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IMPACT OF VARIOUS YARN OF DIFFERENT FIBER COMPOSITION ON THE DIMENSIONAL PROPERTIES OF DIFFERENT STRUCTURE OF WEFT KNITTED FABRIC

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ABSTRACT

In this paper, the unpredictable problem of shrinkage of cotton knitted fabrics and garments, faced by the industries were investigated by knitting weft knitted fabrics using 100% cotton yarn, chief valuable cotton (CVC) yarn, mélange yarn, polyester-cotton (PC) yarn and 100% polyester yarn on Fukahama knitting machine. The aim of this work was to compare the spirality and shrinkage% of different weft knitted fabric structure. The experiment showed that percentage of spirality and shrinkage is higher for 100% cotton yarn and lower for 100% polyester yarn. It was also found that slub single jersey (S/J) fabric has higher spirality% in case of all types of yarn and terry single jersey gives higher shrinkage%, when produced from CVC yarn. On the other hand, cross tuck fabric gives lower spirality% in case of all types of yarn.

KEY WORDS: Spirality, Shrinkage, Single Jersey, Knitting, Yarn

1. INTRODUCTION

The dimensional stability of knitted fabrics is an important factor of the knitting industry. Fabric shrinkage and spirality is the ultimate problem if the dimensional stability of the knitted fabrics is not properly taken care. Spirality has an obvious influence on both the aesthetic and functional performance of knitted fabrics and the garments produced from them (Tao et al., 1997). Manufacturing of knitted fabrics involves intermeshing of yarn loops where one loop is drawn through another loop to form a stitch (Saufley, 1992; Shah, 2003). Knitted fabrics are prone to stretching and mechanical deformation (Zanaroli, 1990). There are various factors influencing the dimensional stability as well as the shrinkage and spirality of the knitted fabrics. Though the factors such as fiber characteristics, stitch length, machine gauge, yarn twist, knitting tension causes dimensional variations, the most prominent factor causing spirality in a single jersey fabric is the relaxation of torsional stresses in the yarn (Davis and Edwards, 1934; Haigh, 1987, Nutting, 1960). Spinning technology influences the degree of spirality in fabrics (Araujo and Smith, 1989). Reduction of dimensional stability of finished fabric is called shrinkage. It is important for the dyer and finisher to make an effort to remove as much shrinkage from the product as possible. Fabric shrinkage is a serious problem for knitwear, originating from dimensional changes in the fabric, particularly stitches (Mikučionienė and laureckienė, 2009). During the knitting process, the yarns forming the fabric are constantly under stress. As a result, the fabric on the machine is more distorted than in natural relaxed state. When the fabric is removed from the machine, it has time to relax and overcome these stresses, which is easily recognizable by the changes in dimensions (Quaynor et al., 1999). Shrinkage is a result of the combined effect of numerous factors such as relaxation, finishing, drying, and effects of machinery (Mikučionienė, 2003). The effect of various fabric characteristics on the shrinkage behavior of weft knits is as important as that of the fiber characteristics (Onal and Candan, 2003).

Spirality of knitted fabric is obtained when the wale is not perpendicular to the course, forming an angle of spirality with vertical direction of the fabric. It affects particularly single jersey fabrics and presents a serious problem during garment confection and use. Causes of spirality are yarn twist multiple and it is directly proportional residual torque in the yarn, higher number of feeder is also cause of higher spirality.

2. MATERIALS AND METHOD

2.1 Materials

The weft knitted fabric samples are produced on Fukahama knitting machine. The machine parameters used to produce the samples are machine diameter 28 inch, no of feeder 84, machine gauge 24, no of needle 2110T and machine speed 28 rpm.

