韓蠶學誌 37(2), 191~196 (1995)
Korean J. Seric. Sci.
〈資 料〉

# Defects in Tussah(Tasar) Silk Yarn

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## Abstract

**The aim of the present work is to investigate the level of faults present in tussah silk yarn as detected on an Uster instrument for four different varieties of commercially available tussah(tasar) silk yarns. The structure of these faults were analysed further so as to understand the mechanism and source of their generation.**

**Key words : Tussah silk**

## INTRODUCTION

Magnitude of faults is an important criteria that decides the quality of a yarn. A large number of faults in a given section of a yarn detract its appearance and hence negatively influence the appeal of a fabric made out of it. Besides faults can also lead to processing disturbances such as increase in down time of the machines involved in the conversion of yarn into fabric. As the level of faults is an important criteria for a buyer in selection of yarn for a particular end use, similarly control of incidence of fault is an equally important process control activity for the yarn producer. Control of fault is only possible if the sources of generation of faults are identified first. In this regard an understanding of the mechanism of generation of faults through careful analysis of their structure can only logically lead to their possible sources. A control strategy can be worked out provided faults are first classified according to their size so as to know which type of faults are more serious ones and demand immediate control. Hence size of faults, their mechanism of generation and location of possible sources have been the theme of the present investigation. For detection and quantification of fault in an objective manner the Uster evenness tester was used.

## MATERIALS AND METHODS

### 1. Materials

The varieties of tussah silk yarn(Antheraea mylitta D) used for this study are given in Table 1.

The yarns were subsequently evaluated for the following properties for their further characterization.

### 2. Methods

#### 1) Mass Irregularity(Evenness)

Short term mass irregularity was determined on Uster I. The running speed and duration of test were 25 m/min and 5 min, respectively. Number of sample tested were at least thirty.

#### 2) Imperfection

The level of imperfections such as thick, thin places and neps present in the yarns were determined on Uster I. The sensitivity settings used were:

| | |
|---|---|
| Thick places | +50% |
| Thin places | −50% |
| Neps | +200% |

At least thirty readings were taken per variety each sample containing 125m of yarn.

#### 3) Visual Studies

The imperfections were caught using 'select' mode of operation on Uster. Whenever an imperfe-

**Table 1.** *Structural characteristics of yarn*

| Type of yarn | Linear density(dtex) | No. of plies | Twist (t.p.m) | Brins/cross-section |
|---|---|---|---|---|
| Thigh reeled | 84.56 | Single | 59.05-157.48(S) | 12 |
| Machine reeled | 101.00 | Single | nil | 14 |
| Single twisted (tram) | 78.99 | Single | 376.77(Z) | 12 |
| Double twisted (organzine) | 128.67 | Two | 486.22(Z)<br>348.03(S) | 22 |

Note: Z and S indicate direction of twist

**Table 2.** *Evenness and Imperfection values of yarn*

| Type of yarn | Linear density (dtex) | Evenness (CV%) /125m | Thick places /125m | Thin places /125m | Neps per /125m | Total imperfection /125m |
|---|---|---|---|---|---|---|
| Thigh reeled | 84.56 | 18.99<br>(35.82) | 16.83<br>(48.56) | 8.13<br>(160.98) | 33.03<br>(47.72) | 57.99 |
| Machine reeled | 101.00 | 23.73<br>(30.15) | 21.93<br>(66.30) | 7.30<br>(156.23) | 43.43<br>(61.64) | 71.66 |
| Single twisted (tram) | 78.99 | 18.97<br>(27.35) | 11.50<br>(39.13) | 6.56<br>(180.48) | 24.53<br>(37.38) | 42.59 |
| Double twisted (organzine) | 128.67 | 16.22<br>(38.08) | 12.30<br>(55.72) | 3.06<br>(324.27) | 29.56<br>(48.27) | 44.92 |

Note: Values in parenthesis indicate coefficient of variation

ction beyond a critical dimension set on the instrument passed between the measuring plates, the instrument sensed it and stopped the delivery of the yarn. The section of the yarn containing the imperfection therefore could not leave the delivery roller. The sections of the yarn were thus collected for subsequent visual observations. These collected sections were observed on Hirox 3-Dimensional measuring system(model DG-3D) attached with HI-SCOPE Compact Micro Vision System(model KH-2200 MD2). The structural details were noted down for classifying each type of imperfections according to structural similarity. Some typical imperfections were photographed for permanent record.

