

# The Effects of S, Z and S/Z Twist Yarn and the Number of Feeders on Spirality of Single Jersey Knitted Fabric

MR. KAMON LERTNUMPONG <sup>(1)</sup> DR. SATIT PUTTACHAIYOUNG <sup>(2)</sup>

Rajamangala University of Technology Krungthep

Degree Sought Master of Science in Textile and Garment

Faculty of Textile Industrial

2 Nanglinchee Road, Sathorn, Bangkok 10120 E-mail: JUNKIENIGHT@HOTMAIL.COM<sup>(1)</sup> SATHIT@RMUTK.AC.TH<sup>(2)</sup>

## Abstract

This paper investigates the effect of fabric S, Z and S/Z twist yarn and different numbers of feeders, 32, 64, 96 on spirality of single jersey knitted fabric. The hypothesis is set for as for increasing numbers of feeders may result in the higher degree of spirality of the fabrics. In addition, the yarn twist direction may add more effect to the spirality value on the single knitted fabrics. All fabric samples are dyed, analyzed and measured for values of spirality through course and wales in each significant step that may have an effect on spirality value. The objective of this study is to explore and develop the factors that determine the least angle of spirality. The results of the experiment shows S twist yarn has the highest degree of spirality followed by the Z twist yarn and S/Z gives the lest degree of spirality.

**Key words:** S twist yarn, Z Twist yarn, S/Z twist yarn, Single jersey fabric, Feeders, Spirality

## 1. Introduction

The main objective of this research aims to at least reduce or eventually eliminate spirality of cotton knitted fabric in circular knitting machine in early stage and creating value added qualities to the knitting products. The benefit of studying the spirality of knitting fabric in this paper enables the learning toward different various factors that influence stability of knitting product. Garment industry has suffer from spirality on their production line on T-shirt, polo shirt and caused by fabric spirality such as mismatched patterns, sewing difficulties, displacement of side seams at the back and front of the body, and garment distortion. Spirality is an obvious evident that greatly effect garment aesthetics as it places an essential concern to unbalanced structures of the fabric, such as single jersey fabrics, if this issue is solved. Textile and garment industry will be able to produce more stability knitted fabrics and are able to add more value to the knitting products.

## 2. Research Methodology

The fabric and degree of spirality measurement in circular knitting is carried out at Viriya Textile Company Limited, Bangkok, Thailand.

This experimentation begins with checking the quality of yarn with observation and quality report. The yarns that fail to meet quality check are rejected. The yarns are fed into circular knitting machine with the feeders tension set at the same value and different number of feeders. S, Z and S/Z yarns are measured for course and wale and degree of spirality manually, and then put into dyeing process and measured course and wale and degree of spirality once again. After that, all dyed fabric are cut and sewed into medium size t-shirts. After this process, all t-shirts of different yarn twist directions are measured for values of course and wale and degree of spirality and recorded into each category and the percentage of fabric. The shrinkage will be measured and collected. All t-shirts are washed in washing machine and measured for all values. The studies included in this research will be through external research, hands-on experience, self-study, experiment and existing and new theories. The properties of yarn direction, S, Z, S/Z and the number of feeders that affect the result of spirality level will be used throughout this paper.

### 2.1 Identifying Yarn Twist Directions: S, Z, S/Z

Yarn twist direction has a direct influence in the spirality of the fabric. Z

twist yarn is commonly used in textile industry in Thailand while S twist yarn is rarely used in Thailand. Therefore; it is selected to be experimented in this research in order to explore the effect of yarn twist direction on the spirality level. Additionally, S/Z twist yarn mixed is also explored in this research as an experiment due to their opposite yarn twisted directions. The hypothetical theory is that the hybrid of S/Z twist yarns should offer a new consequence towards the spirality aspect. This is due to Z twist yarn go to the right and S twist yarn makes opposite direction, which is left.

## **2.2 Choosing Number of Feeders: 32, 64, 96**

The higher number of feeders practically speeds up the process of operation as well as increases the angle of spirality. Different numbers of feeders are tested to confirm how spirality level is affected by 32, 64 and 96 number of feeders.

## **2.3 Selecting Feeder Tension**

Feeder tension were fixed and measured randomly in the feeders throughout the process. An average feeder tension of 10 cN (Centinewton) is set throughout the experiment. While circular knitting machine is working, each feeder is

continuously checked to make sure that the amount of yarn feeding in the knitting is correct and being recorded all the time to maintain and control the average feeder tension value throughout the process

## **2.4 Needle-out Slit Line for Open Width Fabric**

All fabric has been processed in dyeing, cleaning, steaming process and cutting to control the shrinkage percentage of fabric.

