A Test Method for Studying the Setting Behaviour of Cotton Yarns

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A new test method for studying the setting behaviour of cotton yarns is described. The method, based on yarn angle measurements, is useful in the case of yarns to which setting is imparted by chemical treatments. Pretreatments were given to cotton yarns with benzyl trimethyl ammonium hydroxide and zinc chloride and it was found that the pretreatments help in getting better set yarns.

Materials and Methods
Cotton sewing thread and unmercerized cotton spun yarn were used. The characteristics of these yarns are given in Table I.

The setting on these yarns was imparted as follows:

1. Sewing thread mounted on angular blocks was set with 30% sodium hydroxide (a swelling reagent) and 5% ammonium thiocyanate solution (a hydrogen bond breaker) at 92°C for 1 hr or at 20°C for 20 hr.

2. Sewing thread was pretreated with benzyl trimethyl ammonium hydroxide (BTMOH) in 40 ml solution of 2.1 N at 25°C for 10 min followed by centrifugation. These yarns were further treated with 25% sodium hydroxide. BTMOH was used as a preswelling agent, as it swells and opens the fine structure of cotton cellulose.

3. Unmercerized cotton yarns were treated with 65% zinc chloride (a swelling agent) at 92°C for 1 hr followed by rinsing in 3% acetic acid solution.

4. A part of the yarns from (3) was resin treated with dimethylol dihydroxyethylene urea (DMDHEU) and 18% MgCl₂·6 H₂O at 28°C for 1 hr to stabilize the set. The yarns were then washed with sodium carbonate (2%) and soap flakes solution (2%) at 65°C for 30 min.

A minimum of 50 angle measurements were taken on set yarns for each treatment which give a precision of ±6% at 95% confidence level.

The cotton yarn was wound round a triangular stainless steel block, so that the cross-section was an

Table 1—Characteristics of Yarns Used

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Cotton sewing thread</th>
<th>Cotton spun yarn</th>
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</thead>
<tbody>
<tr>
<td>Tex</td>
<td>2/23.6</td>
<td>14.7</td>
</tr>
<tr>
<td>Twist/cm (double)</td>
<td>10.4</td>
<td>—</td>
</tr>
<tr>
<td>Direction of twist</td>
<td>S'</td>
<td>—</td>
</tr>
<tr>
<td>Twist/cm (single)</td>
<td>8.4</td>
<td>10.6</td>
</tr>
<tr>
<td>Direction of twist (single)</td>
<td>Z</td>
<td>Z</td>
</tr>
</tbody>
</table>
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is isosceles triangle with a 20° angle at the vertex. The yarn was subjected to a uniform tension (sufficient to remove slackening or kinks) on one end, while the other end was firmly fastened to the block. Fifty turns were given within a distance of 12.5 cm. Now this end was also secured firmly with the block. This block was subsequently subjected to setting treatments by completely dipping the block in setting solution for suitable periods at any specified temperature. After the setting treatment, the block was rinsed and/or washed with water and kept for the drying of yarns. Each turn of the dried yarns so set was fixed well on both sides with an adhesive at the base of the block to facilitate smooth cutting of yarn legs without any distortion to yarn angles.

Each turn of the set yarns was cut with the help of a sharp razor at a distance of 0.5 cm from the vertex on both the sides. The angles between the legs were measured after conditioning them at 65% RH and 27°C for 24 hr subsequent to wetting with water (containing 0.1% Sandozine NIS) at 60°C for 10 min. Wetting was done to remove the cohesive set imparted during drying.

The angle between the two legs of the yarn was measured on a projection microscope with the help of a protractor and a scale. Larger angles indicate poor setting.

Results and Discussion

The results obtained by the angular block method are given in Table 2. The difference between the two combinations of temperature and time in relation to alkali set, i.e. treatment A and treatment B, has been brought out significantly. The angles after setting are 48° and 30° for the treatments A and B respectively. This indicates that the higher temperature of treatment gives better set yarns, as reported by Karrholm and Asnes. It is further indicated by the data in Table 2 that the alkali and salt treatment at higher temperature is comparable to BTMOH and alkali treatment (treatment C), as the differences between them are not significant. The presence of BTMOH, however, has helped in imparting a better set to yarns, as the angle for its alkali control (treatment D) is 63°.

The setting behaviour of spun cotton yarns is obvious from the data given in Table 3. Zinc chloride treatment gives an angle of 35° in comparison to 120° of its control treatment (treatment F). Resin treatment to these yarns further increases the set from 35 to 29°, indicating that better set yarns could be obtained if the ZnCl₂ treated yarns are further resin treated.

The resin treated yarns, however, show an angle of 104° (treatment H). This shows the usefulness of ZnCl₂ treatment as a pretreatment to obtain good set yarns prior to resin treatment.

Conclusion

The method is simple and rapid and can be used for studying the setting behaviour of any type of cotton yarns. Pretreatments of cotton yarns with BTMOH and zinc chloride help in achieving better set yarns.

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References