2.2 Methodology

There are three well known standard test methods, IWS test method no.276 (IWS Test Method), British standard 2819 (British Standard), and ASTM D 3882-88 (ASTM Standard), available for determining the spirality of knitted fabrics. But in the industrial or practical purposes spirality is measured in percentage. For measuring spirality samples are marked with two sets of markers in each direction (lengthwise and widthwise) a minimum of 50cm apart and at a distance of approximately 3cm from the edge. No tension is applied to samples during measuring spirality percentage (Shahid et al., 2010). Calculation of Spirality:

$$\text{Spirality\%} = \frac{\frac{\text{Left side} + \text{Right side}}{2}}{\text{Length}} \times 100$$

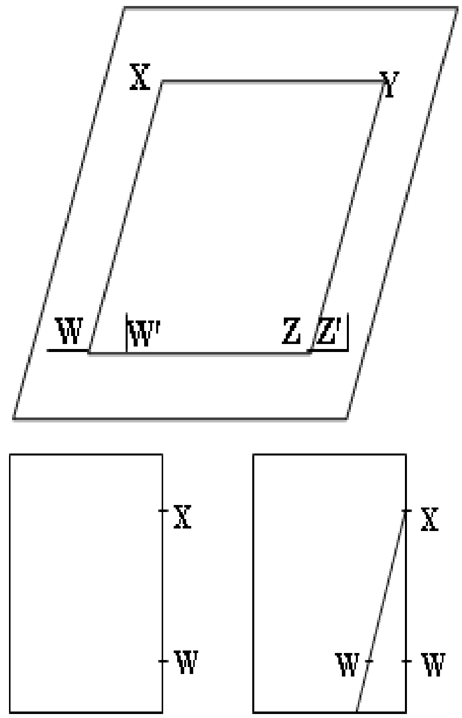

Figure 1 : Industrial measurement technique of spirality% and shrinkage%

$$P = 100 \times \frac{WW' + ZZ'}{WX + YZ}$$

Where P = % change in spirality

Shrinkage% = $\frac{100 \times (W - X)}{W}$

Where,

W= Distance between two ends before treatment

X= Distance between two ends after treatment

Spirality and shrinkage percentage of the samples are measured from the sample after finishing the samples.

3. RESULTS AND DISCUSSIONS

Different weft knitted fabric samples were produced on Fukahama Circular Knitting Machine are plain S/J fabric, Slub S/J fabric, Cross Tuck fabric, Polo Pique fabric, Single Lacoste fabric, Double Lacoste fabric, Lycra S/J fabric and Terry S/J fabric is represented by ‘A’, ‘B’, ‘C’, ‘D’, ‘E’, ‘F’, ‘G’ and ‘H’ respectively. The lengthwise and widthwise shrinkage% of different samples were produced from 100% cotton yarn, CVC (60% cotton+ 40% polyester) yarn, mélange (85% cotton+15% viscose) yarn, PC (65% polyester+ 35% cotton) yarn and 100% polyester yarn are measured and listed in the “Table 1”.

“Table 2” shows the spirality% of different samples produced from different yarn of different fiber composition are measured and listed.

Table 1. *Shrinkage% of different fabric produced from different yarn*

SL NO.	Fabric Types	Shrinkage %									
		100% Cotton Yarn		CVC (60%C+40%P) Yarn		Mélange Yarn (85%C+15%V) Yarn		PC (65%P+35%C) Yarn		100% Polyester Yarn	
		Length	Width	Length	Width	Length	Width	Length	Width	Length	Width
1	A	3.0	3.5	1.7	2.3	2.3	3.3	1.1	1.8	1.0	1.4
2	B	3.6	5.0	1.7	2.9	1.9	3.8	1.3	4.3	1.2	1.4
3	C	3.5	4.3	1.2	1.9	3.5	4.5	1.3	3.3	1.1	1.3
4	D	3.5	7.5	1.6	1.9	1.0	2.1	1.1	2.1	0.3	0.9
5	E	2.5	4.5	1.6	2.9	1.0	2.4	1.3	3.0	1.1	2.5
6	F	3.5	6.1	2.6	3.9	2.0	3.5	1.3	1.9	1.0	1.4
7	G	3.4	6.5	1.7	2.3	1.3	3.3	0.3	1.3	1.1	2.4
8	H	3.5	5.8	2.6	4.1	1.0	1.8	1.3	2.0	1.6	2.4

