Influence of weave design on Shrinkage Potential of stretch fabric

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Abstract

A rapid increase in the use of cotton/spandex stretch fabrics for apparel has occurred greatly. This raises a need to investigate the factors that influence properties especially stretch properties of such fabrics. The present study was undertaken to investigate the effect of various weave designs on the elongation, growth and shrinkage properties of elastic (cotton/spandex) fabrics, in which cotton/spandex core-spun yarn was used in weft direction and keeping all other fabric constructional parameters constant. The obtained results could be used in designing of high stretch fabrics.

Keywords: Lycra, stretch, shrinkage, weave, cotton fabric

1. Introduction

The wearing comfort provided by a fabric plays a decisive role in its acceptance as a suitable apparel fabric for mass consumption. The achievement of this level of comfort is determined by the mechanical properties of a fabric including stretch properties. Stretch is regarded as an importance property of textiles as it decides the comfort to the wearer. The greater acceptability of stretch fabrics is due to their exceptional qualities like higher extensibility, high degree of recovery, elasticity and simple care. To impart stretchability to the yarns, elastic fibres like lycra/spandex are incorporated in them. Core-spun yarns having elastane filament at the core and wrapped cotton fibres are commonly used in the weaving process [1].

Maqsood et al. have studied the effect of elastane linear density, thread density and weave float on the stretch, recovery and compression properties of bi-stretch woven fabrics, and it was observed that the elastic recovery was highly influenced by elastane count (higher elastane count resulted in higher recovery) whereas the fabric contraction was influenced by thread density and float size [2]. An increase in the amount of spandex significantly influenced the physical and elastic properties of woven fabrics. Fabric contraction and fabric breaking elongation increased with increase in the spandex rate, while fabric tensile strength decreased with spandex rate [3].

It has also been reported that weave patterns of 100% woven fabric have significant effect on their dimensional stability. Fabric with higher number of interlacing demonstrated lower shrinkage values, also lower crimp values led to better dimensional stability of the fabrics [4]

Gorjanc D S et al. carried out research to study the effect of changing constructional parameters like weave and thread density on deformability of conventional cotton and elastic cotton/elastane fabrics. The results showed that the breaking extension of fabric increases as the amount of elastane incorporation increases. However, increase in thread density has insignificant influence on breaking. The samples woven with twill weave show more deformation compared to plain weave [5].

Mathur K et al conducted a research to investigate the stretch potential of woven stretch fabrics of different degree of tightness and containing spandex of different type. An attempt was made to find how fabric stretch properties vary for change in its constructional parameters. Woven samples produced from spandex filaments are wet relaxed and selective samples were subjected for a sequence of processes for finishing. The dimensions of fabric samples were recorded before and after wet relaxation and used for calculating stretch potential. The results indicate a higher stretch potential in weft direction compared to warp direction. It was also concluded that there is an insignificant effect of spandex draw ratio during weaving on stretch potential. Also the tighter construction woven show lower stretch potential and hence came out as more dimensionally stable. Hence for stretch fabric, the basic fabric construction should be looser than normal so that spandex yarn can have some space to contract. To achieve high stretch, the fabric should be constructed with a low to medium tightness [6].

Celik H I et al investigated how elastane draw ratio, weft density and weave structure of bi-stretch denim fabrics influence the air permeability of the fabric and concluded that no clear trend was shown by air permeability of the different weave fabrics with increasing elastane draw ratio. However, higher thread density leads to lesser air permeability [7].

Sawhney A P discussed that the parameters of fabric structure influences the stretch and other properties of the bi-stretch fabrics. The test samples were woven with four different weaves and different thread densities. The experimental results showed that for a given construction an open weave fabric offers higher values of stretch than a tighter weave. An increase in thread density in the grey fabric reduces the elastic properties of the finished fabric [8]

As we can see, the various researchers studied the effect of weave type on fabric properties of stretch fabric but along with other variables also. Here, an attempt has been made to analyze the effect of various weave designs on the elongation, growth and shrinkage properties of elastic (cotton/spandex) fabrics, in which cotton/spandex core-spun yarn was used in weft direction and keeping all other fabric constructional parameters constant. The obtained results could be used in designing of high stretch fabrics.

2. Materials and Methods:

2.1 Materials

In this study, woven fabric with five different weaves was prepared in a weaving mill under controlled manufacturing conditions. The warp yarns taken are 100% cotton spun on Open End spinning system. The weft yarns are the cotton wrapped spandex-core spun yarns. The construction details of fabric samples are listed in Table 1.

