WRINKLE RECOVERY Behaviour of the Fabrics Constructed with Plied Yarns

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The appearance of the garments is significant to fulfill the requirements of the consumers. Therefore, it is important to achieve desirable appearance and quality parameters on the structure and to avoid undesirable defects. Crease is mostly an undesirable property for the textile fabrics. Wrinkle or crease recovery is defined as the property of a fabric that enables it to recover from folding deformations. When fabrics are crumpled and then allowed to recover, the degree of recovery will depend on the morphology, inherent structure of the fiber and fabric construction. Wrinkles can occur in fabrics during the production; however they more often appear in textile end products when the fabrics are subject to creasing, shearing, compressing, bending, bulging, or washing in use and care. In this paper, fabrics, which were produced from plied yarns spun in 3 different twist level and woven in 3 different weft densities were tested for their crease recovery angles. Thereafter, the results were compared and evaluated.

**Key Words:** Wrinkle recovery, crease recovery, crease recovery angle, woven fabrics, plied yarns.

1. INTRODUCTION

Appearance of the garments is very important. Therefore, it is important to achieve desirable appearance and to avoid undesirable defects in the structure [1]. Crease is mostly an undesirable property for the textile fabrics, unless it is consciously given to the fabric structure. Currently, there is a great interest in textile market for the demand of easy care, wrinkle (crease) resistant products [2].

Wrinkle or creasing recovery is defined as the property of a fabric that enables it to recover from folding deformations. When fibers are crumpled and then allowed to recover, the degree of recovery will depend on the morphology and inherent structure of the fiber [1].

Wrinkles may form in fabrics during manufacturing, but more often they appear in textile end products when the fabrics are subject to creasing, shearing, compressing, bending, bulging, or washing in use and care [1].

Wrinkles can be defined by their height; slope, wrinkle density and the isotropy (uniformity) index are all important factors in measuring wrinkling. There are numerous standard tests that detail the procedures used to define the degree of wrinkling and creasing in a fabric [3].

There are several methods for crease recovery tests, such as ISO 2313, AATCC 66 and M&S P22 and TS 390 EN 22313 [4]. The most common method of measuring crease recovery uses the method of bending a strip of fabric by a folding force, maintaining it in the bent configuration for a given period of time, and then measuring the angle of recovery after the
bending load is removed [1]. Improvements in crease recovery property are obtained by chemical treatments, which improve the ability of fibers to maintain configurations in which they are treated [2].

However the ability of textiles to recover from creases is determined mostly by the measurement of its crease recovery angle [5]. “Shirley crease recovery tester” is an instrument used for this purpose. The instrument has a circular dial which carries the clamp for holding the specimen. Directly under the centre of the dial there is a knife edge and an index line for measuring the recovery angle. The scale of the instrument is engraved on the dial [6].

There are several factors influencing crease resistance of the materials such as fibre properties (coefficient of friction, bending modulus and bending recovery) and fabric construction (yarn construction and type of weave/knit) [3].

Different fibers reflect different crease resistance properties. For example, wool and silk have a good resistance to creasing whereas cellulosic materials such as viscose and linen have very poor resistance [7]. Although cotton is still one of the most preferred fibres in many applications, due to its comfort properties and natural feel, fabrics made from 100% cotton suffer from their propensity to crease formation and poor crease recovery. For this reason, there are some methods to avoid this property. The usage of resins is a well-known method to improve the crease recovery performance of cotton fabrics [8].

Although there are various studies about crease recovery properties of cotton fabrics, effect of yarn twist coefficient and yarn density on crease recovery angle of the fabrics woven with plied yarns have not been studied yet. In this study, 5 different 100% cotton woven fabrics produced from plied yarns were investigated for their wrinkle recovery angles.

2. MATERIALS AND METHODS

Fabrics used in the study were woven in plain weave structure. Properties of the selected fabrics are given in Table 1.
Table 1. Properties of the fabrics

<table>
<thead>
<tr>
<th>Code</th>
<th>Yarn Count (Ne)</th>
<th>Twist Coefficient ($\alpha_e$)</th>
<th>Material Type</th>
<th>Warp density * weft density</th>
<th>Fabric Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100/2</td>
<td>3,3</td>
<td>100% Cotton</td>
<td>56*31</td>
<td>medium</td>
</tr>
<tr>
<td>2</td>
<td>100/2</td>
<td>3,8</td>
<td>100% Cotton</td>
<td>56*31</td>
<td>medium</td>
</tr>
<tr>
<td>3</td>
<td>100/2</td>
<td>4</td>
<td>100% Cotton</td>
<td>56*31</td>
<td>medium</td>
</tr>
<tr>
<td>4</td>
<td>100/2</td>
<td>4</td>
<td>100% Cotton</td>
<td>56*36</td>
<td>tight</td>
</tr>
<tr>
<td>5</td>
<td>100/2</td>
<td>4</td>
<td>100% Cotton</td>
<td>56*26</td>
<td>loose</td>
</tr>
</tbody>
</table>

The fabrics were treated according to the standard pretreatment processes including the burning, disizing, rinsing, bleaching, mercerizing and drying. Thereafter, the fabrics were treated with the softener, wetting agent and optics.