Table 2 : Spirality% of different fabric produced from different yarn

Sl No.	Fabric Types	Spirality %				
		100% Cotton Yarn	CVC (60%C+40%P) Yarn	Mélange (85%C+15%V) Yarn	PC (65%P+35%C) Yarn	100% Polyester Yarn
1	A	5.7	3.5	2	0.5	0.6
2	B	7.9	5.5	4.7	3.5	0.7
3	C	4.0	1.5	1.0	0.5	0.5
4	D	4.5	2.0	1.0	0.5	0.5
5	E	4.5	4.0	1.0	1.0	0.4
6	F	4.0	3	1.0	0.5	0.4
7	G	4.0	2.5	1.0	0.5	0.5
8	H	5.0	3.0	1.0	0.5	0.5

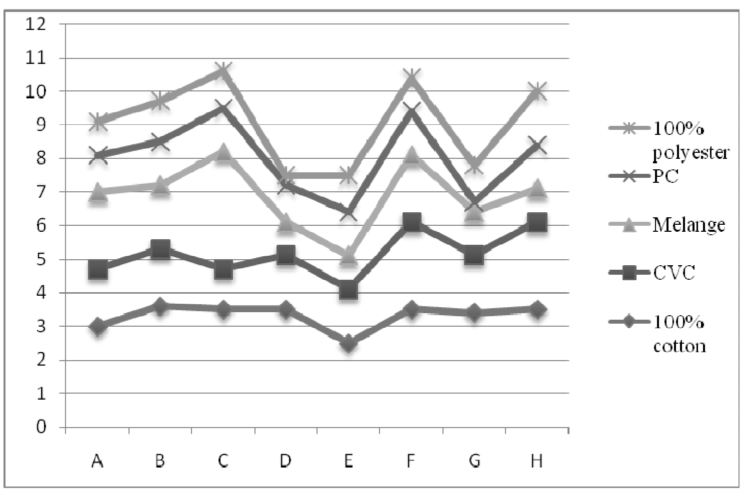

Figure 2 : Lengthwise shrinkage% of different fabric

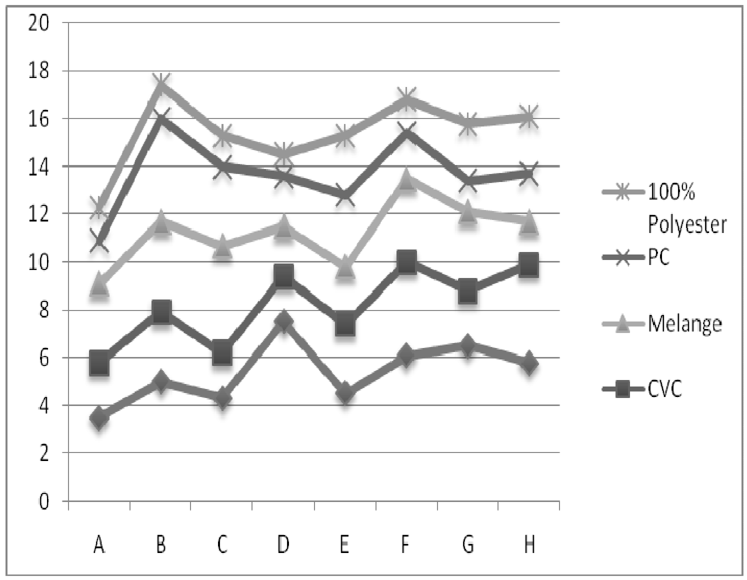

Figure 3 : Widthwise shrinkage% of different fabric

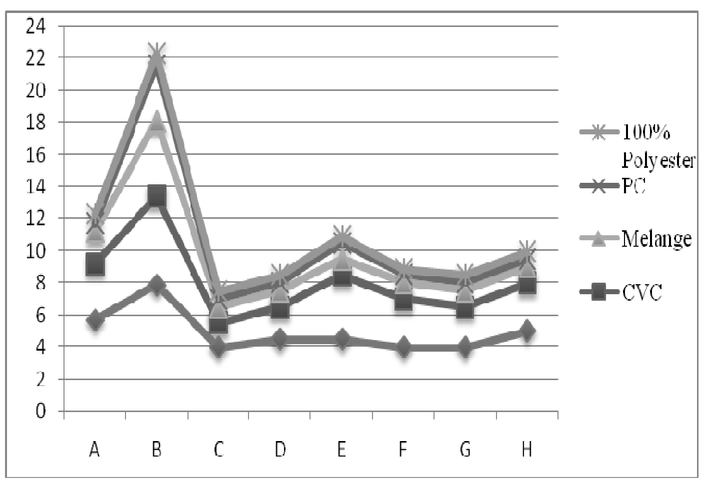

Figure 4 : Spirality% of different fabric

It is well known that, the relaxed dimensions of circular knitted fabrics are different for different fiber type-e.g. natural Vs synthetic, or cotton Vs wool (Hunter et al., 1979; Gowers & Hurt, 1978; Postle, 1968; Nutting & Leaf 1964).

"Figure 2" shows the lengthwise shrinkage% of eight different samples, produced from five different yarns. From the figure, it is found that sample "H" i.e. Terry S/J fabric, produced from CVC yarn, has higher shrinkage% than other samples. Cross Tuck sample i.e. sample "C" produced from CVC yarn and mélange yarn shows lower and higher shrinkage% respectively. Lycra S/J and Polo Pique produced from PC yarn and 100% polyester yarn respectively, shows the lower shrinkage% and same in value i.e. 0.3. Among the samples of 100% cotton yarns, Single Lacoste shows the lower shrinkage% and it is same for mélange yarn.