## RESULTS AND DISCUSSION

### 1. Evenness and Imperfection values

The results of yarn evenness, frequency of frequently occurring faults i.e., thick places, thin places and neps are shown in Table 2.

It may be observed from Table 2 that the evenness value ranges between 16% to 23% for all the yarns. Machine reeled and Organzine yarns show the highest(23.73) and lowest(16.22) values of evenness, respectively. The coefficient of variation of evenness varies between 27% to 38% indicting a high variation in evenness.

Considering the total values of imperfections which varies between 42.59 to 71.66 per 125m of yarn, total imperfection is maximum for machine reeled yarn. Neps contribute maximum i.e. around 60% towards the level of imperfections while the thick and thin places contribute around 30% and 10%, respectively. Hence, reduction in neps will improve substantially the quality of these yarns.

All the imperfection values vary over a wide range especially the thin places. The thin places are more or less similar in thigh, machine reeled and single twisted(tram). It is however, significantly less

**Table 3.** *Correlation coefficients between faults of tasar yarn*

| Type of yarn | Correlation coefficient | | |
|---|---|---|---|
| | Thick & Thin places | Thick places & Neps | Thin places & Neps |
| Thigh reeled | 0.39 | 0.94 | 0.41 |
| Machine reeled | 0.60 | 0.95 | 0.55 |
| Single twisted(tram) | 0.13 | 0.83 | 0.27 |
| Double twisted(organzine) | 0.60 | 0.80 | 0.39 |

in case of organzine yarn. The lowest thin place value in organzine is probably due to doubling effect of this yarn which is also reflected in its evenness value.

Thick places as detected by the Uster vary over a wide range for each type of tussah yarn. The number of such faults may vary between 11.5 to 21.9 per 125m. Tram and organzine yarn appears to contain minimum number of thick places.

The level of neps varies between 24.53 to 43.43 per 125m for all the yarns. The high CV values are also observed in their numbers.

### 2. Association between Thick, Thin places and Neps

With a view to explore the possibility of a common cause of generation of thick, thin places and neps, the correlation coefficient values between thick and thin places, thick places and neps and thin places and neps were determined for various types of yarn as shown in Table 3.

For all the types of tussah yarn there exists an excellent correlation between thick places and neps. The correlation coefficient values lie between 0.80 to 0.95. However, the associations between thick and thin places and thin places and nep are not so strong. The Table 3 therefore, indicates a common cause of generation of thick places and neps in such type of yarns.

### 3. Structural feature of Thick, Thin places and Neps

The structural feature of imperfections will facilitate in understanding the mechanism of generation of these imperfections which in turn may lead to pin point the source of their generation and extent of control that can be exercised.

#### 1) Thick places

After examining at least fifty faults of these category, the common feature observed in them, was classified into four groups,

such as:

Type I. Core surrounded by entangled loose bave (Figure 1a)

Type II. Core wrapped by loose bave(Figure 1b)

Type III. Snarled core(Figure 1c)

Type IV. Lengthy knot(Figure 1d)

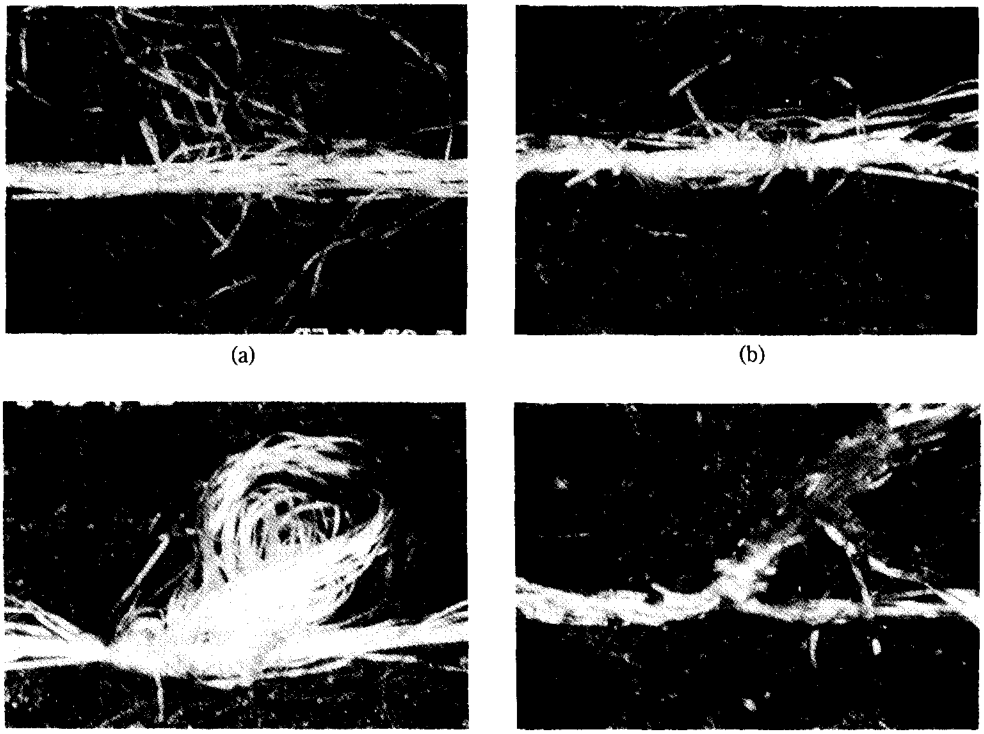
Distribution of the types of thick places irrespective of type of yarn are shown in Table 4.

