AN EXPLORATORY STUDY OF THE INFLUENCE OF DRAWING ON THE PROPERTIES OF RING AND ROTOR SPUN COTTON YARNS

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Abstract

The influence of drawing on the quality of ring and rotor spun yarns is reported in this paper. The results revealed that two drawing passages yield better yarns than one drawing passage. Although this result is a well established fact, the results showed that the type (basic or autoleveled) and the order of drawing seem to have less significant effect on the quality of yarns produced from doubly drawn slivers.

Introduction

In the recent past, there have been a number of measures to improve the yarn quality and performance (Balasubramanian and Janakiraman 1991). In studying the influence of different stages of processing on the quality of yarns, draw frame occupies an important part (Chellamani 1996). Draw frames decide the regularity and the performance of yarns. Therefore, a study that delves into the effect of various draw frame passages on the properties of yarns is important from the technical point of view. Such a study will be of practical importance to the textile manufacturers for improving the quality of yarns and controlling the cost of production (Ramkumar 1999). The principal objective of the study reported in this paper is to investigate the effect of various drawing arrangements on the properties of ring and rotor spun cotton yarns.

Materials Used

As the primary objective of the study was to investigate the influence of draw frame type and the number of passages on the quality of yarns, only one variety of cotton was used in the study. The physical properties of cotton used in the study are given in Table 1.

Experimental Procedure

Figure 1 delineates the stages involved in the processing of ring and rotor yarns. The process up to the first draw frame passage is similar for all yarns manufactured. The different draw frame combinations used in the study are given in Table 2. The drawing speed was kept constant at 1320 ft/min (400 m/min) in all the experiments. The yarns are coded according to the type and the number of draw frame passages through which they have been processed.

The slivers after being processed through appropriate draw frame passages (Table 2) were processed on ring and rotor spinning machines. Two different ring spinning machines were used in the study: Saco Lowell SF-3H Ring Spinning Frame and Zinser 330 HS Ring Spinning Frame. And, two different rotor spinning machines were used: Schlafhorst Autocoro SE-9 and Rieter R20. This was intended to investigate the effect of different draw frame passages on the properties of yarn spun in different spinning systems and machines. Two different yarn counts: 22 Ne and 30 Ne were spun on ring and rotor spinning machines. Machine speeds used were: Saco Lowell ring frame – 10, 000 rpm for 20 and 30 Ne yarns counts, Zinser spinning frame – 17, 000 rpm for 22 Ne and 18, 000 rpm for 30 Ne yarns. The rotor speed used was 100, 000rpm.

An important observation during the spinning of ring yarns on the Zinser machine was that it was not possible to spin 30 Ne yarns from single passage drawn slivers. This indicates the importance of well-drawn and uniform feed material for the better performance of the spinning machine. In particular, this situation becomes more critical with machines having higher production speeds such as the Zinser ring spinning machines.

Yarn Measurements

Strength and Tenacity

Skein breakage tests were performed on the Scott skein-breaking tester. Ten cones were tested and the average value was used for analysis. Single end strength was obtained using the Uster Tensorapid 3 tester. Ten cones were tested and twenty breaks per cone were made. In total, 200 readings were obtained for each yarn type.

Evenness Testing

Zellweger Uster UT3 yarn evenness tester was used to obtain the yarn irregularity and imperfection values. Ten cones were broken and each cone was tested at a speed of 400yards/min for one minute. The average reading was used for further analysis.

Results and Discussion

Mechanical properties of yarn are influenced by the type and the number of draw frame passages. Hence, it was thought necessary to have a thorough discussion on the effect of drawing on the properties of ring and rotor spun yarns. Due to the enormity of the data on yarn measurements, individual yarn property results such as tenacity, thin and thick places, etc., are not given in this report. A single factor analysis of variance (ANOVA) was performed to test the significance of difference in the means of different yarn properties. The

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results of the single factor ANOVA for different yarn characteristics are summarized in Tables 3-8.

Statistical Analysis of Results

As mentioned above, a single factor ANOVA test was performed to test the significance of difference in the means of different yarn properties. The significance of difference in means was verified using F ratios. For the statistical analysis, yarns were grouped into two groups: Group I consisted of yarns 1 to 6 and Group II consisted of yarns 3 to 6. As is evident from Tables 3-8 in most cases in Group II yarns, the means do not differ significantly. This trend is evident for different yarn properties investigated. The results indicate that when slivers from two draw frame passages are spun into ring and rotor yarns, there are no significant variations in their properties. However, when yarns spun from single passage drawn slivers are grouped together with yarns from two passage drawn slivers, the variations in their properties are found to be significant in most cases. This signifies the influence of the uniformity of slivers on yarn properties.

Conclusions

The limited work done on the study of the influence of drawing on yarn properties leads to the following conclusions:

- Two draw frame passages help to obtain a better quality yarn with reduced variations.
- An interesting observation from this study is that the properties of ring and rotor spun yarns spun from doubly drawn slivers (Group II) do not differ significantly among each set based on the type of drawing, spinning and yarn count.
- An important revelation from this preliminary study is that the number of drawing process influences the properties of yarns equally to that of the type of the spinning process. However, this needs further verification.