"Figure 3" exhibit the widthwise shrinkage% of different samples produced from different yarn. Polo Pique produced from 100% cotton yarn, shows higher shrinkage%. But when it is produced from CVC yarn, it shows lower shrinkage%. Slub S/J fabric, produced from PC yarn, shows very high shrinkage%. Similarly Terry S/J, produced from CVC yarn, shows higher shrinkage%.

"Figure 4" represent the spirality% of different samples. It is found from the figure that, Slub S/J fabric, produced from all types of yarns has higher spirality%. All samples, produced from 100% cotton yarn, shows higher spirality% and the result is opposite to all 100% polyester yarn samples. Spirality% increases from PC yarn to mélange yarn to CVC yarn.

4. CONCLUSIONS

Dimensional stability changes with the changes of fabric structure and yarn types of different fiber composition. Polo Pique fabric shows very low shrinkage%; both lengthwise and widthwise, produced from 100% polyester yarn. Cross Tuck fabric of CVC yarn shows the same result but in case of mélange yarn it gives opposite results. Spirality% and Shrinkage% is higher for 100% cotton yarn but low for 100% polyester and medium for CVC, PC and mélange yarn. In case of same yarn spirality% and shrinkage%, this change, when knit structure of fabric is changed i.e. fabric produced from 100% cotton yarn gives different results for different knit structures; although all of them are single jersey fabric.

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6. NOMENCLATURE

S/J	Single Jersey
CVC yarn	CVC is the abbreviation of Chief Valuable Yarn in which 60% is cotton yarn and 40% is polyester yarn
Mélange yarn	In this yarn 85% cotton yarn is mixed with 15% viscose yarn
PC yarn	It is called polyester –cotton yarn in which 65% is polyester is mixed with 35% cotton yarn

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