Influence of preparatory processes on blend irregularities of rotor-spun blended yarns

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The effect of flock blending, drawframe blending and drawframe passage on blend homogeneity and yarn quality of polyester-viscose and polyester-cotton blended yarns has been studied. It is observed that for both the blended yarns, flock blending results in better blend intimacy compared to drawframe blending. An additional second drawframe passage after flock blending has no significant effect on the index of blend irregularity. However, it improves the yarn evenness to the level of drawframe blended yarns.

Keywords: Blend homogeneity, Clustering coefficient, Drawframe blending, Flock blending, Index of blend irregularity, Index of rotational blend irregularity, Intensity of migration, Rotor spinning

1 Introduction

Rotor spinning is more economical and productive compared to ring spinning. Till now, the blended yarns are mostly spun on ring spinning system, but in the coarse and medium count range they can be spun efficiently on rotor spinning system. Nowadays, many mills have started spinning of blended yarns on rotor machines.

Blend intimacy is an important characteristic of the blended yarn. The mechanical and aesthetic properties of blended yarns depend largely on fibre blending irregularities in the yarns. Normally, in mills, blending is done either at blowroom or at drawframe stage. It is well known that for ring spinning, blowroom blending results in better blend regularity compared to drawframe blending. Besides, successive passages of drawframe, even in case of blowroom blended materials, are found to improve blend intimacy. But in rotor spinning, which itself is a good blender by virtue of the back doubling effect, the relative merits of the above two stages of blending as well as the advantages of successive passages of drawframe are still debated. Sengupta et al. demonstrated the superiority of rotor back doubling over any pre-blending in achieving blend intimacy. However, in practice, a spinner can do little to increase the number of doublings inside the rotor, as the yarn twist is fixed by the end-use requirements. Moreover, the trend is to use smaller diameter rotor with high rotor speed. These considerations have established the need for a study to explore the suitability of other alternate methods of enhancing the blend intimacy. In the present study, an attempt has been made to investigate the effect of stage of blending (e.g. flock and drawframe) and the passages of drawframes on blend homogeneity of polyester-viscose and polyester-cotton blended yarns.

2 Materials and Methods

2.1 Preparation of Blended Yarn Samples

Polyester fibre (38 mm, 1.2 D) was dyed in blue colour using 4% of a disperse dye and blended separately with viscose fibre (38 mm, 1.2 D) and combed cotton (MCU-5) in the proportion of 50:50 by weight for the production of polyester-viscose (PV) and polyester-cotton (PC) blended yarns. The combed cotton was having 2.5% span length of 33.2 mm, uniformity ratio of 0.54, micronaire value of 3.4, and bundle strength (3 mm gauge) of 27.6 g/tex.

Blending was carried out at two stages: (i) flock blending before carding, and (ii) drawframe blending. Both were followed by a post-drawing passage. Half of the slivers from flock blending were subjected to an additional drawframe passage so as to study the effect of drawframe passages on blend irregularities. However, for drawframe blending, a second
additional post-drawing passage was avoided though the slivers of each component were subjected to a pre-blend drawing passage so as to adhere strictly to practices normally adopted in mills. All the drawn slivers were spun into 30's yarn on a rotor spin-trainer using a TM of 4.5 and rotor diameter of 55 mm. The rotor and opening roller speeds were kept constant at 45,000 rpm and 7,000 rpm respectively. In all, six blended yarn samples were produced.

2.2 Anatomization of Yarn Cross-sections

Short segments of yarn samples were embedded in methyl methacrylate and butyl methacrylate. For each yarn sample, fifty cross-sections were cut under stereomicroscope and studied under projection microscope.

2.3 Computations

Various blending parameters related to blend homogeneity were computed following the methods developed by Coplan and Klein. Intensity of migration for component fibres was assessed by the method developed by Townend and Dewhirst.

2.4 Other Yarn Properties

The yarn were tested for single yarn tenacity and breaking elongation on a Uster tensorapid automatic tensile tester with 20 ± 3 s average time to break and 500 mm gauge length. Evenness and imperfections were tested on Uster evenness tester.

3 Results and Discussion

3.1 Blend Homogeneity

The values of different parameters related to the blend homogeneity for both the blends are shown in Tables 1 and 2.

<table>
<thead>
<tr>
<th>Blend Blending Drawframe IBI Clustering IRBI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyester-Viscose Flock 1 0.74 0.55 1.08</td>
</tr>
<tr>
<td>(50:50) Drawframe 2 0.78 0.61 0.95</td>
</tr>
<tr>
<td>Polyester-Cotton Flock 1 0.84 0.71 1.06</td>
</tr>
<tr>
<td>(50:50) Drawframe 2 0.92 0.85 0.89</td>
</tr>
</tbody>
</table>

IBI—Index of blend irregularity IRBI—Index of rotational blend irregularity.

