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SPIRALITY IN COTTON KNIT FABRICS BEFORE AND AFTER COMPACTING USING SELECTED YARN COUNT AND STITCH LENGTH

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ABSTRACT

Shahid MA, Ahmed F, Mahabubuzzaman AKM, Hannan MA, Khan AN (2010) Spirality in cotton knit fabrics before and after compacting using selected yarn count and stitch length. *J. Innov. Dev. Strategy* 4(2), 11-17.

Single jerseys knitted fabrics were produced from different yarn count (26^s/1, 28^s/1, and 30^s/1) using different stitch length (2.58mm, 2.63mm, 2.68mm, 2.70mm and 2.73mm) with positive feed device in Jiunn long knitting machine. The fabrics were dyed in light shade by a winch dyeing machine, dried with Unitech Stenter machine and compacted by Ferraro compactor using selected parameters. The results showed that spirality% were lowest for 26/1 Ne, 28/1 Ne and 30/1 Ne knitted fabrics at stitch length 4.58mm, 2.70mm & 2.73mm before compacting and at stitch length 2.68mm, 2.68mm & 2.73mm after compacting respectively.

Key words: *yarn, count, single jersey, stitch length, spirality*

INTRODUCTION

The single jersey knitted structures, used widely in knitted garments, has a particularly serious problem for plain knitted fabrics due to asymmetric loops (Chen *et al.* 2003). The most important problem of the single jersey structure is fabric spirality, which affects all the fabric and creates big problems at the clothing step. Spirality can be defined as a fabric condition resulting when the knitted wales and courses are angularly displaced from that ideal perpendicular angle. Other terms such as torque, skew, bias and shear distortion are often used to refer to the same phenomena. Regardless of the term used, this displacement of the courses and wales can be expressed as a percentage or as an angle measurement in degrees. Examples of skew can be seen in Figure 1.

Wale Skew Course Skew

Figure 1: Example of wale skew and course skew

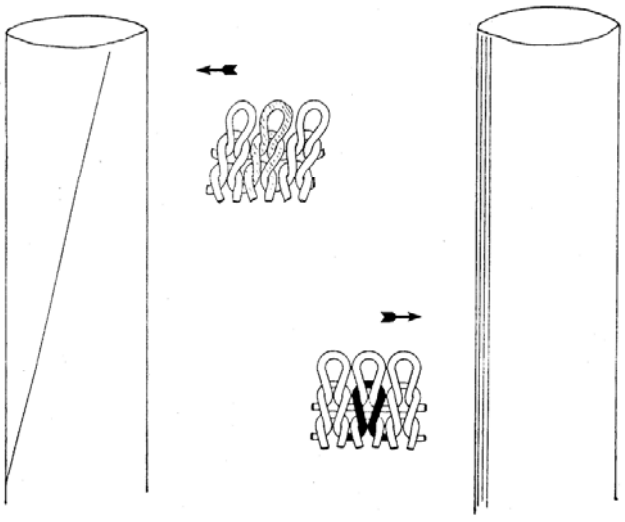
It affects the garments as the displacement of the side seams and this causes an important quality problem. This problem is prevented during the finishing and dyeing processes by different methods, however these preventions are temporary and after washing processes, on the clothes the displacement of side seam is occurred. Spirality depends on feed density, machine cut, and loop shape, but the magnitude of spirality can be offset by the selection of yarn twist direction. In addition, reduction in yam "torque" can only partially reduce fabric spirality, but the use of plied yams and plaiting techniques may completely eliminate it (Araujo and Smith, 1989).

Cotton single jersey knits exhibit a tendency for the course and wale loops to skew (spirality) when allowed to relax. The ideal model for a single jersey fabric would have the courses and wales aligned at a perpendicular angle with the wales oriented parallel to the edge of the knitted tube or open width fabric which is shown in figure 2 (Technical Bulletin 2002).

