Influence of Process and Machine Variables on the Blend Characteristics of Rotor Spun Yarns

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The influence of process and machine variables on various parameters of blending has been investigated. It has been observed that the mixing stage has very little influence on the blend characteristics of rotor spun yarns. The results also indicate that preblending cannot be used as a substitute for rotor doublings. In terms of fibre dispersion and arrangement of fibres in the yarn cross-section, beater feed machine gives better results compared to the roller feed machine.

Many research workers\textsuperscript{1–4} have observed that even a direct feed of two different slivers to the rotor spinning machine leads to the production of homogeneous yarn, provided the sliver linear density is constant and the feed mechanism works properly. Other workers\textsuperscript{5–9} recommended preblending with one or more draw frame passages to avoid blend level variations which may arise due to changes in the linear density of the sliver. No attempt has, however, been made to present a comparative picture of blend intimacy with respect to process and machine variables, such as mixing stage, rotor doublings, etc. The present work brings out the influence of mixing stage, spinning system and rotor doublings on various parameters of blending.

Experimental Procedure

\textit{Fibre dyeing} — About 1 kg of viscose staple was dyed to red and blue colours using direct dye. The percentage shade employed (4\%) was the same for both the colours. To avoid entanglement during dyeing, the fibres were loosely bound in a gauze cloth and the stirring of material in the dye bath was completely avoided. The dyed material was squeezed gently and then allowed to dry under atmospheric conditions.

\textit{Preparation of yarn samples} — Red and blue viscose fibres were fixed in the proportion of 50:50 (wt/wt) at three different stages, namely, before the card, at the draw frame and at the rotor or OM (sliver to yarn) ring frame. Material corresponding to the above three stages of mixing was used to produce 18\(^{\circ}\) count yarn on three different types of spinning machines: the roller feed and beater feed rotor spinning machines and OM ring frame. Study on the effect of rotor doublings was restricted to the beater feed rotor spinning machine. Rotor doublings were changed by varying the twist level in the yarn, which, in turn, was controlled by increasing or decreasing the rotor speed at constant take-up speed.

Carding and drawing of the material were carried out on Shirley miniature card and miniature draw frame respectively. The OM ring frame and the beater feed rotor spinning machine were fed with drawn slivers, whereas the roller feed rotor spinning machine was fed with rovings prepared from the drawn slivers.

\textit{Preparation and examination of yarn cross-sections} — The method used consisted in embedding short segments of yarn in a plasticized methyl methacrylate resin and polymerizing the resin with the aid of a catalyst and heat. A rotary microtome was used for section cutting and 50 sections were examined for each sample.

\textit{Computational methods} — Three blending parameters, namely, index of blend irregularity (IBI), index of rotational blend irregularity and clustering coefficient, were evaluated using the measures developed by Coplan and Klein\textsuperscript{10}. The limits of IBI values\textsuperscript{11} were also computed to study their departure from randomness.

Results and Discussion

\textit{Radial blend irregularity} — The IBI values for yarns prepared under various stages of mixing using different spinning machines are presented in Table I. It is obvious that the rotor is a very efficient blender. The stage of mixing has very little influence on blend irregularity. Irrespective of whether the two groups of fibres are thoroughly intermingled prior to feeding at the rotor or are fed as two separate entities, the rotor homogenizes them all and produces a random blend. This is found to be true for both beater and roller feed machines. In sharp contrast to this, the blend intimacy
of ring spun yarns is influenced by the mixing stage. When two slivers (red and blue) are fed to the OM ring frame, a very irregular blend is obtained.

Coming to the influence of rotor doublings, it is observed that the blend intimacy improves from 'random' to 'between perfect and random' when the number of doublings is increased from 103 to 137. No further improvement in blend intimacy is seen when the number of doublings is increased to 166. It is interesting that preblending, whether it is done at the card or draw frame, does not fully compensate for the reduction in rotor doublings in improving the blend irregularity.

**Clustering coefficient** — The clustering coefficient values presented in Table 2 show that at comparable number of doublings at the rotor (137 for the beater feed and 141 for the roller feed), the beater fed rotor produces a lower clustering coefficient than the roller fed rotor. This is presumably due to more efficient separation of fibres by the beater or the combing roller. The clustering coefficient values of ring spun yarns show that while these are extremely high for the yarn blended at the ring frame, the other two modes of blending produce yarns with clustering coefficients similar to those of roller fed rotor yarns. This also goes to signify that the combing action of the beater results in better individualization of fibres, which may not be obtainable through drafting between rollers irrespective of the number of stages and levels of draft employed.

**Table 3—Values of Index of Rotational Blend Irregularity**

<table>
<thead>
<tr>
<th>Mixing stage</th>
<th>Beater feed rotor spinning machine</th>
<th>Roller feed rotor spinning machine</th>
<th>OM ring frame machine</th>
</tr>
</thead>
<tbody>
<tr>
<td>16.4 TPI</td>
<td>21.8 TPI 26.4 TPI</td>
<td>(103 doub-137 doub-166 doub-141 doub)</td>
<td>(18 TPI)</td>
</tr>
<tr>
<td>1</td>
<td>0.82 0.74 0.73 0.83 0.88</td>
<td>1.07 1.02 0.90 0.99 1.09</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.93 0.60 0.66 1.03 1.03</td>
<td>1.03 1.02 0.98 1.02 1.07</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1.00 0.75 0.78 1.02 1.76</td>
<td>1.03 1.01 1.06 1.21 3.40</td>
<td></td>
</tr>
</tbody>
</table>

**Fig. 1** — Histograms of 't' values for yarn samples spun on the beater feed machine.
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References

7 Text Topics, 8(8) (1978).