Table 1. Construction details of fabric samples

Code	P	T(2/2)	M	T(3/1)	S
Warp	32’s OE Cotton				
Weft	20’s spx,70den cotton spandex-core spun				
Weave	1/1 Plain	2/2 Twill	2/2 Matt	3/1 Twill	4/1 Satin
EPI	146				
PPI	76				
Reed	72/4				
Reed space	185.4 cm				
Loom	Dobby-Rapier				
RPM	550				

2.2 Methods

Grey fabrics were tested for construction (Width/GSM), on Loom as well as off Loom & After keeping 48 Hrs open for dry relaxation. Shrinkage Potential was evaluated for grey fabric after boil off with the standard process parameters used for commercial production

2.3 Testing

In the present study, the fabric samples were tested for important mechanical properties viz., areal density, fabric width and fabric shrinkage and stretch properties of elongation, growth and recovery. Fabric samples were tested according to the below mentioned standard test methods (Table 2). An average of 3 observations was taken for each sample.

Table 2: Test standards for fabric properties evaluation

Parameters	Unit of measurement	Test method
Finish width	Cm	ASTM D 3774-96
Weight	Gm/sq Mts	ASTM D 3776-2002
Shrinkage (Warp & Weft)	%	AATCC-135
Elongation (initial % A/F 3 wash)	%	ASTM-3107
Growth (initial % A/F 3 wash)	%	ASTM-3107

3. Results and Discussion:

The samples with different weaves were evaluated for Width, GSM, Shrinkage, Elongation, Growth, Recovery and Contraction. The results were drafted into charts as shown in Figure1-7 respectively.

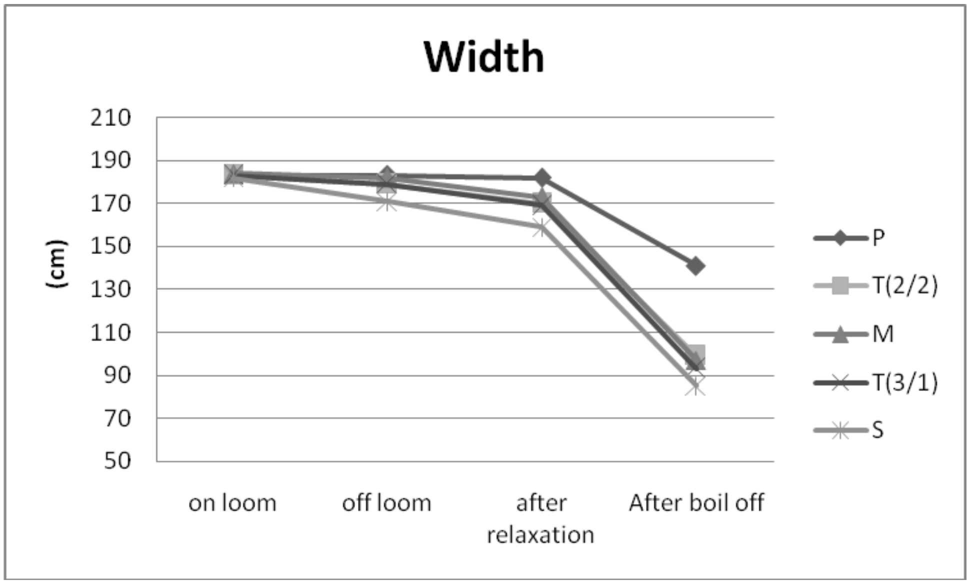

Figure 1: Effect of different weaves on Width

Figure 1 depicts the values of fabric width on loom and during relaxation. An overall decrease in width can be seen and is obvious as the fabric leaves the loom, it tends to relax from the induced stresses and tensions during weaving and hence contraction takes place that lowers the width [3,9]. In case of different weave structures individually, we can find a relatively lesser width contraction in plain weave sample. This can be attributed to the compact structure of plain weave because of maximum number of interlacing. Also, as the float length increases in fabrics from plain to satin, the amount of width reduction increases. For fabrics with higher float length yarns are relatively freer to come closer and result width contraction. The results of fabric contraction (in figure 2) are in correspondence with width reduction for the same reason as mentioned. The width contraction directly affects the areal density of the fabric. As the fabric contracts width wise, yarn density increases and thus results in an increase in weight per unit area of fabric [8]. The GSM of various fabrics with different weave structure is shown in figure 3.