<table>
<thead>
<tr>
<th>Blend Blending Drawframe Intensity of migration(M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyester-Viscose Flock 1 +0.080 0.0769</td>
</tr>
<tr>
<td>(50:50) Drawframe 2 +0.209 0.0643</td>
</tr>
<tr>
<td>Polyester-Cotton Flock 1 -0.115 0.0589</td>
</tr>
<tr>
<td>(50:50) Drawframe 2 -0.079 0.0585</td>
</tr>
</tbody>
</table>

(+) Sign of M indicates outward migration of polyester fibre. (-) Sign of M indicates inward migration of polyester fibre. *Statistically significant.

3.1.3 Index of Rotational Blend Irregularity

The pattern of rotational distribution of fibres in both PV and PC blends, whether flock or drawframe blended, are found to be random (Table 1), though an additional second drawing passage for flock blending has the effect of shifting the index of rotational blend irregularity from random to perfect. The randomness in the rotational fibre distribution is further verified from the histograms of 't' values computed for each octant of a section comprising all the sections studied in a sample (Fig. 1).

3.1.4 Intensity of Migration

In general, the values of intensity of migration (M) for rotor-spun blended yarns are very low (close to zero). Out of the six blended yarn samples studied, only for two blended yarns, statistically significant preferential inward migration of polyester fibre is observed (Table 2). The effect of the stage of blending and the number of drawing passage on intensity of migration shows no definite trend.
Gupte et al.: Blend Irregularities of Rotor-Spun Yarns

**Fig. 1**—Histograms of 't' values

<table>
<thead>
<tr>
<th>Blend</th>
<th>Blending Passage</th>
<th>Uster CV %</th>
<th>Index of Irregularity (Observed)</th>
<th>Imperfections/km</th>
<th>Tenacity g/tex</th>
<th>Breaking Elongation %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Thin Places (-50%)</td>
<td>Thick Places (+50%)</td>
<td>Neps (+280%)</td>
<td></td>
</tr>
<tr>
<td>Drawframe</td>
<td></td>
<td></td>
<td>23</td>
<td>32</td>
<td>39</td>
<td>10.7 (21.3)</td>
</tr>
<tr>
<td>Polyester-Viscose (50:50)</td>
<td>Flock</td>
<td>1</td>
<td>19.4</td>
<td>2.14</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Drawframe</td>
<td>1</td>
<td>16.9</td>
<td>1.85</td>
<td>8</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>Flock</td>
<td>1</td>
<td>15.4</td>
<td>1.78</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Drawframe</td>
<td>1</td>
<td>14.4</td>
<td>1.59</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polyester-Cotton (50:50)</td>
<td>Flock</td>
<td>1</td>
<td>14.3</td>
<td>1.61</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Drawframe</td>
<td>1</td>
<td>14.3</td>
<td>1.61</td>
<td>2</td>
<td>6</td>
</tr>
</tbody>
</table>

The values in parentheses indicate CV %.
3.2 Yarn Properties

3.2.1 Yarn Unevenness

Table 3 shows that drawframe blending followed by one post drawing passage produces better yarns in terms of CV % and imperfections when compared with flock blending with a subsequent passage on drawframe. The additional drawframe passage in case of flock blending improves the yarn unevenness to a comparable level with that of the drawframe blended yarns. The trend can be further verified from the values of index of irregularity determined from a ratio of the actual to the limit irregularity. The limit irregularity was calculated from an actual count of the average number of fibres in the cross-sections.

3.2.2 Yarn Strength and Elongation

Drawframe blended yarns have marginally better strength compared to flock blended yarns with a post passage of drawframe (Table 3). In general, the results of yarn properties are in agreement with those reported by Srinathan et al.\textsuperscript{3} from bulk trials on PV blend.

4 Conclusions

4.1 Both for polyester-viscose and polyester-cotton rotor yarns, flock blending before carding results in better blend intimacy in terms of index of blend irregularity and clustering coefficient compared to drawframe blending.

4.2 The index of blend irregularity for flock blended yarn lies between perfect and random, whereas the drawframe blended yarns suffer from inhomogeneity by about 50% from random.

4.3 An additional drawframe passage in case of flock blending has no significant effect on index of blend irregularity. However, it tends to shift index of rotational blend irregularity (IRBI) from random to perfect. IRBI for rotor-spun blended yarns is random irrespective of the preparatory processes.

4.4 Both the blended yarns exhibit very low level of radial fibre migration for the component fibres.

4.5 Flock blending with two post-passages of drawframe produces yarns comparable to those obtained from drawframe blending in terms of unevenness, imperfections and strength.

Acknowledgement

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References