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Original Research Article

Investigating the Strength Variation of Jute Spun Yarn Produced by Modified Spinning Frame

Md. Khalilur Rahman Khan[1*], Hosne Ara Begum[2]

[1]Faculty of Engineering & Applied Sciences, Bangladesh University of Business and Technology, Dhaka, Bangladesh
[2]Faculty of Textile Engineering, Bangladesh University of Textiles, Dhaka, Bangladesh

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***Corresponding author:** Md. Khalilur Rahman Khan

Abstract

Strength is one of the main criteria characterizing quality for jute staple spun yarn. Variation in yarn strength is considered as significant as the average value of strength. However, jute flyer spinning frame had been modified in the drafting zone to improve the quality parameters of jute yarn. In this study, variation in results of jute yarn strength values have been investigated by producing two types of jute yarn counts (i.e., 6.5 and 10 lbs/spy) for both the existing and the modified spinning frame. Hence, the variation in the results of jute yarn strength values have been compared between modified and existing spinning frame. Results reveal that strength variations of jute spun yarn have been decreased for modified spinning frame irrespective of yarn linear densities in general. It is seen that CV% of jute yarn strength values have been reduced by 64.3% and 53.4% for the jute yarn of 6.5 lbs/spy and 10 lbs/spy respectively in the modified spinning frame. Finally, it can be remarked that modified spinning frame produces better quality of jute yarn as far as the strength variation is concerned.

Keywords: Jute Yarn, Strength Variation, Modification, Spinning Frame.

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INTRODUCTION

Jute industry is one of the oldest industries of Bangladesh and has been continuing to function with large number of age-old machinery and technologies. Now-a-days, diversified jute products are increasing profusely. As a result, production of jute yarn with improved quality is a matter of concern for the spinner. However, the properties of yarn are very important in determining their possible applications [1]. Breaking strength is a prime quality attribute of any staple spun yarn. Yarn strength represents a crucial parameter to determine the performance of any spinning technique. The strength of a yarn is significant to the process ability of the yarn in the downstream processing and operational life of the substrate made with the yarn [2, 3]. Variation in yarn strength is as important as the average value of strength. The high level of strength variations will affect the productivity of the weaving preparatory process and weaving process severely [4]. However, variations in strength values of jute spun yarn also needs attention because it can be considered as one of the drawbacks of jute spun yarn for its applications in diversified fields.

A research work had been carried out for the production of jute spun yarn by modification of drafting zone of jute flyer spinning frame [5] destined to make a comparison between the existing frame and modified frame in terms of yarn quality parameters such as hairiness, strength etc. However, in this work, variation in results of jute yarn strength values have been investigated by selective type modification of jute spinning frame and a comparison has been made between the modified spinning frame and the existing frame as well.

MATERIALS AND METHODS

Modifications of Jute Spinning Frame

The major modifications that had been carried out for performing this experiment are as follows:

a) The drawing pressure roller (diameter=70 mm & Durometer hardness = 96 in Shore A Scale)) of the apron draft spinning frame had been substituted by a rubber coated top roller (diameter=40 mm & Durometer hardness = 85 in Shore A Scale).
b) An extra slotted roller (Diameter= 26 mm & Durometer hardness = 74 in Shore A Scale) had also been nipped with bottom drawing

roller and positioned parallel to the modified top roller (shown in figure-1).

c) The angle between the slot direction of the slotted roller and the centerline of drafted fiber strand was selected as 60° for this experiment.

