

Investigating the creasing properties of cotton knit jersey in the open-width processing

Yinqing Luo^a, Rui Wang^b, Jianhao Wang^c, Longyun Hao^{d,*}

Collaborative Innovation Center for Eco-Textiles of Shandong Province, Textile and Garment College, Qingdao University, Qingdao 266071, China.

^a905758039@qq.com, ^bwangrui12345@163.com, ^cL.Hao@qdu.edu.cn, ^dhly1978@163.com

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Abstract: Single jersey knit has a high tendency to crease. Some researches on the creasing properties in the rope processing have been reported, however its creasing properties during the open-width processing are few disclosed previously. There is no generally accepted method for evaluating the creasing extent of knit after this continuous process. The aim of this research is to develop a simple and repeatable way to evaluate the evolution of creasing defects during open-width processing of knit fabrics. As well as investigating the influences of various processing factors such as folding direction, wet pickup, steaming time and pre-heatsetting on the crease formation to provide insights into the key elements needed in an appropriate processing.

1. Introduction

Knitting is an important process of producing textile fabrics and it is a quicker and less expensive fabric preparation method relative to weaving ^[1,2]. In this method, a series of loops are formed from a continuous length of yarn and loops are interlocked using needles with the preceding row, thus generating the stretchable, smooth, and porous structure of knitted fabrics ^[1,3]. The global demand for knitted fabrics is increasing. Nowadays, knit fabrics are widely used in the textile and apparel industry for sportswear, underwear and bathrobes due to their good comfort, touch, and aesthetic properties ^[4,5].

At present, most knitted fabrics are bleached and dyed by intermittent rope processing. This method would result in various quality problems such as high strength loss, high energy and water consumption, severe abrasion, apparent wrinkles, coarse fabric surface and low reproducibility ^[6,7]. Therefore, there is a growing demand for continuous open-width processing technique in recent years because it can overcome most defects from rope processing and save 10%-15% cost ^[8].



Single jersey knit is a fabric constructed with one needle bed and one set of needles and it has a high tendency to crease ^[1]. Some researches on its creasing properties in the rope processing have been reported previously. However, its creasing properties during the open-width processing are never disclosed previously. There is no generally accepted method for evaluating the creasing extent of knit after this continuous processing. The aim of this research is to develop a simple and repeatable way to evaluate the evolution of creasing defects during open-width processing of knit fabrics. As well as investigating the influences of various processing factors such as folding direction, wet pickup, steaming time and pre-heatsetting on the crease formation to provide insights into the key elements needed in an appropriate processing.

2. Experimental part

2.1 Materials

Single jersey knit was purchased from Qingdao Donglin Textile Company. Fabric properties were given in Table 1.

Table 1 Fabric specifications

Sample	Weight (g/m ²)	Thickness (mm)	Face side	Back side
Jersey knit	280	0.63		

2.2 Measurements

The wrinkle properties of jersey were evaluated by measuring wrinkle recovery angle (WRA) of fabric using the AATCC 66-2008 method on a YG 541 digital fabric wrinkle instrument (Laizhou, China). Instead of testing only in two directions (warp and weft), the samples were measured in 12 directions for corresponding with the real behavior of fabrics during wearing. The edge of cutting samples was turned by 30° owing to the warp yarns in the interval from 0° to 330°.

The creasing properties of jersey during the open-width processing were evaluated by a length test method. A shrinkage rate (SA) of samples during the processing was calculated by using the following equation:

$$SA(\%) = (L_0 - L_1) / L_0 \times 100$$

Where L_0 and L_1 are the original length and after-processing length of fabric, respectively. Higher SR value means severer creasing occurs during the open-width processing.

3. Results and discussion

3.1 Anisotropy of jersey wrinkling

Since the jersey is a single-face knit, the test for it is divided into front and back side. The results are shown in Fig. 1. It can be seen that the creasing properties on both faces of the cotton jersey are opposite. For the face side, the force of the curling of the fabric in the transverse direction accelerates the recovery of the cylinder of the stretched coil, making the lateral folds more resilient. For the back face, the opposite situation occurs and the longitudinal folds are more resilient.