Figure 2: Ideal alignments of Course and Wales

Manufacturing of knitted fabrics involves intermeshing of yarn loops where one loop is drawn through another loop to form a stitch (Shah 2003; Saufley 1992). Since the last few years knitted fabrics are used in manufacturing of fashion garments and even it has the potential in the formal wear segments also. Accordingly, many developments have taken place in the machinery for processing of knitted fabrics in both tubular process and open width forms. Specification methods of knitted fabrics, usually, include loop density, width of the fabric, weight per square meter and the loop length (Bourah 2004)). Flexibility exists at the various stages of wet processing in terms of process machinery and methods followed by calendaring or compacting which is often, the final operation prior to the packaging step (Tendulkar and Kulkarni, 1994; Euscher and Jayachandran, 1997). The level of shrinkage control needed, composition of yarn (100% cotton, blends) and type of chemicals applied to the fabric decide the final process, i.e., whether calendaring or compacting. Variable compactors are used to achieve specific stitch count and wet compacting is also carried out in certain cases. Yarns of different counts knitted to the same loop length display different physical properties such as drape, openness, permeability, handle and spirality etc.

It is necessary that the wale on the knitted fabric be perpendicular to the course. However, the wales are not always perpendicular to the course and skew to the right or left, forming a spirality angle. This creates a serious problem, especially in the apparel industry (Ozkan *et al.*2005). If the wales are skewed from the vertical, the resulting configuration will be called "wale skew". Conversely, if the courses are skewed from the horizontal, the resulting configuration will be called "course skew" (Abdel-Megied and Ahmed, 2008).



Wale Skew No Skew

Ideal Condition

Figure 3: Knit fabric skew or spirality caused by wale loop distortion

When knitted fabrics are allowed to relax off the knitting machine, they will spiral. Some relaxation of yarn and knitting stresses occurs when the fabric is first unrolled after knitting. If the goods are subsequently wet processed, relaxation certainly occurs. Finally, drying without tension will maximize spirality.

MATERIALS AND METHODS

The single jersey knit fabrics were produced from selected three different yarn count (24^s/1 26^s/1, 28^s/1, and 30^s/1) by Jiunn long (Taiwan) knitting machine with three different stitch length. The single jersey fabrics were dyed in light shade by a winch dyeing machine with reactive dye and then the fabrics were dried with Unitech Stenter machine at a temperature 150˚c and over feed 70%. Finally fabrics were compacting by Ferraro compactor with compaction 2%, over feed 25% and diameter setting 50″ using selected parameters. Spirality of the produced fabrics were measured before compacting and after compacting at 20°C ± 2°C, and 65% ± 2% relative humidity condition.

Knitting

The same parameters and machine was used for knitting 26^s/1 28^s/1 & 30^s/1 yarn using positive feed device. Parameters of the knitting machine were as follows:

Brand name of machine	Jiunn long (Taiwan)
Diameter of machine	: 25"
Number of feeder	: 75
Number of needle	: 1872T
Machine gauge	: 24G
Machine speed	: 26 rpm

Dyeing process

Dyeing process was carried out in FONG'S dyeing machine with the following recipe.
Recipe for Pretreatment Process:

Imerol PCLF (Wetting agent)	: 0.7 gm/L
Jinsofter HG (Anticreasing agent)	: 1.0 gm/L
Arboquest 340 (Sequestering agent)	: 0.5 gm/L
Prostab S-205 (Stabilizer)	: 0.5 gm/L
Caustic Soda	: 2.0 gm/L
H2O2	: 3.0 gm/L
PC (Peroxide killer)	: 0.75 gm/L
Acetic acid	: 1.0 gm/L

Recipe for dyeing process:

Arboquest 340 (Sequestering agent)	: 0.5 gm/L
Ionactive PP-105 (Leveling agent)	: 1.0 gm/L
Jinsofter HG (Anticreasing agent)	: 1.0 gm/L
Reactobond blue RR	: 0.05350 % owf
Reactobond red RR	: 0.02300 % owf
Reactobond yellow RR	: 0.12800 % owf
Glauber salt	: 15 gm/L
Soda ash light	: 3.0 gm/L
Clean RB (Washing off)	: 1.0 gm/L