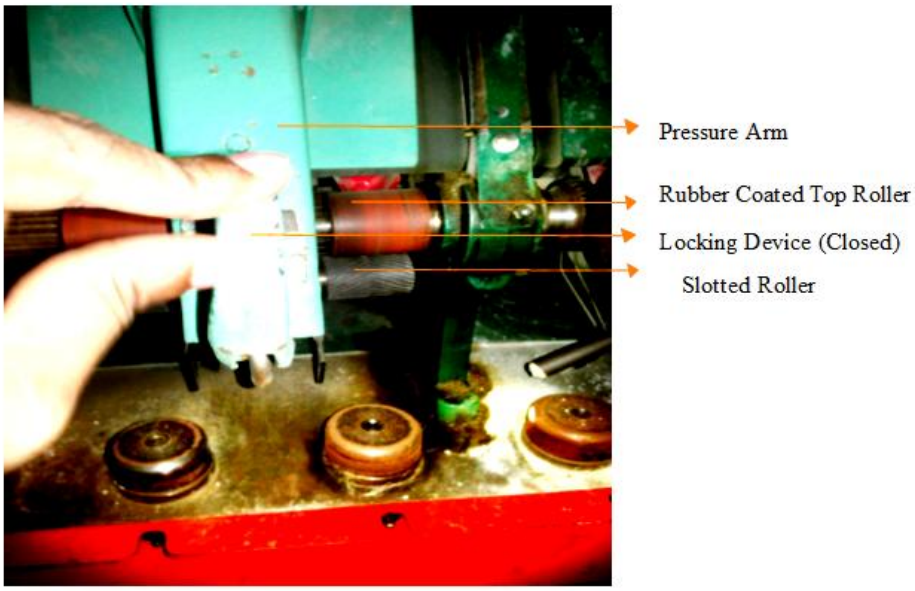

Fig-1: Modified drafting system of jute spinning frame

Yarn sample Preparation

Jute slivers of 0.69 lbs per 100 yards were produced by using white B grade jute as raw materials. One breaker card, one finisher card and three consecutive jute drawing frames were used for this experiment. However, bundle fiber strength (g/Tex) of breaker card sliver, finisher card sliver and third drawn sliver were found 35.92, 31.73 and 30.60 respectively measured by Stelometer. Processing parameters of this experiment are given in table-1. Jute yarn counts of 6.5 lbs/spy and 10 lbs/spy were selected as nominal count for this work. Moreover, nominal twist per meter for 6.5 lbs/spy and 10 lbs/spy were kept 194.38 and 155.51 respectively.

Testing Procedure

Before testing of yarn fineness and strength value, every sample has been conditioned in quality room for 48 hours. Wrap reel and electric balance method has been used for measuring jute yarn fineness. At first, for each sample testing, 25 yards of jute yarn by wrap reel has been measured and then it is weighed by electric balance machine. Finally, jute yarn fineness has been determined by direct system (i.e., lbs/spy). Results of yarn tensile properties were obtained by single jute yarn strength tester of Good brand & Co. Ltd. Results of jute yarn strength are then converted from pound-force to cN. Quality ratio percentages for 6.5 lbs/spy and 10 lbs/spy were calculated by following formula:

$$\text{Quality Ratio \%} = \frac{\text{Strength in lbf}}{\text{Count in lbs/spy}} \times 100\ \%$$

Table-1: Processing parameters of the experiment

Serial No.	Parameters	Value
1.	Avg. MR% of breaker card sliver	17.49%
2.	Avg. MR% of Finisher card sliver	15.96%
3.	Avg. MR% of 3rd Drawn sliver	12.45%
4.	Twist factor (k-factor)	12
5.	Avg. Input sliver weight for spinning frame	0.69 lbs per 100 yards
6.	Input sliver MR%	12.45
7.	Flyer RPM	3300

Table-2: Experimental Results of jute yarn count and strength

Obs. No.	Experimental Results							
	Existing Frame		Modified Frame		Existing Frame		Modified Frame	
	Nominal Yarn Count (Lbs/Spy)				Yarn Tensile Strength (Lbf)			
	6.5 lbs/spy	10 lbs/spy	6.5 lbs/spy	10 lbs/spy	6.5 lbs/spy	10 lbs/spy	6.5 lbs/spy	10 lbs/spy
1	6.32	9.52	6.59	10.18	4.9	7.9	5.2	8.1
2	6.27	9.46	6.52	10.05	5.6	6.7	4.7	7.3
3	6.42	10.83	6.34	9.75	4.4	8.3	5.3	7.4
4	7.22	9.48	7.02	10.11	4.1	7	5.1	7.6
5	6.15	9.33	6.67	9.86	6	7.9	5	7.6
6	6.31	10.31	6.44	9.63	4.5	8.2	5.1	7.8
7	6.21	9.57	6.82	9.92	5.2	7.8	5.2	7.6
8	6.17	9.36	6.55	10.08	5.7	6.7	4.9	7.9
9	6.33	10.72	7.15	9.84	4.3	7.1	5.4	7.4
10	7.16	9.63	6.38	9.96	4.5	7.5	5.1	8.1
11	6.58	10.31	6.41	9.77	5	8.4	5.2	7.9
12	6.21	10.81	6.61	9.58	4.1	7.9	4.9	7.7
13	6.37	10.59	6.29	10.13	5.1	7.4	5.2	7.8
14	7.06	9.76	6.57	10.52	4.3	7.2	5.1	7.6
15	7.15	9.68	6.39	9.67	4.8	6.6	4.9	7.4
16	6.38	10.22	6.49	9.81	5.3	6.9	5	7.2
17	6.18	9.37	6.62	9.94	4.5	7.5	5.4	7.8
18	7.32	10.81	6.93	10.21	4.7	7.4	5.1	7.5
19	6.5	9.38	6.78	9.75	5.2	6.7	5.6	8.2
20	6.44	9.17	6.46	10.15	5.5	7.9	5	7.8
Avg.	6.5375	9.9155	6.6015	9.9455	4.885	7.45	5.12	7.68
SD	0.3996	0.5879	0.2332	0.2340	0.5556	0.5726	0.2067	0.2758
CV%	6.11	5.92	3.53	2.35	11.37	7.68	4.03	3.58

