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EFFECTS OF YARN TWIST ON THE SPIRALITY OF PLAIN KNITTED COTTON FABRICS

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ABSTRACT

Akter N, Islam S, Tania IS (2011) Effects of yarn twist on the spirality of plain knitted cotton fabrics. *J. Innov. Dev. Strategy* 5(3), 92-97.

Spirality is a particularly serious problem for plain knitted fabrics due to asymmetric loops. This study investigates the relationship between the spirality of plain cotton knits and yarn TPI. The experimental results show that the TPI of cotton yarn is the most important factor influencing fabric spirality. Relaxation treatment also shows significant effects. In general, increasing the twist factor of cotton yarn increases the angle of spirality. The experimental results demonstrate that relaxation treatment in water decrease the angle of spirality. The experimental data also lead to the derivation of empirical presentation linking the angle of spirality to the TPI of cotton yarn and loop length in both the dry relaxed and simulated industrial relaxed states. The work thus gives an advantage to solve spirality problem by using suitable TPI against stitch length and relaxation treatment.

Key words: *knitted fabric, TPI, spirality, stitch length, yarn count, single jersey, wales, skewing*

INTRODUCTION

One of the problems inherent in plain knitted fabrics is course spirality. 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 (www.indiantextilejournal.com/Spirality). Some of the practical problems arising from loop spirality are encountered in garments produced from knitted materials, such as displacement or shifting of seams, mismatched patterns, and sewing difficulties etc. These problems are often corrected by finishing steps such as setting with resin, heat and steam, so that the wale lines are perpendicular to the course lines. However, such setting is often not stable and after repeated washings, skewing of the Wales normally re-occurs, spirality has an obvious influence on both aesthetic and functional performance of knit wear. Research on knitted fabric spirality (Davis and Edwards, 1934; Araujo and Smith, 1989; Haigh 1987) has clearly demonstrated that its most prominent cause in plain knits is the relaxation of residual torque present in the yarn. It is known that a fabric with a highly twisted yarn will have higher spirality (Hepworth 1993). Usually in knitting, low twisted yarns are used. High twisted yarn has a great impact on spirality due to its unrelieved torque. With the increase in twist, the twist liveliness increases, this in turn, causes the angle of spirality to increase. The direction of spirality in the fabrics knitted from short staple ring spun single yarns is determined by the yarn twist direction. Thus, the technical face of single jersey fabric exhibits spirality in the Z direction if a Z twisted yarn is knitted and spirality in the S direction if a S twisted yarn is knitted. Yarn twist multiplier(TM) is also effect on spirality, TM = T.P.I. / √N, where T.P.I. indicates twist per inch and N represents yarn number in an indirect system, the cotton system unless otherwise specified. With the increase in twist multiplier, the angle of spirality increases. Fabric relaxation (dry and wet) treatment removes the residual knitting tension in the yarn introduced during the knitting process. The relaxation treatment relieves the residual yarn torque as a result of changes in the molecular structure and increasing yarn mobility (www.fibre2fashion.com). This article presents an experimental investigation of the effects of cotton yarn twist on the spirality of plain cotton knits and their relaxation treatment.

MATERIALS AND METHODS

Sample preparation

At first 8 cotton yarns cones of 12/1Ne and 20/1Ne with different TPI were taken. Twist per inch (TPI) of these yarns were determined by Quadrant twist tester.15.24 TPI, 15.95 TPI, 16.45 TPI and 17.10 TPI were found for 12/1Ne yarn counts and 19.53 TPI, 20.14 TPI, 19.18 TPI and 18.80 TPI were found for 20/1Ne yarn counts. Plain Jersey fabrics of same stitch length were produced by using different TPI of same count yarns in a hosiery knitting machine. Here 5.72mm stitch length were used for prepared samples with 12/1Ne yarn counts and 5.27mm stitch length were used for prepared samples with 20/1 Ne yarn counts. In this way 4 samples of 5.72mm and 4 samples of 5.27mm stitch length with different TPI were obtained. Stitch lengths of these samples were measured by HATRA Course length tester. Then samples were conditioned at dry relaxed state for 48 hours (Temperature: 27ºC and Relative Humidity: 65%).