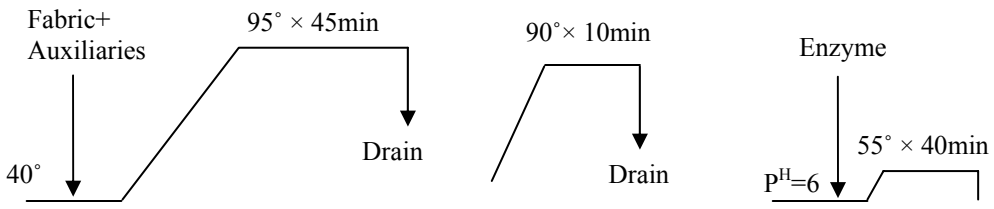


Figure 4: Pretreatment curve

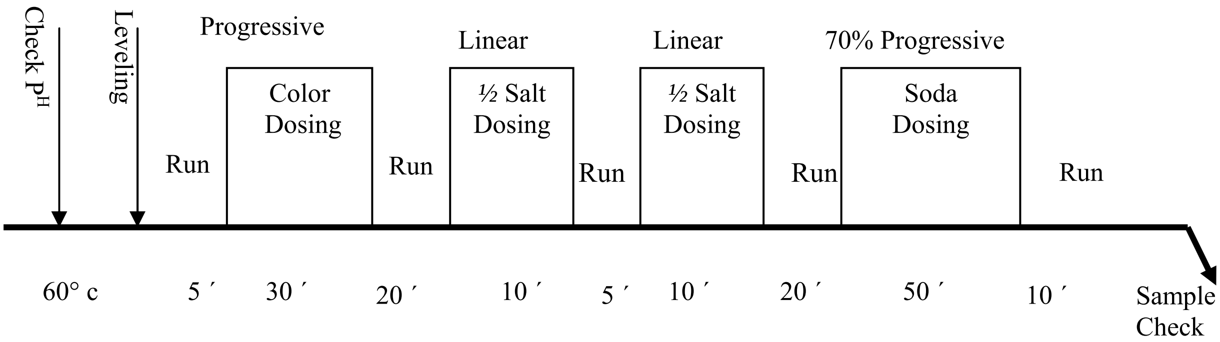


Figure 5: Dyeing curve

Finishing process

The finishing process designated slitting & dewatering on Bianco machine and then stentering was done.

Stentering

Stentering was used to dry the fabric maintaining desired width, GSM, shrinkage. Parameters of the stentering machine were as follows.

Brand name of machine	: Unitech
Chamber	: 8
Temperature	: 150°c
Over feed	: 70 %
Machine gauge	: 24G
Machine speed	: 20 m/min
Set diameter	: 127"
Squeezing roller pressure	: 3 bar

Compacting

The fabrics were compacted in Ferraro compactor with compaction 2%, over feed 25% and diameter setting 50″. Parameters of the compacting machine were as follows:

Brand Name of Machine	: Ferraro
Compaction %	: 2 %
Diameter setting	: 50"
Over feed	: 25 %
Machine gauge	: 24G
Machine speed	: 25 m/min
Set diameter	: 127"
Upper felt tension adjust	: 4.75 bar

Spirality testing

For measuring spirality, firstly, samples were collected from stenter. They were marked with two sets of markers in each direction (length and width), a minimum of 50cm apart and at a distance of approximately 3cm from the edge. No tension was applied to samples during measuring spirality percentage. Calculation of Spirality %:

$$Spirality\% = \frac{\frac{Left\ side\ +\ Right\ side}{2}}{Length} \times 100 \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (i)$$

X = 100 × [(AA´+DD́)/(AB+CD)]

Where X = % change in spirality

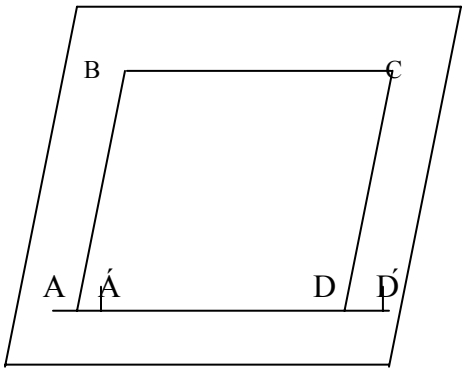


Figure 6: Spirality measurements

RESULTS AND DISCUSSION

Table 1 shows the yarn evenness results that were measured by Uster Tester–5.

Table 1. TPI and evenness results of different yarn count

Actual Count	TPI	Um %	CVm %	CVm 3m %	CVm 10 %	H	Sh	Thin -40% /km	Thin -50% /km	Thick +35% /km	Thick +50% /km	Neps +200% /km
25.90	17.15	11.07	14.11	3.36	2.26	5.67	1.24	11.0	3.3	827.3	142.5	168.8
28.00	18.62	11.60	14.82	4.09	2.66	5.58	1.29	223.0	6.3	931	169.0	242.0
30.05	19.90	11.98	15.35	3.78	2.66	5.57	1.29	227.5	5.3	1169	243.5	353.5

The spirality % of the samples produced from three different count (26/1 Ne, 28/1Ne and 30/1) at five different values of stitch length were measured and compared before and after compacting. The results are listed in the table 2. The minimum spirality of the observed fabrics were found before compacting for 28/1 Ne 26/1 Ne fabrics at stitch length 4.45 mm, for 28/1 Ne fabrics at stitch length 2.70 mm and for 30/1 Ne fabrics at stitch length 2.73 mm and after compacting at stitch length 2.68 mm, 2.70 mm, 2.73 mm for 26/1 Ne, 28/1 Ne and 30/1 Ne fabrics.

