlacements are lesser than number of threads in the repeat. This also means that the float in the yarn is more comparatively. When values of weave factor of sample A and B are compared it can be seen that weave of sample B gives M1 and M2 value of 2.5 whereas for sample A the values are 1.78 and 1.6 respectively. Thus it can be said that the weave of sample B is comparatively looser than weave of sample A.

In the present study width of fabrics was measured so, weft weave factor is more important in comparison of both the fabrics. Sample B is having higher weave factor value because it has higher float than sample A.

Conclusion

The results obtained in this study indicated that there is very good relationship between weave factor and width variation of denim fabric. The weave of fabric plays a very important role in the width reduction of denim fabric. The longer float length affects width reduction of fabric. There is possibility of simulating the parameters of fabric construction to achieve the required width in denim.

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