Experimental

Spirality is a distortion of a knitted fabric where by the Wales and courses align at an angle other than 90º. Terms such as “fabric skew”, “fabric torque” or “wale skew”, are also used to describe fabric spirality. Yarn twist is the spiral turns given to the yarn in order to hold constituent fibres threads together. Highly twisted yarn is “Lively” and tends to twist upon it and produce “Snarls” fabrics made from highly twisted yarns will possesses lively handle (Booth 1996). The yarn twist factor is the most important variable influencing fabric spirality. In this study work was observed yarn twist effects on spirality. Every samples spirality was measured very cautiously by protractor in dry relaxed state according to the CTI test method (CTI 1988). After that all the samples were then washed in a water bath containing 0.1% nonionic wetting agent for 3 minutes at 35ºC using the Ibis rotary-drum washer, and rinsed twice in cool water with agitation for 3 minutes. Excessive water was hydro extracted for 1.5minutes. Samples were then tumble-dried for 1 hour at 65ºC and finally conditioned at 20±2ºC and 65±2%RH. This fabric state is denoted as the simulated industrial relaxed state. Again the spirality of all the samples was measured in industrial relaxed state.

Data analysis

A total of 8 samples were produced for this research work. 8 different TPI, 2 different yarn counts and 2 different stitch lengths were used for producing all the samples. All the samples were of single jersey structure. Spirality was measured in dry relaxed state and industrial relaxed state.

Table 1. Data for spirality measurement in dry relaxed state for 12/1 Ne yarn and Stitch length: 5.72mm

No of obs.	TPI	Spirality(º)	TPI	Spirality(º)	TPI	Spirality(º)	TPI	Spirality(º)
01		19		20		21		20
02		18		18		19		20
03		22		22		22		23
04		23		23.8		23		23
05		23		23		24		24
06	15.24	22	15.95	22	16.45	22	17.10	24
07		22		21		22		22
08		22		21		21		23
09		19		20		20		20
10		18		19		20		22
Avg.		20.5		20.98		21.4		22.1

Table 2. Data for spirality measurement in dry relaxed state for 20/1Ne yarn and Stitch length: 5.27mm

No. of obs.	TPI	Spirality(º)	TPI	Spirality(º)	TPI	Spirality(º)	TPI	Spirality(º)
01		16		18		20		21
02		17		18		17		20
03		18		17		18		21
04		18		18		17		22
05		17		19		17		20
06	18.8	17	19.18	17	19.53	19	20.14	20
07		16		18		20		20
08		17		17		17		21
09		17		18		18		20
10		16		19		17		21
Avg.		16.9		17.9		18		20.6

Table 3. Data for spirality measurement in industrial relaxed state for 12/1Ne yarn and Stitch length: 5.72mm

No. of obs.	TPI	Spirality(º)	TPI	Spirality(º)	TPI	Spirality(º)	TPI	Spirality(º)
01		19		19		18		18
02		17		18		17		17
03		16		16		17		18
04		18		18		19		19
05	15.24	19	15.95	18	16.45	17	17.10	18
06		17		17		17		17
07		15		16		18		18
08		17		17		19		19
09		18		18		18		18
10		19		19		18		18
Avg.		175		17.65		17.8		18

Table 4. Data for spirality measurement in industrial relaxed state for 20/1Ne yarn and Stitch Length: 5.27mm

No of obs.	TPI	Spirality (°)	TPI	Spirality (°)	TPI	Spirality(°)	TPI	Spirality(°)
01		15		15		15		16
02		15		16		16		17
03		15		17		17		17
04		17		16		17		18
05		15		16		17		20
06	18.8	16	19.18	16	19.53	19	20.14	18
07		16		15		16		19
08		15		17		16		18
09		16		17		17		17
10		16		16		16		18
Avg.		15.6		16.1		16.6		17.8

Table 5. Data for comparison of spirality in dry relaxed state and industrial relaxed state for 12/1 Ne Yarn

Yarn Count	Stitch Length(mm)	TPI	Spirality in dry relaxed state	Spirality in industrial relaxed state
12/1Ne	5.72	15.24	20.5°	17.5°
		15.95	20.98°	17.6°
		16.45	21.4°	17.8°
		17.10	22.1°	18°

Table 6. Data for comparison of spirality in dry relaxed state and industrial relaxed state for 20/1 Ne Yarn

