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Influence of Multiple Taker-in System upon Tensile Parameters of Cotton Yarn

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The study was aimed at comparing the effect of the conventional high production card with a modified card equipped with multiple taker-in system upon tensile parameters (viz., single yarn strength, elongation and rupture per kilometer) of 24^s cotton yarn. The quality of yarn was significantly improved by the modified system. Thus by modifying and updating the webfeed system, an older carding machine can be made to produce yarn of impressive quality.

Key words: Carding, Multiple taker-in system, Tensile parameters, Yarn.

Introduction

Whenever the question is raised of how to achieve high quality in spinning preparations, the cards will be the key machine. It is in this machine that the most important characteristic data of significance to quality in the subsequent spinning process is established. One of the most effective ways of increasing the productivity of a card machine is the enlargement of the pre-carding element. It is well known that an enlarged taker-in assembly extracts a large volume of waste, which is advantageous with regard to improving web and yarn quality (Ghaffar 1990; Irshad 1994). The performance of the cylinder flats assembly and in the final analysis, the quality of the card web depends on the efficiency of the taker-in separating the flocks into individual fibres and of eliminating extraneous matter and neps (Leifeld 1996).

The multiple taker-in system provides a vehicle for the out class effectiveness of the "flat-cylinder" system to the point of full development. In the carding zone, carding results are determined by clothing fineness and condition, by cylinder speed, and by the narrowness of the gap between the flat and cylinder clothing points (Schlichter and Leifeld 1996).

The main effect of the new precarding unit, comprising three opening and cleaning rollers instead of one taker-in roller is not as is generally assumed i.e. the additional cleaning effect, but the possibility of achieving better carding conditions at the cylinder through correctly staged opening. This study is targeted to compare the effect of an existing high production card with that of the modified card (equipped with multiple taker-in system) upon the tensile parameters of 24^s cotton yarn.

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This research work was conducted at the Department of Fibre Technology, University of Agriculture, Faisalabad and at the Aamer Cotton Mills (Ltd.), Jumberkhurd, Distt. Kasur, Pakistan, under the standard atmospheric conditions (i.e., 20±2°C temperature and 65±2 % relative humidity). Cotton variety MNH-93 having 27.06 millimeter length, 4.5 micronaire value, 27 gram/ten strength, 48.62 percent uniformity ratio and 82.55 percent maturity was selected for the study.

The material was fed through the chute feed system at the same rate to the following cards:

A_1 = Modified card, A_2 = Conventional card.

The modified card was equipped with multiple taker-in system (consisting of three additional rollers as shown in Fig 1).

The specifications of these additional rollers are as under:

	Ist roller	2nd roller	3rd roller
Diameter	172.5 mm	172.5 mm	172.5 mm
Wire angle	17°	20°	20°
Points per inch^2	36	162	205
Teeth length	5.0 mm	5.0 mm	8.0 mm
Speed	621-1373 rpm	800-1730 rpm	1066-2488 rpm

The following speeds of both carding machines were changed to study their effects.

a. Taker-in speeds (B)

B_1 = minimum speed of taker-in; B_2 = maximum speed of taker-in

b. Cylinder speeds (C)

C_1 = 450 rpm; C_2 = 500 rpm

c. Doffer speeds (D)

D_1 = 75 ypm (30 rpm); D_2 = 100 ypm (40 rpm); D_3 = 125 ypm (50 rpm); D_4 = 150 ypm (60 rpm)

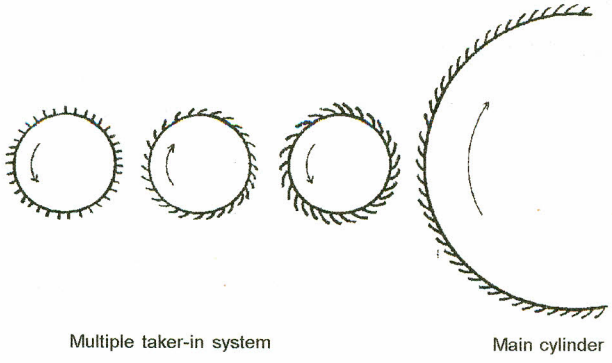

Fig 1. Multiple taker-in system at card.

The sliver samples of both cards were prepared at different treatments of taker-in, cylinder and doffer speed combinations (Table 1). The sliver samples of 60 in/yd of both conventional and modified card were then processed on a drawing and simplex machine and finally the yarn of 24^s English count was prepared using a Toyoda ring frame. The sliver samples obtained from both cards were processed on the same drawing, simplex and spining machines.