Table 2. Spirality % at different yarn count and stitch length before and after compacting

Stitch Length (mm)	Spirality %					
	26/1 Ne		28/1 Ne		30/1 Ne	
	Before compacting	After compacting	Before compacting	After compacting	Before compacting	After compacting
2.58	4.45	2.0	5.00	4.5	7.22	5.0
2.63	5.51	4.0	6.31	4.5	6.13	5.5
2.68	5.57	1.0	6.04	2.0	7.21	4.5
2.70	4.52	2.0	4.70	4.1	4.80	5.5
2.73	6.10	2.5	4.73	4.1	4.00	2.5

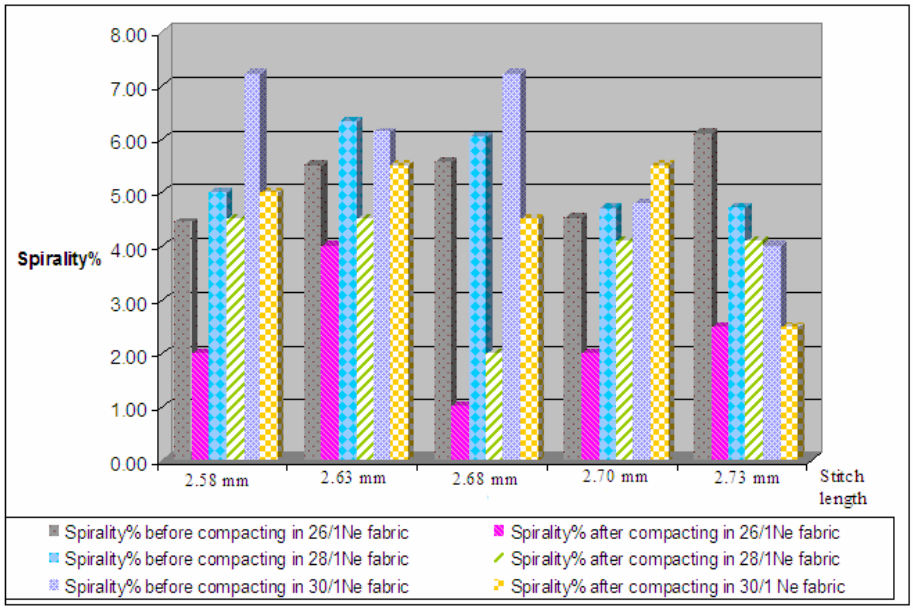


Figure 7: Comparative study on spirality before and after compacting

Table 3. GSM for 26/1 Ne, 28/1 Ne and 30/1 Ne at different stitch length

Stitch Length (mm)	GSM		
	26/1 Ne	28/1 Ne	30/1 Ne
2.58	162	149	136
2.63	160	147	136
2.68	158	146	134
2.70	155	145	133
2.73	157	142	132

The actual GSM of the dyed fabrics after stentering are given in table 3. GSM (grams per square meter) of the fabrics was degreased with stitch length increasing remaining yarn count constant and GSM of the fabrics were also degreased with yarn count was increasing remaining stitch length constant.

CONCLUSION

The following conclusion may be drawn based on the observation carried out during this study: The lowest spirality% of the single jersey knit cotton fabrics produced from 26/1 Ne, 28/1 Ne and 30/1 Ne yarn was minimum at stitch length 2.58 mm, 2.70 mm & 2.73 mm before compacting and 2.68 mm, 2.70 mm & 2.73 mm after compacting respectively. The results show that the increase in stitch length from 2.58mm to 2.73mm has not a specific trend for single jersey fabric spirality after compacting. GSM of the fabrics degreases with increasing the stitch length remaining the yarn count constant. Further study can be done in future to observe the effect of yarn elongation, yarn twist, tightness factor and different fabric construction on spirality of cotton or blended knitted fabrics.

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