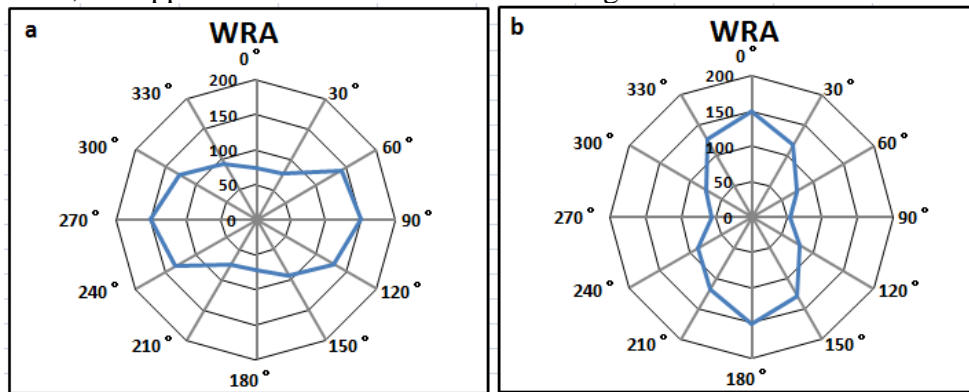


Fig. 1 Relationship between WRA of knitted jersey and direction

(a) face and (b) back side

3.2 The effect of folding direction during open-width steaming

According to the anisotropy of the jersey wrinkles, the folding direction of the fabric during the flat steaming process was adjusted. Meantime, the length shrinkage of the fabric during the steaming process was measured and the result shown in Fig.2.

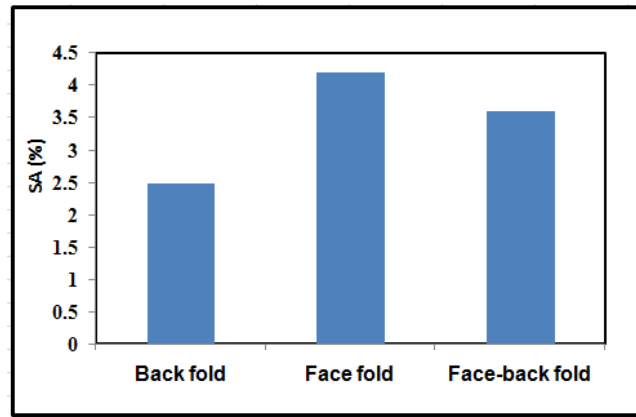


Fig. 2 Relationship between SA of knitted jersey and folding direction

Shrinkage may arise problems such as cockling (an irregular surface effect caused by loop distortion) and creasing. It can be seen that the back-fold fabric has the lowest SA value during steaming and the largest shrinkage occurs on the face-fold one. The fabric is folded in the longitudinal direction during steaming, and the longitudinal recovery angle of the back side is higher than that of face side from the test results of the WRA. This indicates the shrinkage due to creasing is easier to recovery for the back side of jersey.

3.3 The effect of wet pickup

Wet pickup is the amount of water or chemical formulation picked up by the fabric and is usually expressed as a percentage on weight of the dry fabric. The effect of wet pickup on the creasing properties of jersey was evaluated by WRA and SA method, respectively, and the results shown in Fig.3. It can be seen that as the wet pickup is increased, the longitudinal WRA of both sides is reduced. This is because the presence of moisture reduces the ability of the fabric to recover from deformation. Correspondingly, as the wet pickup increases, the SA of the fabric after the flat steaming increases, and it is also verified that the presence of moisture is not conducive to the recovery of the jersey creasing. What's more, the wet pickup must be controlled across the width and along the length of jersey in order to achieve uniform processing effect.