Following characteristics of yarn were determined.
Single yarn strength was measured by "Uster Tensorapid Tester 111" according to the ASTM standards (1968).

Yarn elongation was measured by "Uster Tensorapid Tester 111". The procedure was adopted as laid down in its operational manual (1968).

Table 1
Treatment combinations

Treatments	Combinations of taker-in, cylinder and doffer speeds
1	$B_1C_1D_1$
2	$B_1C_1D_2$
3	$B_1C_1D_3$
4	$B_1C_1D_4$
5	$B_1C_2D_1$
6	$B_1C_2D_2$
7	$B_1C_2D_3$
8	$B_1C_2D_4$
9	$B_2C_1D_1$
10	$B_2C_1D_2$
11	$B_2C_1D_3$
12	$B_2C_1D_4$
13	$B_2C_2D_1$
14	$B_2C_2D_2$
15	$B_2C_2D_3$
16	$B_2C_2D_4$

B=Taker-in speed, C=Cylinder speed and D=Doffer speed

The rupture per kilometer is actually tensile strength of yarn in grams per tex. RKM was calculated by applying the following formula.

RKM (g/tex) = Single yarn strength x 0.00169 x count (Ne)

The data obtained were analyzed statistically as suggested by Steel and Torrie (1980), on M. Stat Micro computer statistical Program devised by Freed (1992).

The individual comparison of means by taking five replication of each tradmark (Table 2, Fig 2) reveals that at modified card single yarn strength of 344.70g is recorded as 344.00g for conventional card and these values differ non-significantly from each other. The results indicate that the multiple taker-in system did not influence the single yarn strength. This is due to the fact that subsequent processes in spinning after carding amend the quality characteristics of the yarn. Schlichter and Leifeld (1996) stated that improved pre-opening of cotton fibres before the cylinder can positively influence the quality of yarn.

For taker-in and doffer speeds, significant differences were recorded in the mean values of single yarn strength while cylinder speed displayed a non-significant effect (Table 2). The combination of power speed of taker-in and D_2 (100 rpm) speed of doffer are thus, evident as better performing speeds for producing higher values of single yarn strength. Previous researcher Nozaki (1968) also recorded improved yarn strength at lower taker-in speed. Present results for the doffer speed variable deviate from the findings of Nozaki (1968) that strength of yarn depends upon neither the production rate nor doffer speed. Variation in the results may be due to many factors such as quality of raw material and machine settings. Douglas (1991) reported that modern high speed machinery has resulted in an overall quality improvement.

The results of the present work deviate from those recorded by Farooqi (1992) as 353.25-388.42 g (range) for single yarn strength of 24^s yarn of MNH-93 cotton variety. The variation in the results may be due to the difference in quality of raw material, machine settings, material handling, etc.

It is apparent from Fig 3 and the comparison of individual means (Table 3) that the modified card equipped with multiple taker-in system produces high percentage of yarn elongation (3.82%) as compared to 3.70 percent for conventional card. Both of these values differ significantly from one another. This improvement might be attributed to the attachment of additional roller (multiple taker-in system) at modified card. Artz and Maidel (1983) mentioned that the elongation of a yarn depends on the amount of work done on the fibres during carding. Schlichter and Leifeld (1996) stated that gentle opening of the material by the web feed results in improved dynamometric yarn values (yarn strength and elongation).

Table 2
Individual comparison of mean values for single yarn strength

Machine means		Taker-in speed means		Cylinder speed means		Doffer speed means	
A1	344.70a	B1	347.03a	C1	343.70a	D1	338.55b
A2	344.00a	B2	341.40b	C2	344.40a	D2	351.52a
						D3	340.24b
						D4	347.09a

Any two means not sharing common letters differ significantly at P=0.05

Table 3
Individual comparison of mean values for yarn elongation

Machine means		Taker-in speed means		Cylinder speed means		Doffer speed means	
A1	3.82a	B1	3.79a	C1	3.73b	D1	3.80a
A2	3.70b	B2	3.73a	C2	3.79a	D2	3.80a
						D3	3.73ab
						D4	3.71b

Any two means not sharing common letters differ significantly at P=0.05

With regard to carding parameters, significant differences in the mean values are observed for cylinder and doffer speeds whereas a non-significant effect is recorded for taker-in speed. Previously many researchers (Rusca 1970; Ahmad 1991) reported that the increase in yarn elongation, requires necessitates increase in twist and consequent losses in strength and production. They further stated that fine yarn has higher elongation variability than coarse yarn. The tenacity and elongation properties of single yarn were related directly to the fibre elongation of cotton from which they were spun.