After the treatments, fabrics were dried and conditioned under standard atmosphere conditions (20 °C±2 °C temperature, 65% ± 4% RH). Afterwards, crease recovery property was measured. In order to determine crease recovery of the fabrics, James Heal -Crease Recovery Angle Tester - Model 150 was used and the tests were conducted according to TS 390 EN 22313 test method.

A test specimen is folded and compressed under controlled conditions of time and force to create a folded wrinkle. The test specimen is then suspended in a test instrument for a controlled recovery period, after which the recovery angle is recorded. Higher the recovery angle means, better the crease recovery property.

20 specimens 40 × 15 mm, ten with their long dimension parallel to the warp direction of the fabric and ten with their long dimension parallel to the filling direction are cut. Half of the test specimens in both cases are folded face to face and the other half back to back. The specimens are folded end to end in half with their edges gripped in one line with the help of tweezers. Tissue is placed inside the folded specimens to counteract any tendency for the two surfaces of the specimen to adhere. The folded specimen is placed between the two leaves of the loading device and immediately the weight is applied for 5 min ± 5 s. A timing device is used and the result is read. Thereafter load is removed quickly so that the specimen does not suddenly spring open, completing the removal in less than 1 s. By means of tweezers, the specimen is transferred directly to the specimen holder of the measuring instrument.

![Figure 2. Angle of crease (left) and James Heal -Crease Recovery Angle Tester [9] (right)](image-url)
While the specimen is in the holder, the instrument is adjusted continuously to keep the suspended free limb always in a vertical position. The crease recovery angle 5 min after the removal of the load is read.

In the study average value of the 10 results -5 face to face and 5 back to back- were taken for test results of the plain fabrics on warp direction, the average value was taken as a test result; in similarly the weft direction was calculated.

3. RESULTS AND DISCUSSION

The effect of the yarn twist on the wrinkle properties of the fabrics were given in Figure 3. According to the Figure, the wrinkle recovery angle of the fabric produced from yarn that has the twist level of \( \alpha_e = 3.8 \) is higher than the others, for both warp and weft yarns. Therefore, it wrinkles comparatively less. However, the wrinkle recovery angle of the fabrics, which have the yarns in the twist level of \( \alpha_e = 3.3 \) and \( \alpha_e = 4 \) are found lower. According to the results, it can be noticed that the best crease property can be obtained at the optimum twist coefficient value (\( \alpha_e = 3.8 \)) for warp and weft direction.

![Figure 3. Wrinkle recovery angle (WRA) results of the fabrics produced from Ne 100/2 yarn in different twist coefficients](image-url)
Figure 4. Wrinkle recovery angle (WRA) results of the fabrics produced from Ne 100/2 ($\alpha_e=4$) yarn in different weft densities

Wrinkle recovery angle results of the fabrics, that were woven in different tightness values are given in Figure 4. As it can be seen from the figure, the fabrics woven in medium weft density has the highest WRA values. For this reason, they wrinkle less than loose and tight fabrics.

As the weft density increase the crease recovery increases too. However, if the weft density is more than optimum density, WRA values decrease. In conclusion, the crease tendency increases again.

4. RESULTS AND DISCUSSION

Since the wrinkle resistant products take more interest in the market, there are increasing numbers of researches in this area. Although it is sometimes a consciously given effect, it is mostly an undesirable surface appearance. Some fibers are comparatively less tendency to crease. However, cotton, as being one of the mostly used fibers, has a disadvantage about its easily creasing structure.

In this study, 5 different 100% cotton woven fabrics produced from plied yarns, were investigated for their crease resistance properties. According to the results it can be concluded that, there is not a linear relationship between twist coefficient and wrinkle recovery angle value. There is an optimum twist level ($\alpha_e= 3.8$), which supplies a high wrinkle recovery angle. For $\alpha_e= 3.3$ and $\alpha_e=4$, wrinkle recovery angle is comparatively lower. As the results of weft and warp directions were compared, it can be stated that, wrinkle recovery angle is higher for weft direction in all types of fabrics.

In the case of fabrics having different weft density values, the fabrics woven in medium weft density has the highest WRA values. However, for the tighter and looser structures, WRA values are lower, which means they have more tendency to wrinkle.
REFERENCES