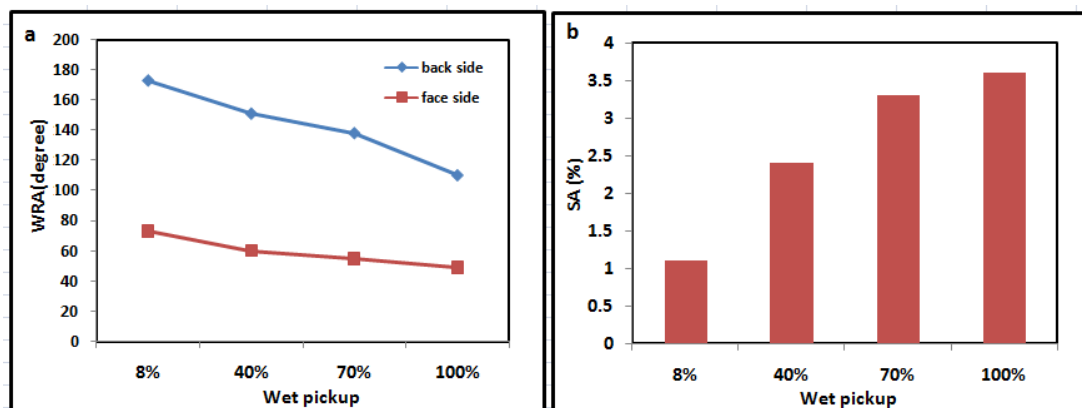


Fig. 3 The effect of wet pickup on (a) longitudinal WRA and (b) SA of jersey

3.4 The effect of open-width steaming time

Steamers are commonly used in continuous wet processes of jersey to rapidly heat it to a temperature of about 100°C. Generally, the jersey should be subjected to sufficient steaming for a good processing effect, so that the steaming batching time has also a significant influence on the creasing properties. The results are shown in Fig.4, where it is found the SA of the jersey is basically completed in the first 10 minutes, and then it doesn't change significantly during the experiment duration.

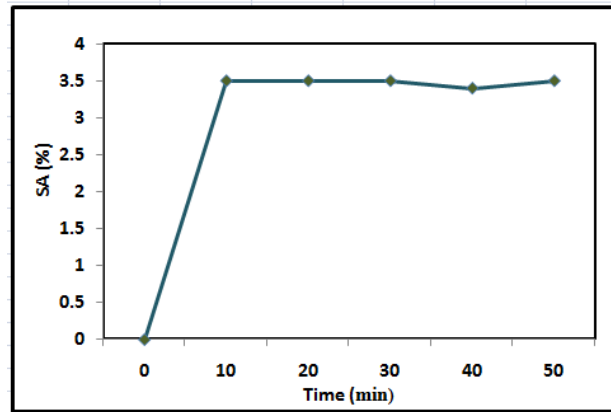


Fig. 4 The effect of steaming time on SA of jersey

3.5 The effect of pre-heatsetting

The dimensional stability, dyeability, creasing and many other properties of knit are affected by heating process because heat relieves stresses in the fabric. Usually, heat setting is the last procedure of processing, by which creases that have developed in the fabric can be pulled out and the width of the fabric can be changed. Heat setting may also be done before any wet treatment as pre-heatsetting to resist undesirable creasing and wrinkling. Heatsetting can be done with either dry heat or steam. In this experiment, the heatsetting is carried out by impinging 160-180°C hot air on the fabric in a tenter frame. After the pre-heatsetting, the fabrics are subjected to conventional steaming process to investigate its influences on creasing properties and the results shown in Fig.5. By this experiment, it is found the pre-heatsetting temperature has little influence on the SA of jersey. That is to say, the creasing properties of jersey are not obviously improved by heat setting treatment.

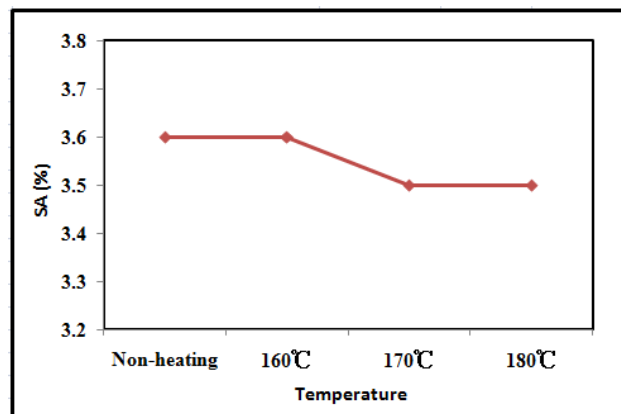


Fig. 5 The effect of pre-heatsetting on SA of jersey

4. Conclusion

This research developed a simple and repeatable way to evaluate the evolution of creasing defects during open-width processing of knit fabrics. The influences of various processing factors on the crease formation were investigated. It was found the shrinkage due to creases is easier to recovery for the back side of jersey. With the increasing of wet pickup, the SA of the fabric after the flat steaming increases, which verifies that the presence of moisture is not conducive to the recovery of the jersey creases. It is found the SA of the jersey is basically completed in the first 10 minutes. Finally, it is detected that the pre-heatsetting temperature has little influence on the SA of jersey, meaning the creasing properties of jersey are not improved by heat setting treatment.

Acknowledgments

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