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A STUDY ON YARN ELONGATION AND YARN HAIRINESS FOR DIFFERENT DELIVERY SPEEDS AND OTHER MECHANICAL/PROCESSING VARIABLES AT DRAWFRAME FOR 20^{8}

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The drawframe plays an important role in spinning for the production of good quality yam. The yarn elongation and hairiness was improved by the delivery speed of 600 m/minute as well as by increasing the break draft and drawing passage of drawframe for 20'.

Key words: cotton yarn 20', drawing process, elongation and hairiness, spinning

INTRODUCTION

Drawframe is the last compensation point for the elimination of errors produced earlier by the machines during fibre to yam spinning. This action is obtained by using several pairs of rollers running at different speeds. The invention of the apparatus to perform roller drawing was one of the first power driven machinery developments and its application is in roving and spinning. Taking roller drawing as a broad general action, it serves two purposes; first, to straighten the fibres within mass being treated and second, to reduce the size of the strand. Cotton slivers have very low tensile strength and are liable to unexpected drafting and breakage processing. With the exception of increase in sliver strength, higher delivery speed of drawframe exposes the cotton sliver to high level of tension during processing and may result in sliver quality problem if preventive measures are not taken. When the strand is properly twisted, it produces the maximum strength of yarn. It makes a yarn with regularity of fibre arrangement which produces a smooth yarn and exists in maintaining the maximum uniformity of cross-section. Card slivers consist of entangled fibres. To prepare uniform yarn it is necessary to straighten and parallelise these fibres. Doubling is the process of combining several slivers into one on drawframe while drafting is the process of attaining or increasing length per unit weight of slivers. The term drawing is applied exclusively to process on drawframe where process of doubling and drafting is completed at a time.

In spinning, the quality of yarn spun depends on both the fibrous material and the techniques adopted in its processing. The qualitative characteristics of the yarn are greatly affected by alteration in any variable in the machine. Zhu and Ethridge (1997) found that fibre fineness and nep content had little effect on yarn hairiness. The objective of present study was to see the effect of delivery speed and other mechanical/processing variables of drawframe on the quality of cotton yarn, particularly elongation and hairiness of yarn.

MATERIAL AND METHOD

The present study was conducted in the Department of Fibre Technology. University of Agriculture, Faisalabad and at the Nishat Textile Mills Ltd., Faisalabad during the year 2000-2001. Lint samples of Punjab American Cotton variety MNH-93 were collected from the running material at the Nishat Textile Mills Ltd., Faisalabad. All setting of machines during fibre to yarn spinning was kept constant except the drawing process.

The following mechanical/processing variables were used at drawframes:

(i) Delivery Speed of Drawframe: D_1 - 400 meters per minute: D_2 - 600 meters per minute; D_3 - 800 meters per minute, and D_4 - 1000 meters per minute.

(ii) Break Draft Range: B_1 -1.16; B_2 1.41, and B_3 1.70.

(iii) Drawing Passages: P_1-first passage of drawing; P_2-second passage of drawing, and P_3-third passage of drawing.

The yarn of 20' was spun at ring frame.

Yarn Characteristics: The breaking elongation is calculated from the clamp displacement at the point of peak force. The procedure adopted is given in detail in ASTM Committee (1997). The hairiness modules of UT-3 consist of an electronic optical sensor which convert the scattered light reflections of the peripheral fibres into corresponding electron signals. Yarn hairiness is expressed in the form of hairiness value H, which is an indirect measure for the number representing cumulative length of all fibres protruding from the yarn surface. The procedure of testing was derived from ASTM Committee (1997). The data obtained were analysed using completely randomized design with three factors, as suggested by Faqir (2000), on M-Stat micro computer statistical programme devised by Freed (1992).

RESULTS AND DISCUSSION

1. Yarn Elongation: Analysis of variance pertaining to yarn elongation data is presented in Table 1a. Highly significant differences were observed for delivery speed (D), passages (P) and break draft (B), while non-significant differences were evident for the interactions D x P x B. It is quite apparent from the individual means (Table 1b) that the delivery speed D_2 (600 m/minute) gave the maximum (5.33) yarn elongation percentage followed by D_3, D_1 and D_4 with values of 5.12, 4.91 and 4.74% respectively. The pairs of delivery speeds D_1, D_4 and D_2, D_3 showed non-significant difference with each other. However, D_4 was significantly different from rest of the values of delivery speed. Previously, Mahmood (1993) recorded the range of yarn elongation from 3.47 to 5.67 with a mean value of 4.52%. Similarly, Sheikh (1991) observed that yarn elasticity i.e. elongation was also very important in yarn spinning process. Yarn with low tenacity i.e. low elongation. tends to break more frequently in weaving.