Yarn Count	Stitch Length(mm)	TPI	Spirality in dry relaxed state	Spirality in industrial relaxed state
20/1Ne	5.27	18.80	16.9°	15.6°
		19.18	17.9°	16.1°
		19.53	18°	16.6°
		20.14	20.6°	17.8°

RESULTS AND DISCUSSION

From Table 1, for 12/1Ne yarn and stitch length: 5.72mm, the relationship between the spirality and the yarn TPI in dry relaxed state can be observed in the following figure:

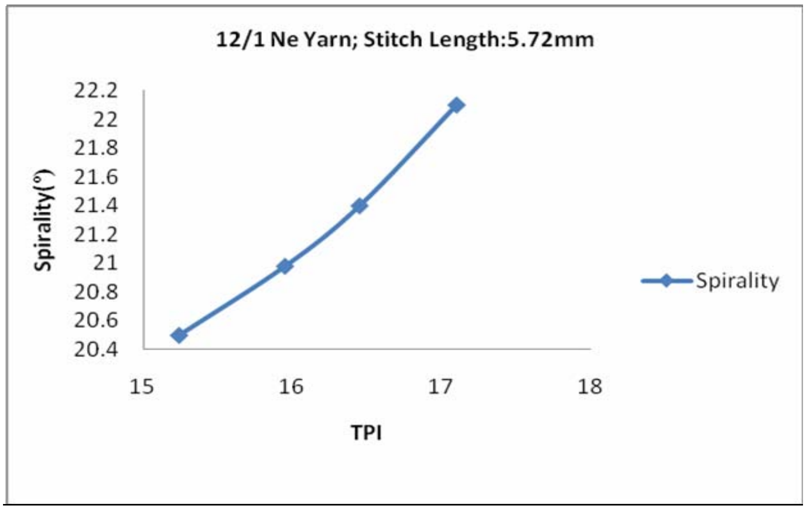

Fig. 1. Change of spirality due to variation of TPI in dry relaxed state

In fig. 1, it is clearly observed that in dry relaxed state as the yarn TPI increases, the fabric spirality also increases.

From Table 2, for 20/1Ne yarn stitch length: 5.27mm, the relationship between the spirality and the yarn TPI in dry relaxed state can be observed in the following figure:

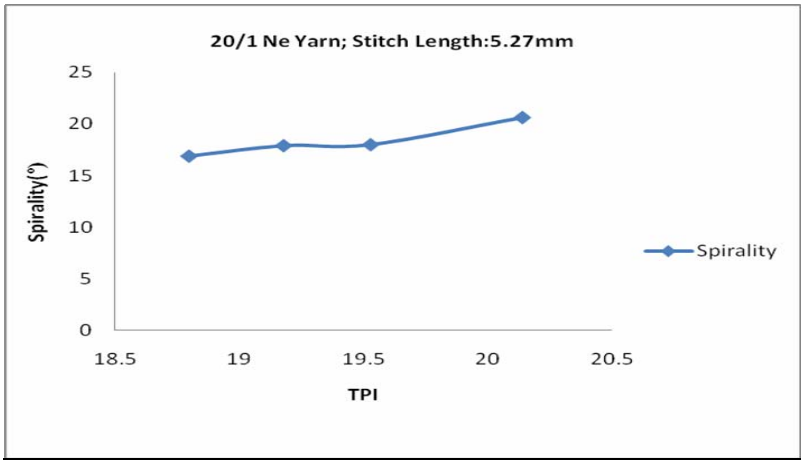

Fig. 2. Change of spirality due to variation of TPI in dry relaxed state

In fig. 2, it is clearly observed that in dry relaxed state as the yarn TPI increases, the fabric spirality also increases.

From Table 3, for 12/1Ne yarn and stitch length: 5.72mm, the relationship between the spirality and the yarn TPI in industrial relaxed state can be observed in the following figure:

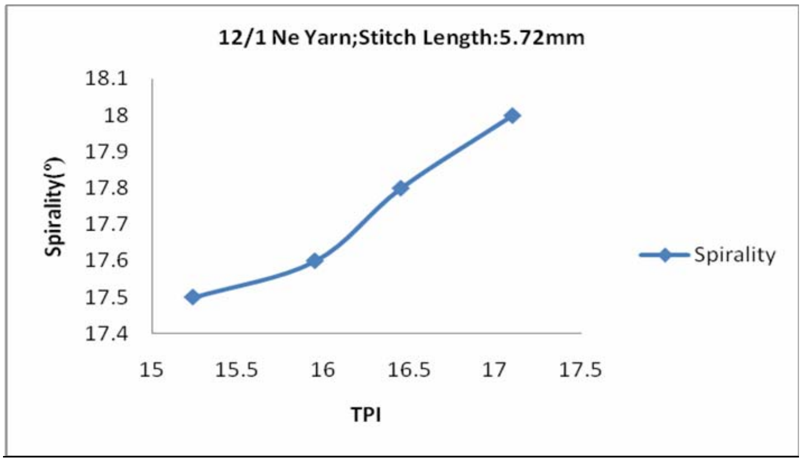

Fig. 3. Change of spirality due to variation of TPI in industrial relaxed state

In fig. 3, it is clearly observed that in industrial relaxed state as the yarn TPI increases, the fabric spirality also increases.

From Table 4, for 20/1Ne yarn and stitch length 5.27mm, the relationship between the spirality and the yarn TPI in industrial relaxed state can be observed in the following figure:

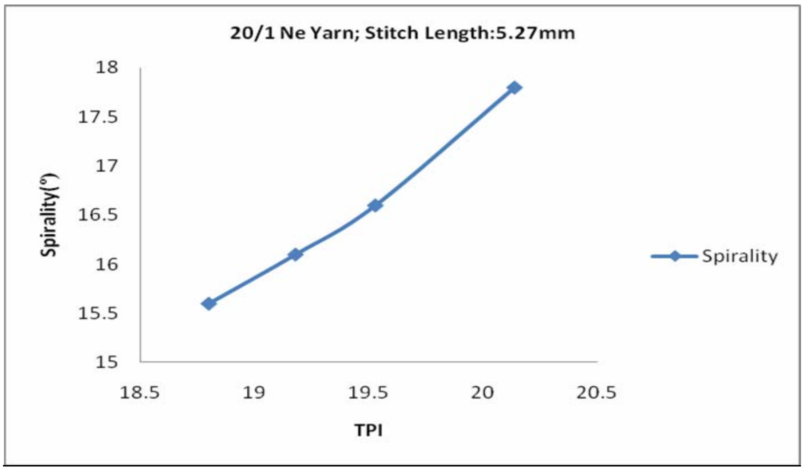

Fig. 4. Change of spirality due to variation of TPI in industrial relaxed state

In fig. 4, it is clearly observed that in industrial relaxed state as the yarn TPI increases, the fabric spirality also increases.

From Table 5, for 12/1Ne yarn and stitch length: 5.72mm, comparison of spirality in dry relaxed state and industrial relaxed state can be observed in the following figure:

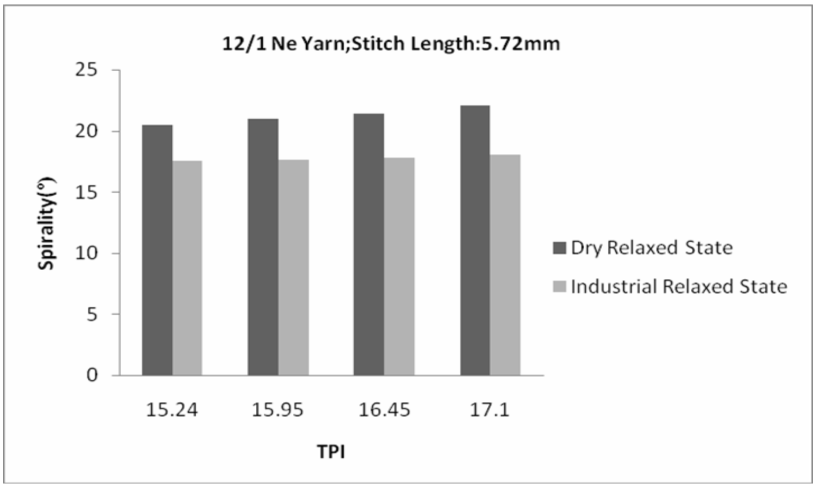

Fig. 5. Comparision of spirality in dry relaxed state and industrial relaxed state

In fig. 5, it is clearly observed that spirality in industrial relaxed state was lower than in dry relaxed state in spite of same yarn count, TPI and stitch length were used. Because in industrial relaxed state fabrics are treated by water with nonionic wetting agent. Fabric relaxation treatment removes the residual knitting tension in the yarn introduced during the knitting process. The relaxation treatment relieves the residual yarn torque as a result of changes in the molecular structure, increasing yarn mobility and decrease fabric spirality.