## **2.5 Measuring Course and Wale of Raw Fabric and Dyed Fabric**

In one square inches, course and wale are measured by counting number of stitches. 40 samples of course wale were counted and collected for each roll of fabric. One roll of fabric approximately 10 – 12 kilograms. 9 rolls of fabric were used.

## **2.6 Measuring Spirality before and after Dyeing**

Spirality is measured in term of degree of spirality. A horizontal line is drawn on the fabric course and a perpendicular line is drawn crossing the fabric course. The angle is measured as the distance angle away from the exact 90 degree perpendicular line to the line where

fabric wale actually is. That angle determines the spirality angle.

## 2.6 Finished Product as Medium Sized T-Shirt (Garment)

Spirality Check Courses and wales of the T-shirt are measured and degree of spirality is evaluated. All values are collected again before and after washing in the normal washing machine.

## 3. Agreement

All parameters are carefully set and controlled under the environment in order to reach the best possible outcomes. Nonetheless, there are some uncontrollable factors that could cause slowdown or deviation during the experiment such as human error, machine breakdown, skills and experience of tailors.

## 4. Result of spirality from different number of feeders

According to the results, the twist direction is another important parameter for spirality. The machine's rotation anti-clockwise could have an effect on the yarn twist tension force, which increases spirality. When the results as well as the graphics and statistical analyses were examined, it was concluded that the spirality values of Z

twisted yarn fabrics were less than those of S twisted yarn fabrics, depending on whether the machine rotation direction S or Z

## 4.1 Grey fabric process

The degree of spirality on S twist yarn when processed from 32, 64 and 96 number of feeders shows 1.025, 1.225 and 1.400 respectively. The average of Z twist yarn, which is commonly used in Thailand textile industry, shows the similar trend of increasing degree of spirality as the number of feeders increase, 0.800, 0.850 and 1.075. The inclination for S/Z twist yarn illustrates the same degree of spirality shows 0.525, 0.875 and 1.000.

## 4.2 Dyed fabric process

After S, Z and S/Z yarn fabric have been measured for spirality level; the dyeing process is another step in reevaluation of such value. The S twist yarn's degree of spirality after dyeing process shows 5.250, 5.450 and 5.650 for 32, 64 and 96 number of feeders respectively. Similarly, 3.000, 3.975 and 4.250 are the results of spirality degree for Z twist yarn. S/Z twist yarn shows 2.100, 2.850 And 3.425 as the number of feeders increase. More number of feeders causes the yarn to have higher degree of spirality and vice versa.

### 4.3 The result of spirality from different yarn twist direction: S, Z and S/Z

#### 4.3.1 Raw fabric process.

Before the dyeing process, S/Z twist yarn shows the lowest degree of spirality, followed by Z twist yarn and S twist yarn accordingly. This is applicable for all number of feeders throughout. The result of each yarn twists direction are; S twist direction, 1.025, 1.225 and 1.400. Z twists direction, 0.800, 0.850 and 1.075. S/Z twists direction, 0.525, 0.875 and 1.000 for 32, 64, 96 number of feeder.

#### 4.3.2 Dyeing fabric process.

The result on degree of spirality also leans towards the same trend, i.e. S/Z twist yarn still shows the lowest spirality level for all number of feeders, however, at a higher spirality level than before dyeing process followed by S, Z, and S/Z twist yarn. S twist yarns are 5.250, 5.450 and 5.650; Z twist yarns are 3.000, 3.975 and 5.650. The values of S/Z twist yarn are 2.100, 2.850 and 3.425.

#### 4.3.3 Before washing

After the fabric were cut and sewed into t-shirt; S twists yarn t-shirt has the average values of spirality level of 3.40, 5.50

and 5.05 respectively for increasing number of feeders of 32, 64 and 96; Z twist yarn t-shirt has the values of 1.85, 3.25 and 4.9; while S/Z twist yarn t-shirt has the values of 0.60, 1.45, 1.80. The hypothesis should show the trend of increasing values of spirality as the numbers of feeders are more intense. However, the assumption is true for S/Z twist yarn t-shirt but proves otherwise for S and Z twist yarn t-shirt. An uncontrollable factor that is the suspect of this result are how the t-shirt is cut and sewed, the skills and experience of tailors and how each fabric is stretched during cutting and sewing.

#### 4.3.4 After washing

All t-shirts are washed in the washing machine and hanged dry. Degree of spirality is measured for each yarn twist direction for each number of feeders. The average value shows 8.45, 8.20 and 12.60 for S twist yarn t-shirt, 7.50, 8.50 and 11.80 for Z twist yarn t-shirt and 7.50, 8.50, 11.80 for S/Z twist yarn t-shirt. Although there is a slightly different in the S twist yarn t-shirt results, there displays the trend of higher spirality level as the number of feeder increases and shows the higher level of spirality from S/Z, Z and S twist yarn t-shirt accordingly.

