Effect of cleanness defects of raw silk on tenacity and elongation

T N Sonwalkar *, S Roy & B V Vasumathi
Central Silk Technological Research Institute, BTM Layout, Madivala, Bangalore 560 068. India
Received 3 October 1991; accepted 4 November 1991

The effect of cleanness defects of raw silk on tenacity and elongation has been studied to quantify the extent of damage. Multivoltine raw silk reeled on multiend reeling machine was used for the experiment. About 100 pairs of defective part and the adjoining normal part were tested for strength and elongation. It has been observed that around 85% of the cleanness defects show a decrease in strength and elongation. Cleanness defects with additional material attached to raw silk do not affect the strength and elongation. The average decrease in strength and elongation of defective parts is 18% and 39% respectively. Around 20% of the defects show a tenacity of 3 g/den and below and around 38% of the defects show an elongation below 15%.

Keywords: Cleanness defects, Elongation, Raw silk, Tenacity

1 Introduction
The cleanness defects are classified into three general groups¹, viz. Super Major Defects, Major Defects and Minor Defects.
(i) Super Major Defects — Defects which are ten or more times as large as the minimum size of major defects in length or size.
(ii) Major Defects — The major defects are divided into five kinds as follows:
  Waste — A mass of tangled cocoon filaments or fibres attached to the thread.
  Large Slugs — Considerably thickened places in the thread, 7 mm and above in length, or extremely thickened places with less length.
  Bad Casts — Abruptly thickened places in the thread due to the cocoon filaments not being properly attached to the raw silk thread, or made by adding more than one cocoon filament at a time.
  Very Long Knots — Knots which have loose ends, 10 mm and above in length, or those caused by improper tying of threads.
  Heavy Corkscrews — Places in which one or more cocoon filaments are longer than the remainder and give the appearance of a thick spiral form.
(iii) Minor Defects — The minor defects are divided into four kinds as follows:
  Small Slugs — Considerably thickened places in the thread, from 2 mm to less than 7 mm in length, or extremely thickened places having less than 2 mm length.
  Long Knots — Knots which have loose ends, from 3 mm to less than 10 mm in length.
  Corkscrews — Places in which one or more cocoon filaments are longer than the remainder and give the appearance of a thick spiral form.
  Long Loops or Loose Ends — Loops or split ends, 10 mm and above in length, when measured along the filament.

The average strength of raw silk yarn is by far sufficient to maintain normal weaving performance and quality of fabric. But the variation in strength can lead to serious problems. Individual weak positions can be overloaded and cause a break. Therefore, not only the average strength but also the variation (CV value) in strength and elongation is important. A high elongation can compensate for missing strength.

Hattenschwiler² distinguished three types of thick places (Fig.1) as given below:
A : additional material attached to the raw silk thread. This does not affect strength and elongation.
B : material of thread forming a thick place. This results in a loss in strength and a heavy loss in elongation.
C : only a few fibres in the thread carrying the rest of “pushed together” fibres. A light tension breaks the carrying fibres and the remaining fibres stretch...
Fig. 1—Three types of thick places as distinguished by P Hattenschwiler [A — additional material attached to the raw silk thread; B — material of thread forming a thick place; and C — few fibres in the thread carrying the rest of the ‘pushed together’ fibres]

out. This results in a slack end and most likely a break in the warp.

It is important that all the yarns used in the warp should have the same characteristics. Individual skeins or bobbins having lower strength can be the reason for many warp breaks. The clean surface of the warp yarn is an absolute must as the thick places, knots or high neatness defects and nep or hairiness have a strong tendency to make the yarn stick together or to even entangle yarns. This bears the danger of breaking ends.

Thick places in the weft yarn are less critical but such events on a prin can interfere in a smooth unwinding and any inertia there can result in a yarn break also.

The nature of silk offers a very high strength of the thread which compares favourably with other materials, but it is tapered and therefore a part of the unevenness is unavoidable. Filament, while unwinding from cocoon, also has entangled parts (loops) depending upon the silk worm race. These loops also cause neatness defects, i.e. minor cleanness defects, lowering the grade of raw silk.