The possible mechanism of generation of Type I and II faults are: (i) during casting operation, a bave may not get attached properly to the main body of the yarn causing momentarily slippage and thus may lead to excess accumulated length to remain on the yarn surface in the form of entangled mass. (ii) a casted end may not adhere strongly to the yarn surface and therefore may accumulate on its surface whenever it comes into contact with any stationary surface such as guides, pulleys etc..

The generation of Type III fault was observed only in tram and organzine yarns. The generation of such fault appears to be mainly due to twist liveliness of the tram and organzine yarn. On the other hand, the occurance of Type IV fault is obviously due to long ends of the manually formed knot.

#### 2) Thin places

Observation of fifty faults of this category reveal that all the thin places show a deficiency in the number of brin in the section of the yarn(Figure 2). The mechanism of occurance may be due to either of the following reasons:



(a) (b) (c) (d)

**Fig. 1.** *(a) Core surrounded by entangled loose bave, (b) Core wrapped by loose bave, (c) Snarled core, (d) Lengthy knot.*

**Table 4.** *Distribution of type of thick places*

| Imperfection | Type | Frequency | (%) |
|---|---|---|---|
| Thick places | I | 30 | 60 |
| | II | 15 | 30 |
| | III | 2 | 4 |
| | IV | 3 | 6 |

i) Bad casting: during reeling operation even if a bave breaks, reeling may still continue with less number of ends and during the time elapsing between detection and actual casting of a new bave a section of yarn gets wound with one bave less resulting a thin place. The thin place so generated will cause the mass per unit length to decrease by approximately 17% for a yarn containing six brins.

ii) a simultaneous breakage of more than one end or exhausion of more than one cocoon or a combination of both may also generate a severe thin place.

**3) Neps**

After investigating the faults of this category, the common feature observed in them, can be classified into three groups,

such as:

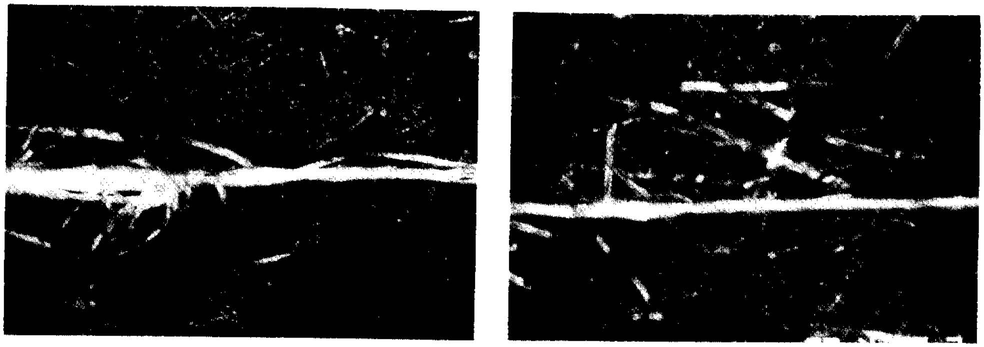
Type I. Core surrounded by entangled baves(Figure 3a)

Type II. Core wrapped by loose baves(Figure 3b)

Type III. Small knot(Figure 3c)