In order to verify the results obtained in this study, a thorough investigation involving different types of cotton and speeds of drawing is necessary. It is anticipated that this project will be continued to explore different types of cotton and different speeds of drawing.

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References

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Table 1. Fiber Properties (HVI 900A)

Fiber Characteristics	Value
Upper Half Mean Length (in)	1.03
Uniformity Index (%)	80.60
Strength (g/tex)	31.70
Elongation (%)	6.30
Micronaire	3.70
Leaf Grade	2
Reflectance (%)	80.30
Yellowness	9.20
Color Grade	11-2

Table 2. Different Draw Frame Passages (RSB 851)

Yarn Code	Passage I	Passage II
1	Basic Draft	-
2	Autoleveled	-
3	Basic Draft	Basic Draft
4	Basic Draft	Autoleveled
5	Autoleveled	Basic Draft
6	Autoleveled	Autoleveled

Table 3. Yarn Tenacity (cN/tex)

			Difference in Means	
Yarn Type	Machine	Yarn Ne	Group I	Group II
Ring	Saco Lowell	22	NS	NS
Ring	Saco Lowell	30	S	NS
Ring	Zinser	22	S	NS
Ring	Zinser	30	-	NS
Rotor	SE-9	22	NS	NS
Rotor	SE-9	30	NS	NS
Rotor	R20	22	S	NS
Rotor	R20	30	NS	NS

Group I: Yarn 1 to Yarn 6 (Single Passage and Two Passages Drawn Slivers)

Group II: Yarns 3 to 6 (Two Passages Drawn Slivers)

(S: Statistically significant, NS: Statistically not significant)

Table 4. Yarn Thin Places

Yarn Type	Machine	Yarn Ne	Difference in Means Group I	Difference in Means Group II
Ring	Saco Lowell	22	S	S
Ring	Saco Lowell	30	S	NS
Ring	Zinser	22	S	NS
Ring	Zinser	30	-	NS
Rotor	SE-9	22	NS	NS
Rotor	SE-9	30	S	NS
Rotor	R20	22	S	S
Rotor	R20	30	S	S

Table 5. Yarn Thick Places

Yarn Type	Machine	Yarn Ne	Difference in Means Group I	Difference in Means Group II
Ring	Saco Lowell	22	S	S
Ring	Saco Lowell	30	S	NS
Ring	Zinser	22	S	NS
Ring	Zinser	30	-	NS
Rotor	SE-9	22	S	NS
Rotor	SE-9	30	S	NS
Rotor	R20	22	S	NS
Rotor	R20	30	NS	NS

Table 6. Yarn Neps (140%)

Yarn Type	Machine	Yarn Ne	Difference in Means Group I	Difference in Means Group II
Ring	Saco Lowell	22	S	NS
Ring	Saco Lowell	30	NS	NS
Ring	Zinser	22	S	S
Ring	Zinser	30	-	S
Rotor	SE-9	22	S	NS
Rotor	SE-9	30	S	NS
Rotor	R20	22	S	NS
Rotor	R20	30	NS	NS

Table 7. Yarn Neps (200%)

Yarn Type	Machine	Yarn Ne	Difference in Means Group I	Difference in Means Group II
Ring	Saco Lowell	22	S	NS
Ring	Saco Lowell	30	S	NS
Ring	Zinser	22	S	NS
Ring	Zinser	30	-	NS
Rotor	SE-9	22	NS	NS
Rotor	SE-9	30	S	NS
Rotor	R20	22	NS	NS
Rotor	R20	30	NS	NS

Table 8. Yarn Neps (280%)

Yarn Type	Machine	Yarn Ne	Difference in Means Group I	Difference in Means Group II
Ring	Saco Lowell	22	S	NS
Ring	Saco Lowell	30	S	NS
Ring	Zinser	22	S	NS
Ring	Zinser	30	-	NS
Rotor	SE-9	22	NS	NS
Rotor	SE-9	30	NS	NS
Rotor	R20	22	NS	NS
Rotor	R20	30	S	NS

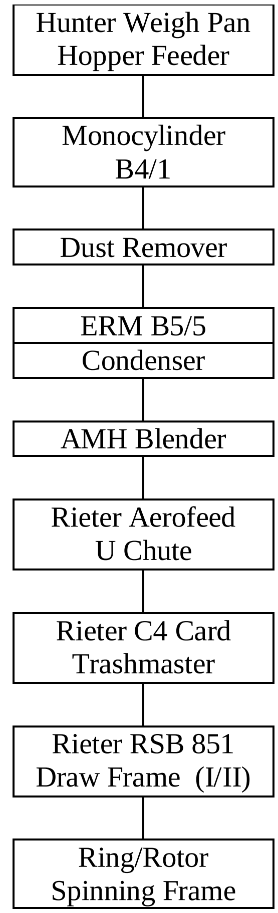

Figure 1. Outline of Mechanical Processes for Upland Cotton.