From Table 6, for 20/1Ne yarn and stitch length: 5.27mm, comparison of spirality in dry relaxed state and industrial relaxed state can be observed in the following figure:

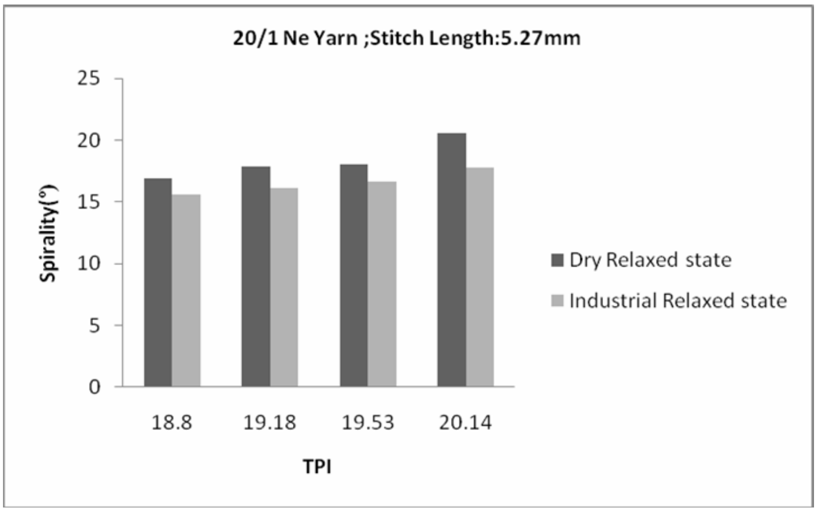

Fig. 6. Comparison of spirality in dry relaxed state and industrial relaxed State

In fig. 6, it is clearly observed that spirality in dry relaxed state was more than in industrial relaxed state in case of same yarn count, TPI and stitch length were used. The relaxation treatment relieves the residual yarn torque as a result of changes in the molecular structure and increasing yarn mobility. For this it can easily say that from this bar diagram the relaxation treatment of fabrics in water with nonionic wetting agent decreases the angle of spirality.

CONCLUSION

The analysis upon the evolution of study it is determined that twist per inch (TPI) of cotton yarns can influence the spirality of plain cotton knits. In order to obtain a fabric without spirality balanced twist factors of yarns are important. This study shows that, in both dry relaxed state and simulated industrial relaxed states, twist per inch of yarns have a major effect on fabric spirality. From the experimental data and graphical diagram, it can be easily said that spirality increased due to the increase of TPI while fabric stitch length is constant. The experimental results also demonstrate the importance of relaxation treatment on fabric spirality. The bar diagram analyses the angle of spirality in dry relaxed state and industrial relaxed state. Spirality in dry relaxed state is more than in industrial relaxed state. Relaxation treatment in water will decrease the angle of spirality of untreated plain cotton knits. It should be remembered that this type of distortion cannot be eliminated but must be controlled within the acceptable limit by using lower TPI, suitable stitch length and relaxation treatment.

REFERENCES

Araujo MD, Smith GW (1989) "Spirally of Knitted Fabrics", Part 1: "The Nature of Spirality", *Textile Res, J.* pp. 247-256.

Booth JE (1996) "Principles of Textile Testing" CBS publishers and Distributors, India, pp.209-235.

Cotton Technology International (1988) "The STARFISH Approach to High Quality Cotton Knit goods" User-Manual Version 88:1, and U.K pp.89-90.

Davis W, Edwards CH (1934) "Spirality in Knitted Fabrics", *J. Textile Inst.* pp.122-132.

Haigh J (1987) "Loop Distortion in Plain Knit Fabrics" Wool Sci Rev, pp.81-119.

Hepworth B (1993) "Spirality in Knitted in Knitted Fabrics Caused by Twist–likely Yarns" A Theoretical Investigation, Melliand Textileber, pp.515-520.

www.fibre2fashion.com

www.indiantextilejournal.com/Spirality