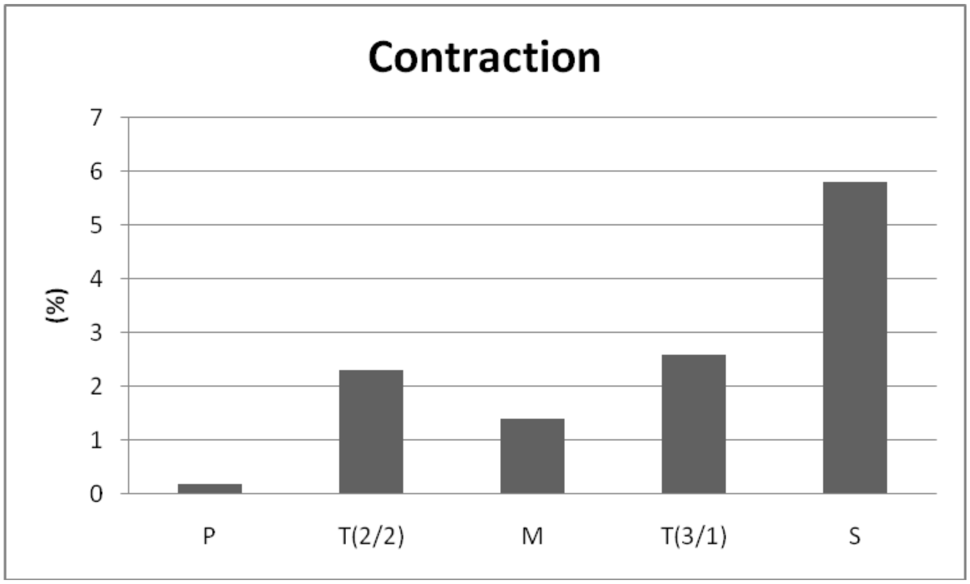

Figure 2: Effect of different weaves on Contraction

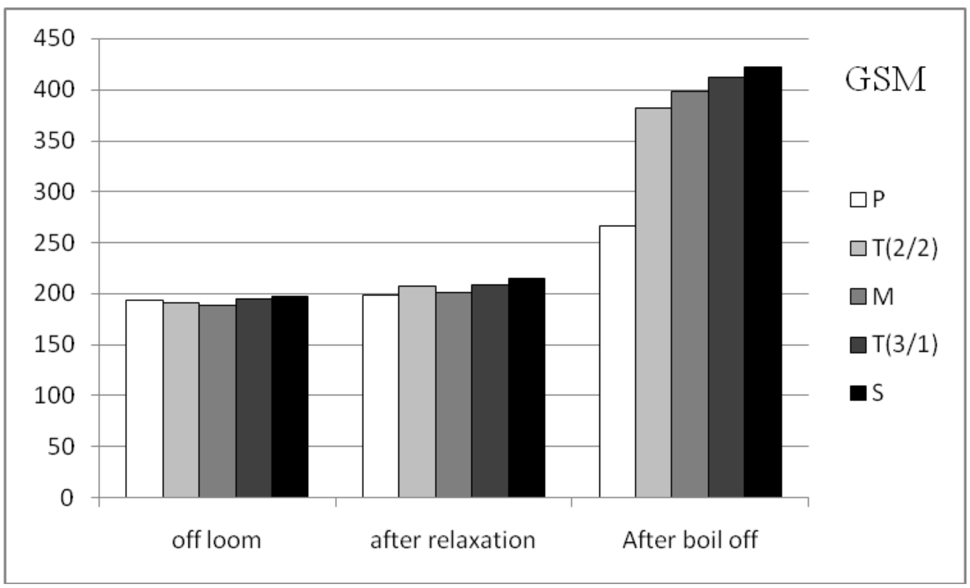

Figure 3: Effect of different weaves on Areal density

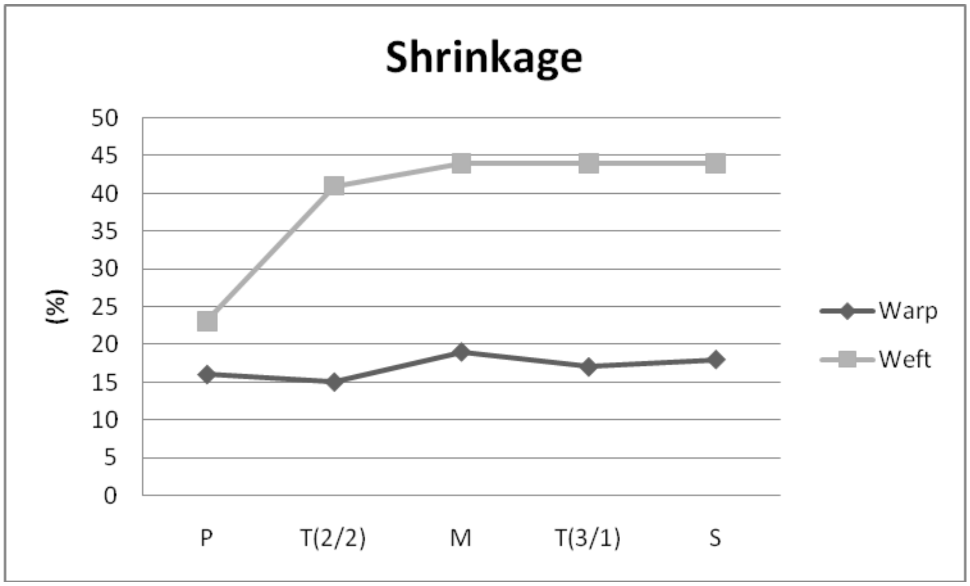

Figure 4: Effect of different weaves on Warp & Weft Shrinkage

The Figure 4 shows that weave type has a significant influence on shrinkage values. Weave structures with more number of interfacings showed lesser shrinkage [4]. That's why, the plain weave sample results in a lesser weft shrinkage as compared to other four weaves.

Also, there is no significant difference in warp shrinkage between the five samples of the different weaves. The reason behind these results can be attributed to the fact that warp yarns are kept in tension throughout the weaving process without any discrimination of weave structure. While in weft direction tension is applied by temples. After the fabric passes temples, the weft yarns are free to contract and make crimp. When this woven fabric is wetted, both yarns try to relax to a more stable state. The already existed crimp in weft yarn limits the warp yarn contraction. Hence, warp shrinkage is lesser than weft shrinkage. This effect is more pronounced in fabric containing spandex filament in weft yarn [9,8]

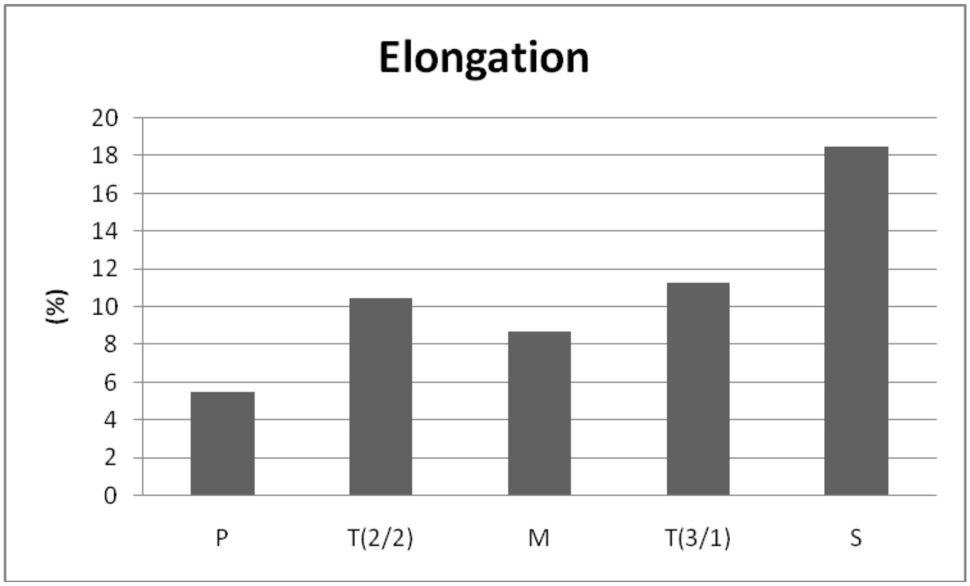

Figure 5: Effect of different weaves on Elongation

The Figure 5 shows an increasing trend in elongation percentage from plain then twill to satin weave. Satin weave samples show maximum elongation. Reason may be the larger float length because of lesser interlacement points. Due to less number of interlacements, fabric is less compact and yarns have more space to contract. In case of stretch fabrics containing spandex in weft, more contraction leads to more elongation percentage. In plain weave, yarns have higher number of interlacement points leads to less free space for yarns to contract [6,8]. The figure 6 and 7 shows the results of fabric recovery and growth respectively. The results indicate a respective behavior of recovery and growth with elongation percentage. In case of plain weave, the compact structure firstly allows the fabric to elongate to a lesser amount and secondly exerts retraction force during recovery from stretch. And more stretch recovery leads to lesser growth. Opposite to plain, satin weave shows maximum elongation and lesser recovery because of the less tight structure. Lesser number of interlacing gives lesser contact points between warp and weft. So, there is a lack of retraction forces for higher recovery from stretch. Hence, a higher growth % is exhibits by the satin weave structure. The twill and matt weaves have fabric tightness in between the plain and satin weaves. Therefore, their behavior for elongation, recovery and growth is also in between the behavior of plain and satin weaves.