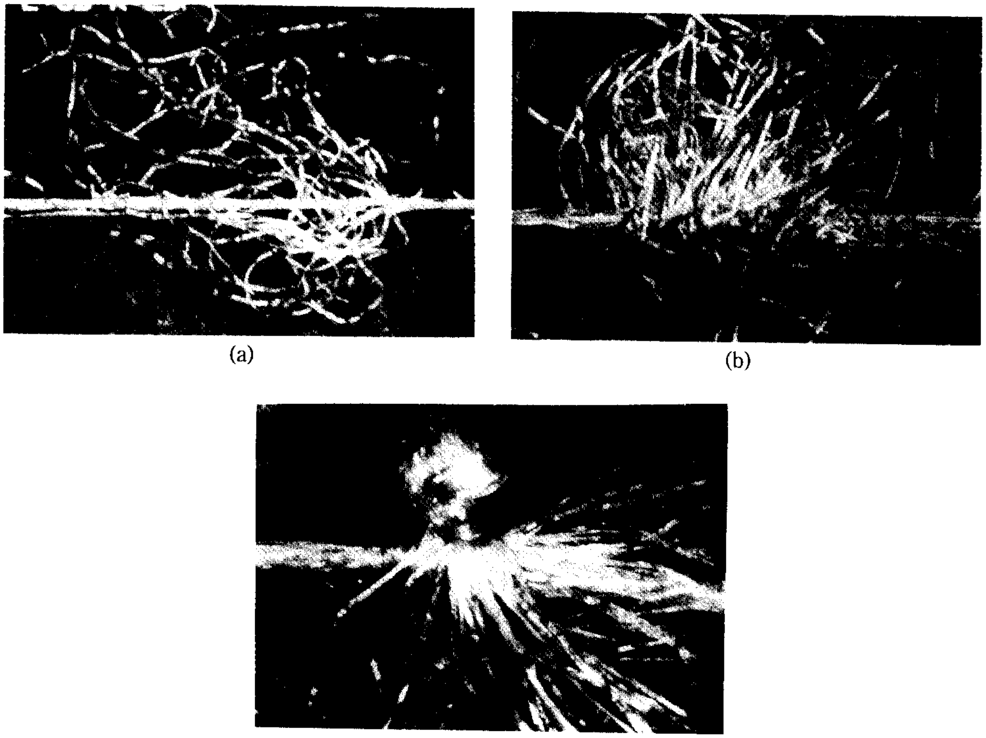
Distribution of different types of neps are shown in Table 5.

The mechanism of generation of these types of neps is similar to the generation of similar type of thick places as explained in the previous section. If the mechanism of generation of thick places and neps are similar, one would expect a high correlation between their numerical values. The high value of correlation coefficients between thick places and



(a) (b)

**Fig. 2.** *(a) Ordinary thin place, (b) Severe thin place.*



(a) (b)

(c)

**Fig. 3.** *(a) Core surrounded by entangled baves, (b) Core wrapped by loose baves, (c) Small knot.*

**Table 5.** *Distribution of type of Neps*

| Imperfection | Type | Frequency | (%) |
|---|---|---|---|
| Neps | I | 30 | 60 |
| | II | 17 | 34 |
| | III | 3 | 6 |

neps as shown in Table 3 indirectly proves this point.

## CONCLUSIONS

Evenness values range between 16~24% for four types of commercially available tussah yarn. Total imperfection values range between 43～72 per 125 m of yarn. The contribution of neps and thick places in total imperfection values are 60% and 30%, respectively. The mechanism of generation of thick places and neps are similar which is supported by the high value of correlation coefficients. Thin places are normally due to lesser number of bave in resultant reeled yarn.

## ACKNOWLEDGEMENTS

We thank Central Silk Board, Ministry of Textiles, Govt. of India, Bangalore, India for the financial assistance under National Sericulture Project.

## 摘　要

現在 生産시판되고 있는 4種의 작잠사에 나타나는 缺點의 程度를 Uster기를 利用하여 조사하였고 이들 缺點의 발생기구와 원인을 이해하기 위하여 그 구조가 분석 검토되었다. 4종 작잠사의 絲條班 값은 16～24% 범위에 있었고 총불량율은 실길이 125m에 대하여 43～72m 범위에 있었다. 총불량율에서 Nep와 太纖部가 차지하는 비중은 각각 60%와 30%이었고 太纖部와 Nep 발생기구는 상관계수값과 일치 하였으며 細纖部는 일반적으로 繰絲繭 粒付數의 減少에 기인하였다.