#### 4.4 Grey and Dyed Fabric

Chart: 1. Effect of number of feeders on spirality

#### S: Twist Grey and Dyed Fabric

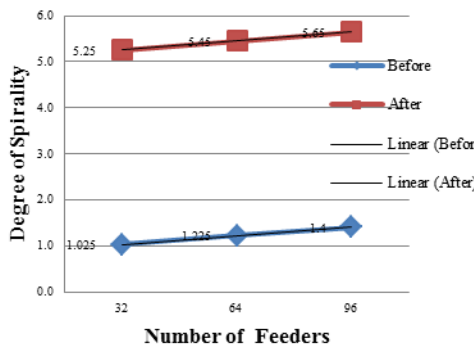


Chart: 2. Effect of number of feeders on spirality

#### Z: Twist Grey and Dyed Fabric

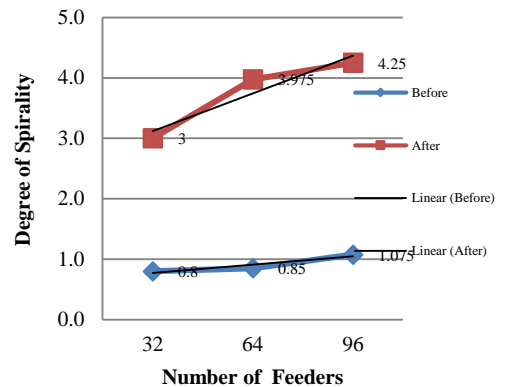


Chart: 3. Effect of number of feeders on spirality

#### S/Z: Twist Grey and Dyed Fabric

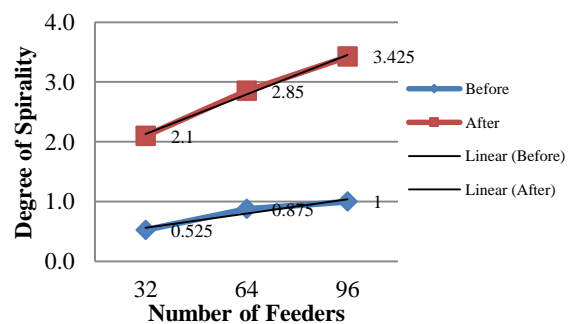


Chart 4 Average Total Degree of Spirality under Different Number of Feeders Comparison

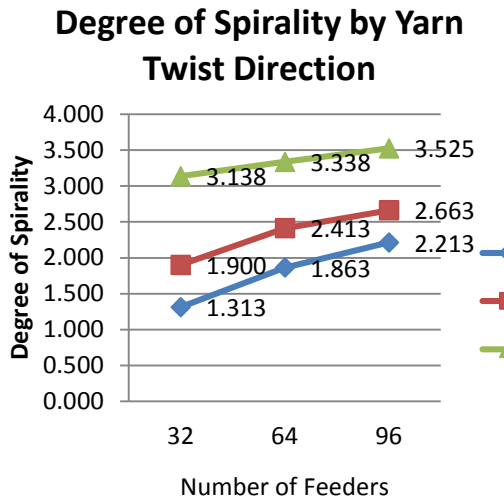


Chart 5. Degree spirality of T-Shirt Before washes.

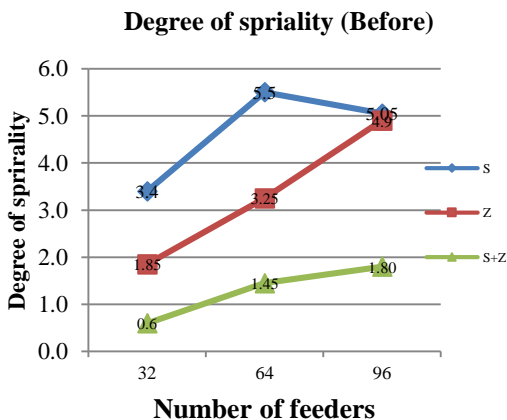
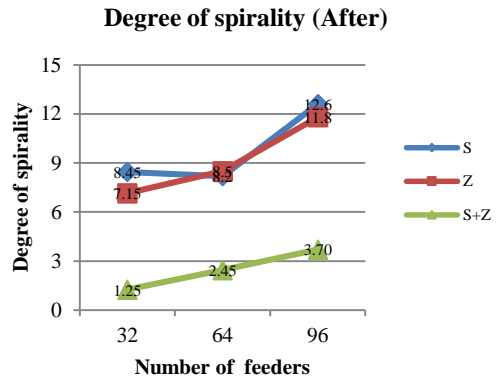


Chart 6 Degree spirality of T-Shirt After washes.