The overall range of yarn elongation percentage is observed as 3.70 to 3.82 percent. The present results deviate from the results described by Farooqi (1992) noted the yarn elongation percentage of 24^s yarn of MNH-93 cotton variety

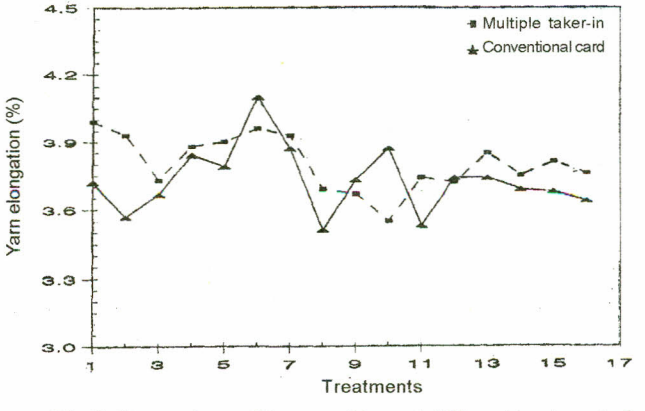

Fig 3. Comparison of two machines at different treatments for yarn elongation.

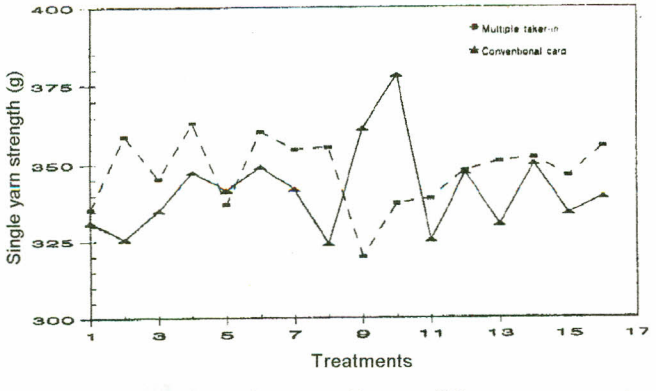

Fig 2. Comparison of two machines at different treatments for single yarn strength.

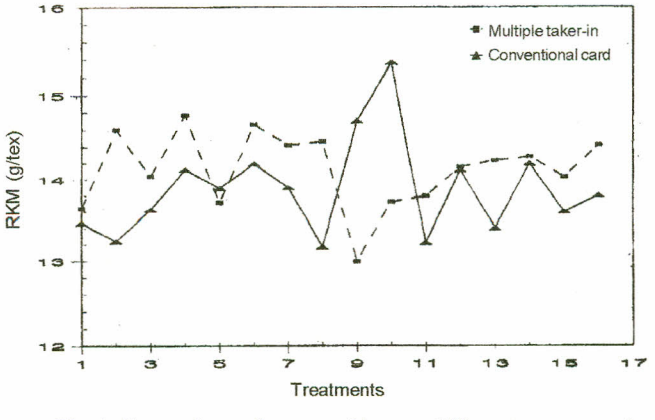

Fig 4. Comparison of two machines at different treatments for RKM.

Table 4
Individual comparison of mean values for RKM

Machine means		Taker-in speed means		Cylinder speed means		Doffer speed means	
A1	14.00a	B1	14.12a	C1	13.97a	D1	13.75b
A2	13.99a	B2	13.87b	C2	14.02a	D2	14.28a
						D3	13.82b
						D4	14.13a

Any two means not sharing common letters differ significantly at P=0.05

in the range of 3.91 to 5.42 percent. Many factors like quality of raw material, material handling, machine settings, etc., are involved for the variation in results.

The comparison of individual means presented in Table 4 indicates the non-significant effect of modified card (equipped with multiple taker-in system) on RKM value of yarn (Fig 4). This is due to the fact that subsequent processes in spinning after carding amend the quality characteristics of yarn.

As far as carding parameters are concerned, significant differences in the mean values are recorded for taker-in and doffer speeds while cylinder speed depicts non-significant effect for RKM value of 24^s yarn. The best performance of lower speed of taker-in (B_1) and D_2 (100 rpm) speed of doffer is thus, evident from the results (Table 4). The present results are in line with the results of Farooqi (1992) who recorded RKM value of 24^s yarn of MNH-93 cotton variety in the range of 13.10 to 15.55 g/tex.

Conclusion

The following conclusions are drawn from the present investigations.

1. In the comparison of conventional high production and multiple taker-in system card, results showed that by modifying and updating the taker-in system, yarn of impressive quality can be produced.
2. Lower speed of taker-in (B_1), higher speed of cylinder (C_2) and D_2 (100 rpm) of doffer is accompanied better performance for yarn tensile parameters.

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