RESULTS AND DISCUSSION

Experimental results summary is given in Table-2. From the obtained results, it is clearly seen that jute yarn strength values for modified spinning frame have been improved irrespective of yarn fineness (shown in Figure-2). In addition, it is also interestingly noticeable that strength variation (CV%) of jute spun yarn have been reduced significantly for both yarn counts of 6.5 lbs/spy and 10 lbs/spy. CV% of jute yarn strength in modified frame have been decreased by 64.3% and 53.4% for jute yarn of 6.5 lbs/spy and 10 lbs/spy respectively (shown in figure-3). The difference between the average tensile strength CV% between the existing and modified spinning frame is more pronounced in the case of finer yarns, that is, yarn count 6.5 lbs/spy. This trend of improvement in jute yarn strength as well as in strength variation can be explained in such a way that distance between the final roller nip point (i.e., nip point of slotted roller and bottom drawing roller) and fiber twisting position has been reduced, ultimately, resulting in better twist back propagation during yarn formation. As a result, better twist flow to the spinning triangle leads to better integrating of fibers in yarn body. Ultimately yarn tensile strengths have been increased in general. However, reduction in variation of jute yarn strength may be attributed due to decreasing level of CV% found in the results of jute yarn linear density (shown in table-2). Variation in weight per unit length is the basic source of yarn strength variation in general. As the variation in the results of yarn linear density has been decreased, then it can be strongly argued that the variation of strength in jute yarn has been lowered accordingly. In case of existing frame, quality ratio percentage (QR%) were obtained 74.7% and 75.1% for 6.5 lbs/spy and 10 lbs/spy respectively whereas QR% were obtained 77.5% and 77.2% for 6.5 lbs/spy and 10 lbs/spy respectively in modified spinning frame.

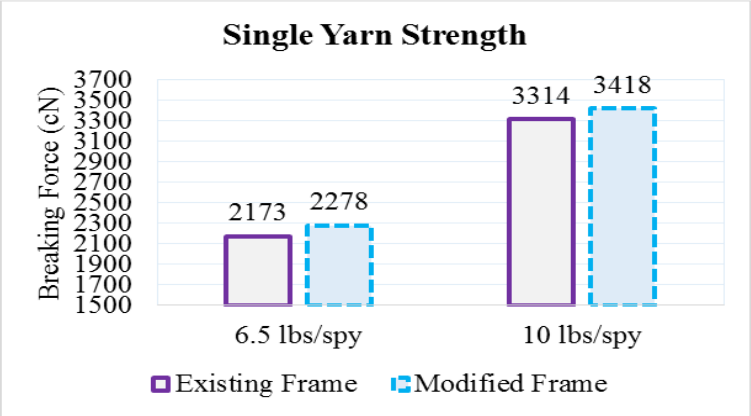

Fig-2: Comparison of yarn breaking force (cN)

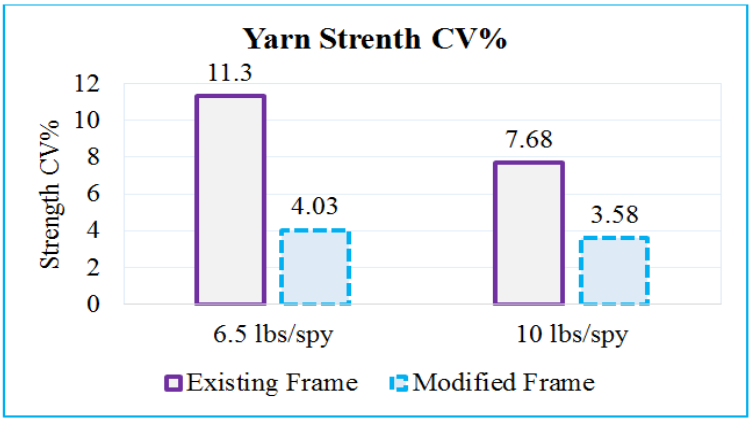

Fig-3: Comparisons for jute yarn strength CV%

CONCLUSION

This study focuses on investigating the effects of modified drafting zone on the results of single yarn strength variation for jute spun yarn produced by jute flyer spinning system. Firstly, it is seen that single yarn strength values have been increased for both types of yarn count (i.e. 6.5 lbs/spy & 10 lbs/spy). With reference to yarn strength variation, a dramatic result is seen in this study. Jute spinning frame modified with 60° slotted roller reduce the strength CV% by 64.3% and 53.4% for the jute yarn of 6.5 lbs/spy and 10 lbs/spy respectively. Besides, it is also worth mentioning that CV% for the results of yarn count have also been decreased by 42.22% and 60.30% for 6.5 lbs/spy and 10 lbs/spy respectively. As a result, it can be concluded that modified spinning frame does not only improve the yarn strength value but also decrease the variation in the strength results. Experimental investigations in this work have been performed by modifying only one head of drafting zone (i.e., two output position) of jute spinning frame that can be considered as a limitation of this study.

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