## 5. Conclusion

A number of conclusions can be drawn from the experiment with comparison among S yarn, Z yarn and S/Z twist yarn with variables among different numbers of feeders 32, 64 and 96. S twist yarn shows the highest degree of spirality. One possible explanation could be due to the machine rotating anti clockwise, which is opposite direction of the machine rotation as S twist yarn, giving and untwisted the yarn twist. S/Z twist yarn gives the lowest degree of spirality as the two opposite twist directions has an effect of self-locking, minimizing the spirality effect; while Z twist's spirality value lies in the middle of the S and S/Z.

The greater number of feeders the greater spirality in the fabric. This is applicable for all yarn twist directions. For instance, for 32 numbers of feeders before and after dyeing, S twist yarn has 1.025 and 5.25 value of spirality, for 64 numbers of

feeders before and after dyeing, S twist yarn has 1.225 and 5.450, and for 96 numbers of feeders before and after dyeing, S twist yarn has 1.400 and 5.650 respectively. This also applies for Z and S/Z twist yarn according

Through the garment processing into t-shirt of cutting and sewing before wash, the result remains the same as the highest spirality degree rests in the S twist yarn direction, the lowest spirality degree rests in the S/Z twist yarn directions, whereas for Z twist yarn, the value of spirality falls between S and S/Z twist. The effect of increasing number of feeders also applies to the greater spirality level in this case.

Pattern on the fabric of S/Z twist direction t-shirt displays an intersecting yarn form. It is noticeable on the fabric



Picture 1 S/Z twist yarn self-locking

## 6. Result & Discussion

This research was shown some of the results; however, a probable explanation is supported and analyzed by graphs and illustrations, considering fixed factors and variables, including uncontrollable factors such as the skills of tailors during cutting and sewing processes. While the left spiral in S twist yarn is loosening by the anti-clockwise turned in circular knitting machine, the spirality is elevated. On the other hand, the right and left rotation direction in S/Z twist yarn is tightened up further by the same, the opposite direction practically cancels each other's spirality, therefore, reducing the degree of spirality. The number of feeders set in the circular knitting machine also has an obvious effect on the spirality level of three kinds of fabric. The higher number of feeders value creates a greater value of spirality level while smaller number of feeders creates a lower spirality level although less production time is spent on the higher number of feeders.

For example, an average of 10 kilograms of fabric with 96 numbers of feeders may consume 1 hours of production, 2.2 hours for 64 numbers of feeders and 3.8 hours for 32 numbers of feeders. This is another important factor in designating that with more numbers of feeders enables faster production speed, however, at the same time more spirality level. The

shrinkage is an absolute factor for natural cotton after washing stage. All factors chosen, whether which twist yarn direction and which numbers of feeders to use, depend on the customer group and specific level of quality demanded

## 7. Acknowledgement

Thank you for a warm support from my family especially my mother she have been waiting for a long time for me to graduated Thank you Mom.

Firstly The Thai Allianz company that support all the yarn because the S twist yarn it's rarely hard to find in Thailand only few company produce it. Secondly all the stuff teacher and student at Rajamangala University of Technology Krungthep that devote their time to talk and advise me and lend me all the equipment that I need.

Dr.Sathit Puttachaiyong, Dr.Somnuk Sungnoo, Dr. Somprasong Parsapratet, Mr. Pornchai Tulpijit

Thirdly all the help from THAIEXPRESS TEXTILE COMPANY for helping cooperated with all the work and let me collect all the data and information in dyeing process.

Forth my team at ViriyaTextile Company for helping me collects all the data that I need throughout all the process.

Lastly all the help from my lovely friend and student from Rajamangala University of Technology Krungthep.

## 8. Reference

1. Course & Wale,  
[www.definetextile.com/2013/04/course-wale.html](http://www.definetextile.com/2013/04/course-wale.html) (2013)Online.
2. Knitting terms and functional elements,  
<http://www.newagepublishers.com/samplechapter/001326.pdf>(2013) online
3. Size Chart  
<http://www.americanapparel.net/sizing/default.asp?chart=mu.shirts>(2013) online
4. Yarn twist  
<http://cottonyarnmarket.net/OASMT/20Twist%20and%20Yarn%20Count.pdf> (2013) online
5. Sadhan Chandra Ray **Fundamental and advance in knitting technology** 2011
6. J.E. Booth 1997 **Textile mathematics volume three**. The textile Institute Manchester.
7. V K Kothari,G Singh,K Roy & R varshney (2010) “ **Spirality of cotton plain knitted fabrics with respect to variation in yarn and machine parameter**” Indian journal of Fibre & Textile Research Vol.36 September 2011
- 8.Züleyha Değirmenci, Mehmet Topalbekiroğlu (2010) “**Effects of Weight,**

Dyeing and the Twist Direction on the  
Spirality of Single Jersey Fabrics” FIBRES &  
TEXTILES in Eastern Europe 2010