Surface Damage to Fibres During Opening in a Rotor Frame

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The combing roller system of fibre separation invariably causes a considerable damage and fibre breakage, observed as minute cuts or bruises on the fibre surface; fibre rupture being an extreme case of such damage.

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That the breakage of fibres is unavoidable in rotor spinning when a combing roller system of fibre separation is used has been confirmed by many research workers both by direct (visual observation) and indirect (finding out the mean length of fibres before and after separation) ways. The breakage has been attributed to the impact of pins/teeth of the combing roller on the fibres held in the nip of the feed system. In a recent paper, we have shown that the fibres suffer some loss in tenacity during this action. This loss was up to 9%, depending upon the fibre type and processing parameters. We have also suggested that weak spots are generated along the length of the fibres owing to the impact of the opening roller teeth on the fibres. The fibre breakage is an extreme case of this action. However, the existence of such damage needs to be confirmed and hence the present study.

American cotton of an effective length of 29 mm and a linear density of 0.157 mg/m was used. About 40 g of fibres was taken, and processed on a Shirley miniature card and a Platt’s miniature drawframe, to produce a sliver of 2.95 g/m (0.20 HK).

The sliver was fed at the rate of 0.5 m/min to the Suessen OE spin tester. The machine was run for a few seconds and then stopped. Three different combing roller speeds were used. The accumulated material in the form of a ring was removed from the rotor groove. Such rings of fibres were collected for different combing roller speeds, viz. 5000, 7000 and 9000 rpm.

To assess the extent of damage, the Congo Red test was carried out on the collected, opened material. About 0.1 g of cotton was placed in a filter flask with water. Air was pumped out to the extent possible by a filter pump. The cotton was taken out, squeezed gently and dried. The visible dyeing of the fibres was observed under a microscope. The extent of damage was found to be quite high at the highest speed used.

Fig. 1 — Effect of combing roller speed on fibre damage

Fig. 2 — Photographs of the damaged portion of fibre
to remove most of the water, and dipped into 25 ml of an 11% sodium hydroxide solution (by weight) for 5 min. The material was washed rapidly in water and placed in a saturated solution (2%) of Congo Red and shaken at intervals for 6 min. The cotton was removed and rinsed with water until there was no pink colour bleeding from the dyed sample. The cotton was again placed in 18% sodium hydroxide solution, teased out and mounted with the same liquid on a glass slide. It was covered with a cover glass and examined at 100 x magnification. The mechanically damaged portions of the fibres showed bruises or cuts and deeply stained portions. For each sample, 50 fibres were examined under the microscope and the number of damaged and undamaged fibres was counted.

The effect of combing roller speed on fibre damage is shown in Fig. 1. The figure shows that the feed material itself had a few damaged fibres. Out of 50 fibres tested, 28 had been already damaged. The incidence of such a high percentage of damaged fibres in the feed material could be attributed to the double carding of the feed material. The results show that the action of combing roller invariably increases the number of damaged fibres. With the combing roller speeds presently used, the number of damaged fibres increased from 28 to 36-41, i.e. around 46% increase, besides damage to the pre-damaged fibres. The prominent minute cuts are clearly seen in Fig. 2.

References

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