Hattenschwiler also stated that thick places are often weak places in the raw silk and that they tend to tangle with neighbouring yarns in warp or on packages and cause disturbance. It appears that about 10-20% of all major cleanness faults create a problem or break and stop the loom. If one end breaks, all other threads (may be 20,000 in a wide warp) will also be stopped and wait until this single break is repaired. On top of all, they may affect the appearance of the fabric.

2 Materials and Methods
Multivoltine raw silk reeled on multiend reeling machine was taken for the study. Raw silk with cleanness defects (major and super major) was mounted such that the defect was centrally placed and then tested for strength and elongation. Next, the normal part (defect free) of raw silk adjoining the defective part was tested for strength and elongation. In this way, the defective and normal yarns were tested in pairs and the decrease in strength due to the occurrence of defect was noted.

The strength and elongation tests were conducted on Instron tensile strength testing machine keeping the gauge length at 50 mm under the prevailing atmospheric conditions (RH, 50-60%; and Temp., around 24°C).

Each defect was observed under a magnifying lens and the nature of the defect noted.

Around 100 pairs of readings were taken for the normal and defective raw silk samples.

3 Results and Discussion
The defective raw silk invariably broke at the cleanness defect in all the cases. The strength of the defective part was lower than that of the normal part of raw silk. In some cases, the defective part showed higher or equal strength. On closer examination of the defect it was observed that the nature of defect was in conformity with the type of defect described earlier under A.

About 85% of the cleanness defects tested showed a tenacity of 3 g/den and below and around 38% of the cleanness defects showed an elongation below 15%.

Raw silk with cleanness defects showed higher tenacity CV% and elongation CV% compared to the normal raw silk.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Normal raw silk</th>
<th>Raw silk with cleanness defect</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Av. tenacity, g/den</td>
<td>3.91</td>
<td>3.20</td>
<td>The difference is significant at 1%</td>
</tr>
<tr>
<td>Tenacity CV%</td>
<td>19.0</td>
<td>28.4</td>
<td></td>
</tr>
<tr>
<td>Tenacity range, g/den</td>
<td>2.6-6.5</td>
<td>0.89-5.6</td>
<td>at 1%</td>
</tr>
<tr>
<td>Av. elongation, %</td>
<td>25.0</td>
<td>15.3</td>
<td>The difference is significant at 1%</td>
</tr>
<tr>
<td>Elongation CV%</td>
<td>19.2</td>
<td>41.6</td>
<td></td>
</tr>
<tr>
<td>Elongation range, %</td>
<td>11.1-33.7</td>
<td>1.3-28.9</td>
<td>at 1%</td>
</tr>
</tbody>
</table>
The variation in tenacity and elongation of normal and defective raw silk is shown in Fig. 2. The graphs also show the difference in the mean tenacity and elongation values of these two pairs of readings. Some of the typical defects tested are shown in Fig. 3.

4 Conclusion
Cleanness defects have considerable impact on the strength and elongation of raw silk. The decrease in strength due to these defects results in higher number of breaks during the preparatory processes and weaving leading to lower efficiency, besides affecting the fabric appearance and quality. The fact that about 85% of the cleanness defects lower the strength and elongation on an average by about 18% and 39% respectively is a matter that cannot be undermined. Although the cleanness defect of highly thickened size does not reduce the strength and elongation, it is a potential source of fabric defect. Silk being a highly priced item, rejection of fabrics is too risky. Every fabric defect adds to its devaluation and all the cleanness defects contribute towards this effect. Hence, it is very essential to have a proper control over the incidence of cleanness defects. Proper cooking of the cocoons, maintenance of the right button size, apt replacement of worn buttons with the new ones, and reeling on multiend reeling machine equipped with tension device for individual reel stop motion will help in reducing the occurrence of cleanness defects.

Acknowledgement
The authors wish to thank Shri Hanumant, Field Assistant, for assistance in conducting the project.

References