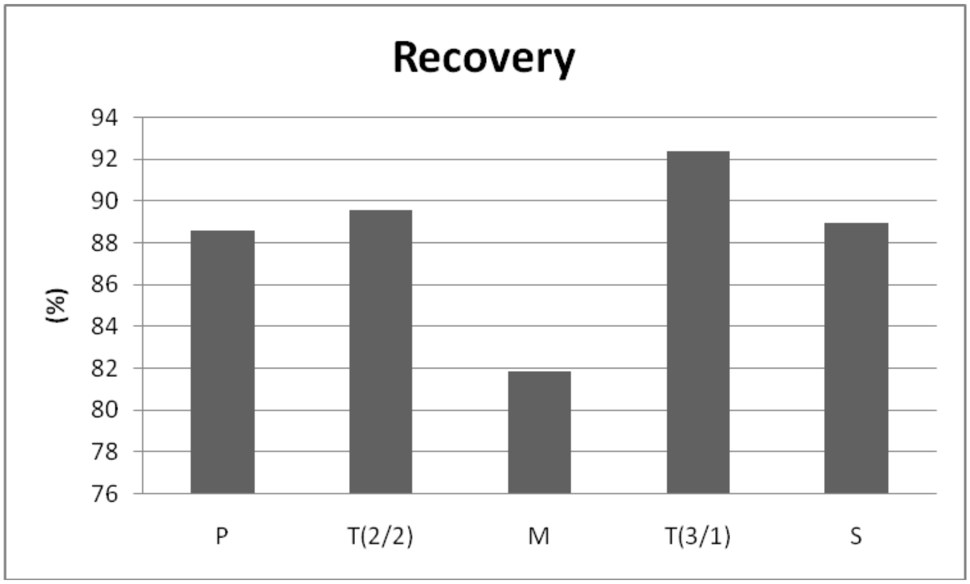

Figure 6: Effect of different weaves on Recovery

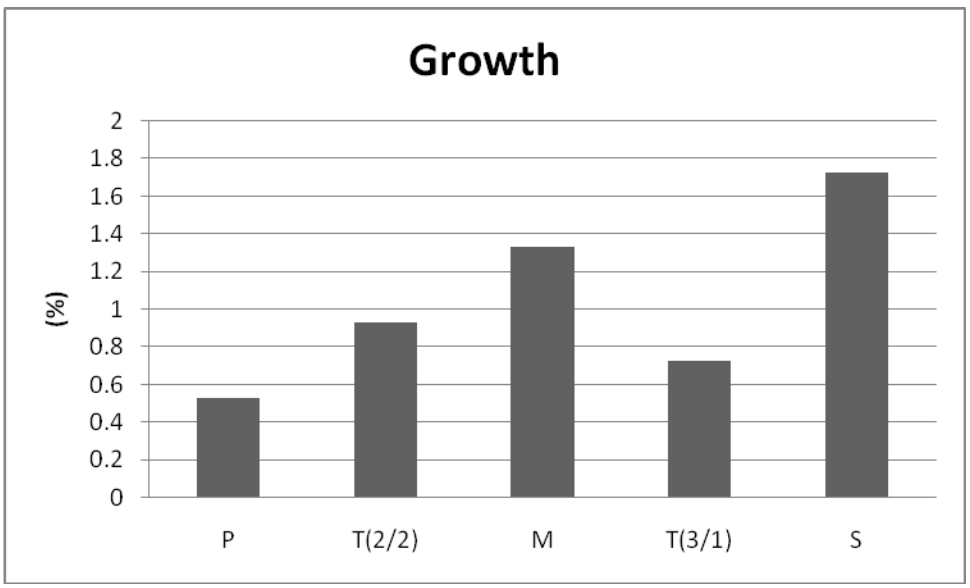

Figure 7: Effect of different weaves on Growth

4. Conclusion

The present study was conducted to analyse the change in shrinkage and stretch properties of woven fabrics containing core spun cotton spandex weft yarns woven with different weave designs. The samples were produced with changing weave design and keeping all other parameters constant. The result outcomes indicate that a weave with more number of interlacement (shorter float length) like 1/1 plain; gives less elongation, smaller growth and lesser shrinkage in weft direction. Less elongation can be a point of compromise here. A weave with comparatively open structure or longer float (like satin) exhibits higher amount of elongation and comparatively more growth. This type of weave shows more growth % that can result in begging problem in garments. In case of 3/1 twill weave, the satisfactory elongation % is indicated along with comparatively lesser growth %. This combination is more desirable for apparels meant for wearing purpose.

5. References

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