Table 1a. Analysis of variance for yarn elongation

DxPxB	OF	S.S.	M.S.	F. value	Prob.
O	3	5.308	1.769	56.741	0.0000**
P	2	17.444	8.722	279.686	0.0000**
B	2	0.690	0.345	11.059	0.0001 **
DxP	6	0.291	0.049	1.558	0.1721 NS
DxB	6	0.182	0.030	0.973	NS
PxB	4	0.394	0.099	3.160	0.0189*
DxPxB	12	0.185	0.015	0.493	NS
Error	72	2.245	0.031		–
Total	107	26.739		–	–

**Highly significant *significant; NS=non-significant; C.V.=3.51%.

Table 1b. Individual comparison of mean values for yarn elongation (%)

Delivery speed	Means	Drawing Passages	Means	Break draft	Means
O_1	4.91 be	PI	4.46 b	B_1	5.03 b
O_2	5.33 a	P_2	5.29 a	B_2	5.12 a
O,	5.12ab	P,	5.33 a	B,	4.92 c
D.	4.74c				

Any two means not sharing a letter in common differ significantly at 0.05 level of probability.

Table 2a. Analysis of variance for yarn hairiness

S.O.V.	OF	S.S.	M.S.	F value	Prob.
O	3	0.414	0.138	6.903	0.0004**
P	2	0.739	0.370	18.492	0.0000**
B	2	0.127	0.063	3.169	0.0480*
DxP	6	0.066	0.011	0.550	NS
DxB	6	0.108	0.018	0.904	NS
PxB	4	0.080	0.020	0.997	NS
DxPxB	12	0.210	0.018	0.877	NS
Error	72	1.439	0.020		–
Total	107	3.183		–	–

**Highly significant; *significant; C.V. = 2.28% .

Table 2b. Individual comparison of mean values for yarn hairiness

Delivery speed	Means	Drawing passages	Means	Break draft	Means
O_1	6.22 ab	PI	6.31 a	B_1	6.24 a
O_2	6.11 c	P_2	6.15 b	B_2	6.19 ab
O,	6.17 be	P_3	6.12 b	B,	6.15 b
D.	6.28 a				

Any two means not sharing a letter in common differ significantly at 0.05 level of probability.

The mean values of yarn elongation by drawing passages of drawness PI> P_Z and P_3 were observed as 4.46, 5.29'; ana 5.33% respectively. From this trend it can be stated that yam elongation percentage increased with the depth of sliver processing. Douglas (1991) reported that modem high speed machinery had resulted in overall quality improvement. Penday and Lyenger (1969) observed a general tendency for strength to decrease with increase in elongation. Amjad (1999) reported that higher the fibre elongation, better would be the yarn breaking strength and yarn elongation.

The individual mean values of yarn elongation for break draft BI> B_2 and B_3 were 5.03, 5.12 and 4.92% respectively. All these values differed significantly from each other. These results are supported by Louis and Fiori (1965) who reported that break draft significantly affected the yarn breaking elongation. Meanwhile Zhu and Ethridge (1997) found that increase in elongation would reduce the hairiness of yam, which is confirmed by the present study.

2. Yarn Hairiness: Data in respect of yarn hairiness are presented in Tables 2a and 2b which show highly significant differences for delivery speed (D) and passages (P). However, non-significant differences were recorded for all the interactions in case of yarn hairiness. The mean values of yarn hairiness (Table 2b)for delivery speed O of drawframe illustrated that O_2 (600 m/minute) generated lower value (6.11) of yarn hairiness followed by O', O_1 and O_4 with respective mean values of 6.17, 6.22 and 6.28. It is clear from Table 2b that O_4 differed significantly from rest of the values of delivery speed exceptDi.

Barella et al. (1991) reported that an increase or decrease of hairiness depended on types of fibres, yarn linear density and yarn structure. Nelson and Illingworth (1991) defined yarn hairiness as the fibre ends and loops standing out from the main yarn body. The mean values of yarn hairiness at Ph P~ and P, are 6.3 L 6.15 and 6.12 respectively. It is evident from Table (2b) that P~ and P_3 differed non-significantly but both values differed significantly from PI. However, the best value recorded for yarn hairiness was 6.15. The present trend, indicated that by increasing the drawing passages, the values of hairiness can be reduced. Zhu and Ethridge (1997) found that nep content had little effect on yarn hairiness.

The analysis of variance for break draft (B) indicated that BI and B~ differed non-significantly from each other but both were significantly different from B_3. The best value of yarn hairiness was recorded at ~2 (6.15) followed by B_1 (6.19) and B, (6.24). From the above trend it was clear that the best value of yarn hairiness was obtained at moderate break draft B~. Viswanathan et al. (1988) expressed that the yam hairiness, an important attribute to yarn quality, is caused by the protrusion of fibres from the body of the yarn imparting a fuzzy appearance, which not only affected the fabric quality but also caused fabric faults.

Conclusion: The study showed that the modern draw frame improved the yarn quality. The values of yarn elongation and hairiness for 20' were observed better at the delivery speed of 600 m/minute with increasing break draft and drawing passages at drawframe,

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